Farnborough House
Berkshire Copse Road
Aldershot, Hants GU11 2HH

Tel: 01252 510300
Fax: 01252 376999
www.aaib.gov.uk

AAIB
Air Accidents Investigation Branch

AAIB Bulletin S1/2017 *SPECIAL*

ACCIDENT

Aircraft Type and Registration:	Sikorsky S-92A, G-WNSR	
No & Type of Engines:	2 General Electric Co CT7-8A turboshaft engines	
Year of Manufacture:	2014 (Serial no: 920250)	
Location:	West Franklin wellhead platform, North Sea	
Date & Time (UTC):	28 December 2016 at 0844 hrs	
Type of Flight:	Commercial Air Transport (Passenger)	
Persons on Board:	Crew - 2	Passengers - 9
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Left outer mainwheel rim distortion, seized tail rotor pitch change shaft bearing, servo piston fracture and minor damage to helideck	
Commander's Licence:	Airline Transport Pilot's Licence (H)	
Commander's Flying Experience:	To be confirmed	
Information Source:	AAIB Field Investigation	

The investigation

The accident occurred on 28 December 2016; the operator raised a Mandatory Occurrence Report and transmitted it to the UK Civil Aviation Authority (CAA) the same day.

The AAIB became aware of the accident[1] during the morning of 5 January 2017 and initiated a Field Investigation. This Special Bulletin is published to provide preliminary information gathered from an initial ground inspection, recorded data, and other sources.

In accordance with established international arrangements, the National Transportation Safety Board (NTSB) of the USA, representing the State of Design and Manufacture of the helicopter, appointed an Accredited Representative to participate in the investigation. He is supported by advisers from the helicopter manufacturer and the Federal Aviation Administration (FAA). The European Aviation Safety Agency (EASA), the UK CAA and the helicopter operator also assisted the AAIB.

History of the flight

The flight was the second sector of a four-sector rotation from Aberdeen to the Elgin-Franklin Offshore Field in the North Sea.

The helicopter commander was the handling pilot for both sectors. The first sector from Aberdeen to Elgin Process Utilities Quarters (PUQ) was uneventful. As the helicopter, on a heading of 270°, with nine passengers on board, lifted from the Elgin PUQ helideck it yawed unexpectedly to the right through 45°. The commander applied full left yaw pedal, checked the rotation and landed back onto the deck. The flight crew discussed the likely cause, which they thought to have been the result of local turbulence or wind effects created by the platform structures which, anecdotally, is not uncommon for this helideck. They decided to continue and during the subsequent lift off into the hover the commander applied left yaw pedal, the helicopter responded and turned to the left; all control responses appeared normal. The commander then climbed to 500 ft for the brief transit to the West Franklin wellhead platform, 3.3 nm to the south.

The helicopter made a normal approach and deceleration to the West Franklin and crossed over the helideck. During the descent to land, at approximately 4 ft above the helideck, it yawed rapidly to the right, reaching a maximum rate of 30 degrees per second. At the same time it rolled 20° to the left, at which point the left main landing gear contacted the helideck. It continued to yaw to the right on its left mainwheels and nosewheels before the right mainwheels contacted the surface. The helicopter came to rest on a heading of 041° having rotated through 187°.

The helicopter was shut down and the crew and passengers disembarked; there were no injuries. The helicopter was subsequently craned from the helideck onto a ship and recovered to Aberdeen.

Footnote

[1] The AAIB have classified this event as an accident; this is consistent with the International Civil Aviation Organisation definition as this helicopter sustained damage which adversely affected its performance and flight characteristics, and required replacement of the affected components.

Weather

The meteorological observation from the Elgin PUQ at 0608 hrs was: surface wind from 220° at 17 kt, visibility 10 km or greater, overcast cloud at 2,000 ft and temperature 8°C, dewpoint 3°C and pressure 1038 hPa. No lightning activity was recorded in the area.

Initial investigation

The technical investigation focussed on the tail rotor and associated components. Once the panels were removed it was immediately apparent that the tail rotor servo piston was damaged. The servo was removed and revealed that the tail rotor pitch change shaft (TRPCS) double row angular contact bearing was in a severely distressed condition (Figure 1).

