INCIDENT

Aircraft Type and Registration:	Sikorsky S-76B Spirit, G-DPJR
No & Type of Engines:	2 Pratt & Whitney Canada PT6B-36B turboshaft engines
Year of Manufacture:	1989
Date & Time (UTC):	22 November 2007 at 0014 hrs
Location:	Approaching Coventry Airport
Type of Flight:	Commercial Air Transport (Non-Revenue)
Persons on Board:	Crew - 2 Passengers - None
Injuries:	Crew - None Passengers - N/A
Nature of Damage:	Heat damage to plastic ducting and cabin trim
Commander's Licence:	Airline Transport Pilot's Licence
Commander's Age:	45 years
Commander's Flying Experience:	6,210 hours (of which 1,356 were on type) Last 90 days - 92 hours Last 28 days - 25 hours
Information Source:	Aircraft Accident Report Form submitted by the pilot and additional AAIB investigation

Synopsis

Whilst operating on a night positioning flight, the aircraft's auxiliary heater system overheated, melting the surrounding ducting and progressively filling the cockpit with smoke. The crew declared an emergency and expedited their landing. The smoke and heat subsided once the aircraft had been shut down on the ground. The electronic control box for the heater was removed and subsequently confirmed to have failed, probably disabling the overheat protection and cockpit controls for the system. One Safety Recommendation is made.

History of the flight

The aircraft was operating a positioning flight from Denham to Coventry, departing at 2345 hrs with the two pilots on board. The aircraft was established in the cruise some 30 miles from Coventry Airport when the PIC noticed an unusual smell which could not be identified. The crew began to troubleshoot the problem and switched off the heating system as a possible source. While the PIC continued to fly the aircraft, the second pilot used a torch to try and identify the cause of the rapidly increasing smell. As a precaution, at 15 miles out, the PIC made a PAN call to Coventry ATC, which was not acknowledged until the second attempt. At this point smoke began filling the aircraft and the PNF felt a hotspot developing to the left and rear of his seat. The

crew continued to attempt to isolate the problem, but there appeared to be no obvious issues with any of the electrical systems on board.

By this time the aircraft was about 8 miles from Coventry Airport. Given the increasing levels of smoke in the aircraft, the crew considered making an emergency landing, but decided it was safer to reach the airfield, where full fire cover had been placed on standby. As the aircraft crossed the airfield boundary, the pilot slowed the aircraft for an expedited landing, at which point the level of smoke increased significantly as did the level of heat below the left pilot seat. At 0013 hrs the PIC declared a MAYDAY and landed directly in front of the attending fire crew. The pilots then shut down the aircraft and evacuated immediately.

The attending fire crew monitored the aircraft and used a thermal imaging camera to confirm the source of the heat and smoke as being the ducting between the cabin and the cockpit on the left side of the aircraft. Eventually the smoke and heat dissipated and the aircraft was declared safe.

Aircraft examination

The cabin seating was removed and extensive heat damage was found around the auxiliary electric heater element located in the ducting on the left side of the aircraft. The plastic ducting had melted and the trim was severely scorched. Resistance checks of the heater element and thermistor did not identify any defects. The system control box was removed and sent to the vendor for further investigation. It was also noted that the vent blower circuit breaker had tripped. The vent blower is a fan located above the cabin which draws air from an external vent, through the heating ducts on either side of the aircraft to the cabin. These are the same ducts in which the auxiliary heating elements are located. The vent blower circuit breaker was subsequently reset and no further failures have been recorded.

Controller examination

The controller was disassembled in the workshop by the manufacturer and several component defects were confirmed on the power supply circuit board. These would have resulted in a total system failure and shutdown of the controller during the incident.

Cabin environmental control system

The cabin Environmental Control System (ECS) is a modification for the S-76B which has been embodied in limited numbers across the world fleet. It provides an additional heat boost to the standard engine bleed air heating system by means of two 1,550 watt heating elements, located in the heating ducts on the right and left lower sections of the aircraft cabin. Electric fans are also installed next to each element to allow the auxiliary system to be used independently of the main bleed air system. A thermistor is located next to each of the elements to provide overheat protection. Two 'single-membrane' switches, located in the cabin and the cockpit, control selection of the heaters.

The system can be selected OFF, HI or LO. With LO selected the heating elements are set to half their rated power. The control panel in the cockpit overrides the cabin controls and allows the system to be armed such that the controls in the cabin become active, without the heaters necessarily being switched on. It also has OVERHEAT and FAN FAIL warning lights for each side of the cabin. The control box for the system is located in an equipment bay in the fuselage behind the cabin. Power to the heating elements is supplied via the aircraft 115 volt ac supply and the controller is powered by the aircraft 28 volt dc supply.

Analysis

Component failures within the control box for the cabin ECS resulted in the controller shutting down. This probably prevented operation of the left fan and the overheat protection system, but did not isolate power to the left heating element, which continued to operate. As a consequence of the lack of airflow over the heating element, the surrounding plastic ducting and trim overheated and generated smoke which slowly filled the cabin and cockpit of the aircraft. The crew were unable to isolate power to the heating element due to the loss of authority of the cockpit switches following the controller failure. As the aircraft slowed, the flow of ram air which had been flowing through the heating duct reduced and overheating of the ducting and surrounding trim became more severe. The resulting increase in smoke forced the crew to make an emergency landing.

Tripping of the circuit breaker for the vent blower may have been unrelated to the cabin ECS control box failure. However, the loss of the auxiliary system fan, in addition to the vent blower, meant that the airflow through the duct was significantly reduced from normal operation, contributing to the severity of the overheat.

As the existing design does not provide for either automatic or crew-selected isolation of this system, the aircraft manufacturer has considered a number of options to resolve the issue. There are a limited number of these systems still in service and one option would be to disable these, pending a design change. The following Safety Recommendation is therefore made:

Safety Recommendation 2009-033

It is recommended that the Federal Aviation Administration require Sikorsky Aircraft to provide the flight crew with the means to isolate the 115 volt ac power supply to the auxiliary heater elements in the event of failure of the cabin Environmental Control System (ECS) controller fitted in S-76B helicopters, and that the power supply to the auxiliary heater is disabled until that means is provided.