ACCIDENT

Aircraft Type and Registration:	Rotorway Executive 162F, G-OHOV	
No & Type of Engines:	1 Rotorway RI 162F piston engine	
Year of Manufacture:	2004 (Serial no: 6885)	
Date & Time (UTC):	30 March 2021 at 1340 hrs	
Location:	Street Farm, Takeley, Essex	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Extensive damage to main rotor blades, tail boom and tail rotor	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	65 years	
Commander's Flying Experience:	238 hours (of which 155 were on type) Last 90 days - 2 hours Last 28 days - 2 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries made by the AAIB	

Synopsis

On the fifth and final of a series of test hovers to 'bed-in' recently replaced drive belts, the helicopter appeared to lose power. The helicopter was at a height of about 10 ft when this occurred, and the pilot carried out a run-on landing. The helicopter touched down on soft rutted earth which prevented the skids from sliding and they dug-in. The helicopter tipped forward and the rotating main rotor blades contacted the ground. As a result, the helicopter was 'violently' tipped onto its side causing disruption to the main rotor blades and tail boom. No fault or malfunction was found with the helicopter. An analysis of data held within the engine control system could not positively determine the cause for the loss of power although a fault code associated with a Central Processing Unit (CPU) error was registered by one of the engine controllers.

History of the flight

The helicopter's transmission drive belts had been replaced and a series of low level hover test manoeuvres had been carried out to 'bed-in' the drive belts. Approximately two hours flight time had been accrued. During the fifth and final test flight, the helicopter was hover taxiing at 10 kt, at a height of approximately 10 ft, when there appeared to be a loss of engine power.

The pilot initiated a run-on landing, bled off some forward speed and settled the aircraft onto its skids. The helicopter landed at "a fast walking pace". The ground where the skids

touched down, was soft and rutted which prevented the skids from sliding and they dug in. This caused the helicopter to tip forward, at which point the rotating main rotor blades contacted the ground. As result the helicopter was 'violently' tipped onto its side causing disruption to the main rotor blades and tail boom.

The pilot was uninjured, made the helicopter safe, released his safety belts and exited through the cabin door.

Discussion

The pilot described how, on the start-up for the fifth flight, there was a problem with one of the fuel pumps. After a brief examination, repositioning and tightening of its electrical connectors, it functioned correctly and so the flight went ahead. All was normal until the pilot became aware of the engine "rolling back" and despite checking and ensuring that the hand throttle on the collective was open, the rotor rpm (N_R) started to decay. The pilot was not aware of any warnings or indications of a malfunction prior to or during the event.

Investigation

Engine control system description

The engine is controlled by a Fully Automated Digital Electronic Control (FADEC) system which incorporate two separate Engine Control Units (ECU)s, referred to as FADEC 1 and FADEC 2. These were removed and downloaded using software and information supplied by the manufacturer.

The ECUs are configured to operate as primary and secondary control devices. The primary ECU (FADEC 1) controls and monitors the engine performance and parameters. The secondary ECU (FADEC 2) monitors in the background and is brought into operation by the FADEC system should a fault develop in the primary ECU or any of its sensors.

The start up procedure requires the engine to be started with the No 1 fuel pump and FADEC 1 selected ON. When the engine has started and stabilised, fuel pump No 2 and FADEC 2 should be set to ON. The system should then be tested by selecting FADEC 1 and the No1 fuel pump to OFF to ensure the engine continues to run on the No 2 pump and FADEC 2. Fuel pump No 1 and FADEC 1 are then reselected to ON. There is a note in the system description in the maintenance manual, that the helicopter can start, hover and fly on the secondary system but it will not control the fuel air ratio as accurately as the primary system. Under certain conditions this will result in a sluggish throttle response.

Analysis

The data shows that FADEC 1 was within its correct parameters with no faults or warnings. In contrast, FADEC 2 shows a discrete indication of a CPU fault during the last few seconds of the data set whilst, at the same time, the throttle position data appears erratic.

Considering the pilot's observations of engine roll back, the erratic throttle position data and the CPU fault recorded, it is possible FADEC 2 was having an influence on engine output rather than the primary. However, there was no indication that FADEC 1 had developed

a fault requiring a switchover to FADEC 2. The download also showed that there was a significant difference in the 'data time stamp' between FADEC 1 and 2. It is not clear whether they contained the data from the same flight. An explanation for this difference could not be found.

The problem with the fuel pump was also considered but despite the accident damage to the helicopter, it was found to operate correctly.

Conclusion

The damage to the helicopter's main and tail rotor and associated structure was directly attributable to the roll over after the main rotor blades contacted the ground. Although FADEC 2 recorded a CPU fault and erratic throttle position data and there was a mismatch in the data time stamps between FADECs, no specific fault or malfunction was identified that would have led to the uncommanded power reduction.