Sikorsky S76A+, G-BVKN

AAIB Bulletin No: 12/99 **Ref: EW/A98/10/1** **Category: 2.1**

Aircraft Type and Registration:	Sikorsky S76A+, G-BVKN
No & Type of Engines:	2 Turbomeca Arriel 1S gas turbine engines
Year of Manufacture:	1980
Date & Time (UTC):	10 October 1998, 08:30 UTC
Location:	8nm West of K14 platform, Dutch North Sea sector
Type of Flight:	Public Transport
Persons on Board:	Crew - 2 - Passengers - 1
Injuries:	Crew - Nil - Passengers - Nil
Nature of Damage:	Confined to IHUMS Maintenance Panel
Commander's Licence:	Airline Transport Pilot's Licence (Helicopters)
Commander's Age:	Not relevant
Commander's Flying Experience:	Not Relevant
Information Source:	AAIB Field Investigation, and the Operators Engineering reports

Introduction

The incident occurred in an area which was under the responsibility of the Netherlands accident investigation authorities, who, under the provisions of ICAO Annex 13, delegated the investigation to the AAIB.

History of the flight

The aircraft (hereafter referred to as KN) was operating a series of flights between platforms, transferring personnel. At approximately 0830 hrs it took off from the ENSCO 85 platform with two crew and one passenger on board. The plan was to route to the K14A platform, 10 minutes flying time, pick up some more passengers and then return to Den Helder. The co-pilot was handling for the flight and the take off was normal and KN climbed to 1,000 feet and routed towards the K14A platform.

About two and a half minutes after lifting KN contacted the K14A and received a wind report of 022 deg 45 kt gusting to 52 kt. Shortly after this the crew noticed an increasing smell which they appeared initially to put down to the heater, to which they had made some adjustment. They were then alerted by the passenger to smoke in the cabin and believed they may have had a fire on board. The co-pilot continued to control aircraft and the commander instructed him to transmit a "MAYDAY" call. Meanwhile the commander left his seat and went to the passenger cabin collecting a fire extinguisher on the way. Smoke was being emitted from a panel located below the left-hand forward passenger window. The commander instructed the passenger to move to a rear seat whilst he investigated the problem. By this time the smoke had diminished somewhat. The cover panel could not be lifted as a Philips screwdriver was required and one was not available. Smoke then re-appeared so the commander discharged the fire extinguisher over the area using several short bursts. The commander told the co-pilot to ask for a Phillips screwdriver to be made available as soon as they landed, briefed the passenger that he would be got off as soon as soon as possible, and informed the co-pilot that he would discharge the extinguisher a few more times over the area and return to the flight deck. The smoke appeared then to be under control and the commander returned to his seat for the landing.

During this time the co-pilot descended KN to 500 feet and had kept the K14A advised of the situation and asked them to have their fire equipment ready.

One and a half minutes later KN landed on deck and the passenger disembarked. Before landing the crew had discussed shutting down on deck, but had decided not to, since the gusting wind was above the limit for a shutdown. The cover panel was opened and the equipment that was emitting the smoke was the Integrated Maintenance Panel (IMP), which was part of the Integrated Health and Usage Monitoring System (IHUMS). Smoke started to appear again and fire extinguishers were used once more. The commander decided to leave the aircraft to contact the maintenance base by telephone for advice, and one of the rig crew was positioned beside the panel with a fire extinguisher, in case smoke re-appeared. The CVR and IHUMS load shed circuit breakers were pulled and the smoke did not re-occur. After consultation with the company it was agreed that the aircraft should not be shut down due to the wind exceeding the limits and that the pulling of the circuit breakers would isolate the smoking equipment. At 09:19 KN departed the K14A and flew to a maintenance base at Great Yarmouth, stopping for fuel en-route.

After the occurrence the commander did not consider the smoke would have been incapacitating to front seat passengers. The trim panel and the IMP remained cold and at no time had flames been visible.

Description of IMP

The IMP was part of the IHUMS and contained two printed circuit boards (PCB), a series of light emitting diodes (LEDs) and switches associated with testing and system status of the IHUMS. It was supplied with power from three sources at four different voltage levels.:-

1. An 18V DC supply from the Cockpit Voice and Flight Data Recorder (CVFDR) unit which powered the preamplifier board for the cockpit area microphone.
2. 24V and 15V regulated supplies, from the IHUMS power supply for feed to PCB components, which were internally fused in the IMP at 125 mA and 250 mA respectively.

