Sikorsky S76A (Modified), G-BHBF

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Aircraft Type and Registration:	Sikorsky S76A (Modified), G-BHBF
No & Type of Engines:	2 Turbomeca Arriel 1S Turboshaft engines
Year of Manufacture:	1979
Date & Time (UTC):	17 November 1999 at 1450 hrs
Location:	3 nm NE of Coltishall, Norfolk
Type of Flight:	Public Transport
Persons on Board:	Crew - 2 - Passengers - 3
Injuries:	Crew - None - Passengers - None
Nature of Damage:	Widely distributed light/medium lightning damage
Commander's Licence:	Airline Transport Pilot's Licence (Helicopters)
Commander's Age:	Not known
Commander's Flying Experience:	Not known
	Last 90 days - Not known
	Last 28 days - Not known
Information Source:	AAIB Field Investigation

History of the flight

The aircraft was in the cruise, en-route from Norwich to the offshore Clipper gas field. Whilst cruising at 2,000 feet in IMC (just above the cloud base) the aircraft was struck by lightning. Approximately 30 seconds later, the crew became aware of a smell of burning. They rapidly descended below cloud and returned visually to Norwich. The landing was uneventful.

Aircraft examination

Initial Examination of the aircraft revealed the following lightning damage evidence:-

Strike damage to all four main rotor blades.

Strike damage to two main rotor tip caps.

Strike damage to both tail-rotor paddle assemblies.

Strike/burning damage to upper surface of horizontal stabiliser.

Arcing/burning of main rotor jumper leads.

Arcing damage to bifilar arm.

A tangential field meter was used to survey areas of the aircraft for residual magnetism. Figures that appeared to be excessive were detected in the following components:-

All four main rotor spindles. Main-rotor drive shaft.

Swashplate guide. Exterior surfaces of both engines.

No 2 engine drive shaft. Main gearbox tail rotor drive shaft flange.

Tail-rotor drive shaft bearing supports. Intermediate gearbox flanges.

Red and yellow tail rotor pitch rods. Red/blue tail rotor paddle.

Horizontal Stabiliser support. Station 300 tailcone attachment bolts.

Further inspection was carried out in accordance with advice provided by the manufacturers to determine whether more subtle damage was present in the structure, gearboxes, shafts, shaft supports, couplings, rotor-head components, mounting bolts, flying control components and servos. All of the tail-rotor shaft bearings were replaced, since the high residual magnetism detected in their proximity indicated that excessive current had passed through the area and could have caused arcing damage between the balls and tracks.

The horizontal stabiliser was scrapped, being damaged beyond economic repair. The major components found to have been affected were returned to the manufacturers or approved overhaul agencies. In most cases no procedures for the necessary repairs existed. In other instances no effective inspection techniques appropriate to lightning events were available. Most of the major components were therefore not returned to service, but replaced using new or overhauled components.

Aerodynamic component structural composition

The three major aerodynamic components of the S76 type are manufactured from the following materials:-

(a) The main rotor blades have a titanium structure carrying the main structural loads, whilst the aerodynamic contour is created by means of cross-plied, woven fibreglass skin, supported by nomex honeycomb, with graphite trailing-edge reinforcing strips. A wire-mesh system impregnated within the fibreglass forms the main lightning protection/current path. (The leading edges have a titanium nosepiece for erosion protection; a nickel erosion strip over the titanium nosepiece further protects the outboard leading edge).

(b) The tail-rotor blades have fibreglass skins incorporating aluminium alloy mesh lightning protection. Both fibreglass nomex and aluminium alloy honeycomb are used for the core. Some graphite is incorporated in the structure and the leading edge erosion protection takes the form of a polyurethane sheath inboard and a nickel sheath outboard.

(c) The horizontal stabiliser utilises a kevlar skin over a kevlar honeycomb core with a spar consisting of a rectangular kevlar wrap over an aluminium alloy honeycomb core with graphite epoxy reinforcing straps.

Meteorological data

Assessment of the available meteorological data showed an unstable north, north-westerly air-stream over the area with a band of showers crossing Norfolk at the time. Cumulonimbus cloud was reported and a thunderstorm with rain was observed at Coltishall at 1450 hrs. The crew reported that at the time of the strike the OAT was 0.5°C.

Neither the Arrival Time Delay (ATD) system of lightning detection, used by the Meteorological Office, nor the Lightning Location System (LLS), which is used by EA Technology for recording strikes to ground, produced any data for this time and position. Both systems were operating correctly at the time. The nearest automatically recorded lightning data was a very weak indication more than 20 kilometres from the point where the strike occurred. This was of a level below that which would normally have been treated as a strike.

Summary

It was concluded that the aircraft was struck by a relatively low magnitude, negative, airborne (as opposed to air to ground) strike, probably triggered by the aircraft. Existing lightning warning systems are not capable of warning against such events.

It was judged that the resulting damage did not constitute a severe hazard during the short duration of flight required to return to Norwich, but sufficient was present to have impaired the longer-term airworthiness of the aircraft. This rendered unwise any further flying prior to the inspection and component replacement that was carried out.