Figure 1

TRPCS double row angular contact bearing from G-WNSR

Further disassembly and examination of the components found signs of severe overheating with extreme wear on the inner and outer thrust races and barrel shaped rollers of the bearing. It was found that the roller bearings seized to the inner member. The outer race roller had excessive axial play (0.5 in), such that the tail rotor driveshaft imparted a torsional load to the tail rotor servo. This torsional load caused the primary piston rod to fracture inside the servo. Due to the failure of the primary piston, the secondary piston sleeve separated axially from the primary piston adjacent to the link fitting, with the consequential total loss of control of the tail rotor.

The components were shipped to the helicopter manufacturer for forensic analysis. Initial findings indicate that the failure of this specific bearing was rapid; a period of 4.5 hours had elapsed from the first exceedance of the relevant bearing condition indicator recorded on the operator's Health and Usage Monitoring System (HUMS) to the point of failure.

Health and Usage Monitoring System

The HUMS used by the operator for this helicopter was the Integrated Mechanical Diagnostic HUMS (IMD-HUMS)[2]. A routine download of the HUMS was performed on the evening of 27 December 2016 and the helicopter was released to service. A detailed analysis of the data, conducted after the accident, showed that the Tail Gearbox Bearing Energy Analysis limit had been exceeded on 27 December 2016.

Previous events relating to the TRPCS bearing

There have been two previous events, the first being in 2007, where a degradation of the TRPCS bearing has occurred, leading to reduced tail rotor control in flight. These events were identified by the flight crews and resulted in immediate landings. The underlying causes were identified and a number of safety measures were introduced. At this early stage of the investigation the helicopter manufacturer is not clear whether this bearing degradation is the result of a new root cause, or a previously unidentified failure mode.

Safety actions

The initial findings suggest that the damage to the servo in this case is such that it could have imparted extreme or erratic inputs to the tail rotor at any time after the failure of the primary piston. Evidence suggests that the yaw which occurred on departure from the Elgin PUQ was uncommanded and may be related to the condition of the TRPCS bearing. The AAIB considers that this failure mode would seriously affect the ability of flight crews to maintain control of the helicopter.

The operator

The operator has subsequently introduced a number of measures to further strengthen the ability to detect impending bearing degradation. These include: a review of all HUMS data to ensure no anomalies, fleet-wide borescope inspections, a requirement for HUMS to be serviceable before flight and the time between HUMS download/analysis reduced to a maximum of 5 hours. The operator has also reviewed their HUMS processes and analytical procedures and introduced a requirement to carry out an additional assurance check.

The helicopter manufacturer

On 31 December 2016 the helicopter manufacturer issued to all operators an ‘All Operators Letter’ (AOL), CCS-92-AOL-16-0019, which described the event. It emphasises the use of the HUMS Tail Gearbox Bearing Energy Tool, provided on the ground station, which will detect a TRPCS bearing that is experiencing degradation, and recommends that this Tool should be utilised as often as reasonably possible.

Footnote

[2] The IMD-HUMS includes the use of additional stand-alone mechanical diagnostic software tools for the HUMS Ground Station (GS) that help assess the condition of a number of specific components, one of which is the Tail Gearbox Bearing Energy Analysis software tool; however, these require the user to visually inspect the data and search for exceedances. The helicopter manufacturer now offers an alternative GS analysis system which offers a number of enhancements to IMD-HUMS, including more advanced algorithms and the automatic alerting of all exceedances on receipt of new HUMS data.

This was followed by an Alert Service Bulletin (ASB) issued by the manufacturer on 10 January 2017. ASB 92-64-011 introduces a one-time inspection of the TRPCS and bearing assembly for ratcheting, binding, or rough turning. The manufacturer has recommended that compliance is essential and is to be accomplished prior to the next flight from a maintenance facility; three flight hours are allowed in order to return directly to a maintenance facility. Concurrent with the release of ASB 92-64-011, the manufacturer published Temporary Revision 45-03 to require operators to use S-92 HUMS ground station software to review Tail Rotor Gearbox energy analysis Condition Indicators for alert conditions on a reduced flight hour interval. Records in excess of published alert levels require inspection of the pitch change shaft and bearing.

Ongoing investigation

The AAIB investigation will continue to examine all the operational aspects of this accident and conduct a detailed engineering investigation of the relevant helicopter components. The AAIB will report any significant developments as the investigation progresses.

Published 11 January 2017