3. A 27.5V main aircraft bus bar supply fed to the IMP via a cockpit mounted 4 amp circuit breaker, for front facia panel lighting, with no internal fusing.
4. A further 27.5 main aircraft bus momentary supply fed to the unit during warning lamp test, also with no internal fusing.

The case of the IMP was of aluminum die cast construction with a screw-attached cover plate on one side to give access. The unit was not designed to be water resistant and as a result there were no seals or sealing of any of the switches, LED apertures or cover plate.

The IMP on this S76 series aircraft was mounted in the lower window recess of the cabin window immediately aft of the co-pilots door. It was mounted with the front facia panel horizontal against the left-hand cabin wall, behind the window recess trim. A hinged flap with Dzus fasteners in the trim provided for engineering access.

Examination of IMP

There was evidence of blistering along approximately 25 millimetres of the edge of the plastic facia lighting panel. Liquid stain marks were evident on the top engraved front of the facia panel. On removal of the main side cover, signs of liquid ingress were evident, with white powder stains and localised electrolytic action residue in numerous areas including PCBs, connectors and casing. Further evidence of liquid ingress was evident when the upper PCB of two, had been removed. A heat blister was present on the back of the plastic lighting facia adjacent to the external blistering observed on the outside. The fibreglass matting of the panel back was exposed at the blister burn area for about 12 millimetres square. On dismantling of the facia panel, which consisted of a milled plastic front and a PCB backing board holding 14 miniature lighting filaments, further evidence of burning was revealed between the plastic front and the PCB. This burn area extended for 50 millimetres along the edge of the lighting panel, including two of the miniature filaments. A groove had been burnt into the plastic of the front panel and the light mounting PCB was blackened in the burn area. The backing PCB showed extensive signs of liquid ingress in the form of white powder and tide marks.

The internal wiring showed no evidence of overheating or damage. The main connector showed some evidence of standing liquid and green copper sulphate type deposits were present, indicating some inter-pin electrolytic action. The die-cast case also showed evidence of standing liquid, white powder and tide marks. The only evidence of burning or overheating was confined to the facia panel assembly. The two miniature fuses were still intact.

Other evidence

Examination of KN and other aircraft revealed water-like staining around the window area and over the inside of the fuselage in that area. This was most likely due to both leakage past the window seals and/or the effects of condensation on the inner fuselage surface. It was also noted that the bracket to which the IMP was mounted and electrically bonded, was in turn mounted on an area which was constructed of composite material, with insufficient electrical bonding to the surrounding metallic structure.

Shortly after the incident the operator surveyed their workshop records and found that of the 20 IMPs serviced, 5 showed evidence of fluid ingress, all of these five were from S76 installations.

Conclusion

All evidence pointed to the ingress of water allowing an electrical path path to be established between the points of differing voltage potential on the facia panel and backing PCB, particularly the legs of the miniature lighting filaments. This had with time and the presence of 27.5 volts supply, allowed sufficient power to be drawn, resulting in the over-heating of the facia and the PCB, leading to the generation of smoke. It was likely that the current drawn did not exceed the circuit limits due to the resistive nature of the carbonised material.

Remedial action

A few days after the incident the operator, who was also responsible for IHUMS installations, issued an alert service bulletin to all IHUMS operators, applicable to all aircraft with an IMP fitted, for the disconnection of the 28 volt DC panel lighting supply. The aim was then to issue a further service bulletin for waterproofing of the IMP installation on S76 aircraft. A program for the removal of all IMPs for checking and repair would then be put in place, with S76 installations being dealt with first.

In mid 1999 an IHUMS modification was issued to incorporate a waterproof cover for the IMP to prevent fluid ingress, and electrical bonding for the composite mounted IMP bracket to enable effective circuit breaker protection to be provided for any similar electrical fault. A service bulletin was also issued enabling other IHUMS operators to modify their installations. The operator also instigated a once only inspection programme to identify and repair any degraded units remaining in service.