Westland Scout AH1, G-BXSL

AAIB Bulletin No: 7/2002	**Ref: EW/C2001/11/3**	**Category: 2.2**
Aircraft Type and Registration:	Westland Scout AH1, G-BXSL	
No & Type of Engines:	1 Rolls-Royce Nimbus MK.10501 turboshaft engine	
Year of Manufacture:	1972	
Date & Time (UTC):	19 November 2001 at 1440 hrs	
Location:	8 miles south-west of Cambridge	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - Nil
Injuries:	Crew - Nil	Passengers - N/A
Nature of Damage:	Helicopter damaged beyond economic repair	
Commander's Licence:	Private Pilot's Licence (Helicopters)	
Commander's Age:	39 years	
Commander's Flying Experience:	299 hours (of which 18 were on type) Last 90 days - 19 hours Last 28 days - 7 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The aircraft experienced a partial engine failure in flight and a forced landing was executed. The aircraft overturned on landing and was substantially damaged. There were no injuries to the two occupants. The investigation concluded that the most likely cause of the engine failure was water contamination of the fuel.

History of the flight

On the day of the accident, the pilot had flown from his home airfield at Draycott Farm to a private landing site at March, in Cambridgeshire. The flight time was approximately one hour. He then flew from March to Cambridge Airport, where he intended to refuel. The fuel remaining on arrival at Cambridge was estimated by the pilot to have been around 400 lb and the helicopter was refuelled with 800 lb of AVTUR fuel from a bowser. This gave an approximate total fuel on board of 1,200 lb, which is the maximum fuel capacity of the helicopter.

The pilot departed Cambridge Airport to the south-west for the VFR return leg to Draycott Farm. The weather conditions were good, with a northerly wind at 5 kt, nil precipitation and visibility in excess of 10 km. Approximately seven minutes after departure, when flying straight and level at 1,500 feet and 95 kt on a heading of approximately 220°M, the pilot heard a noise that he described as sounding like a compressor stall. He observed a simultaneous drop in the rotor RPM. He immediately lowered the collective lever to maintain rotor RPM and reduced the throttle to ground idle. A 180° turn into wind was executed and a run-on autorotational landing was carried out into a field, touching down at between 35 and 40 kt. As the speed decayed, the landing gear skids dug into the soft ground, causing the helicopter to tip forward, and this resulted in the rotor blades striking both the ground and the tail boom. The helicopter came to rest on its right side with the engine still running at idle. The pilot shut down the engine and switched off the master switch, before evacuating with the other crew member through the left front door. A BO105 air ambulance helicopter from Cambridge Airport was dispatched to the scene of the accident to attend to the occupants.

The aircraft had flown for approximately 1/2 hour the previous day with no reported problems and had been refuelled with 800 lb of fuel from the bowser at Draycott Farm, three days prior to the accident.

Aircraft damage

The tail boom was severed by the impact with the rotor blades and these were extensively damaged by contact with the ground. The top of the cabin was struck by a rotor blade, but it had not penetrated the roof, but the cabin and engine exhaust ducts were damaged in the roll-over. The helicopter was determined to be damaged beyond economic repair.

Relevant aircraft information

The Scout AH1 Mk1 is a single-engined helicopter powered by a Nimbus Mk10501 free turbine engine driving a four-bladed main rotor and a two-bladed tail rotor. It was built in 1972 by Westland Aircraft Ltd and operated in military service from 1972 until 1994. A free turbine governor controls the amount of fuel being supplied to the engine to maintain the main rotor RPM within specified limits.

The fuel system comprises three interconnected bag tanks mounted within the structure behind the cabin. The centre fuel tank contains two electric fuel boost pumps which supply fuel to the engine via the Low Pressure (LP) fuel filter and the Fuel Control Unit. Each boost pump has a drain valve and there is a separate larger drain valve for the centre fuel tank sump. The drains are mounted beneath the helicopter, close to the fuselage centreline. The boost pump drains are fitted with conventional drain valves similar to those on most light aircraft. The centre tank sump drain tube is approximately 1 inch in diameter and this terminates in a screw cap at the fuselage skin. A sprung

loaded check valve is recessed inside the tube. In military service a special drain tool was used to drain the fuel from the centre tank sump. This tool screws onto the drain tube in place of the cap and has an outlet tube to direct the flow of fuel into a container. The aircraft has an external fuel filler cap which is located on the right hand side of the aircraft.

Aircraft history

G-BXSL was acquired by a private purchaser in November 1997 and an application was made to the CAA for a Permit to Fly, which was duly approved. One of conditions included in the Airworthiness Approval Notice (AAN) for the approval of the Permit was that the aircraft must be maintained by a particular named maintenance organisation which was experienced in maintaining the Scout helicopter. An additional condition was that the helicopter must be operated and maintained in accordance with the A.P. 101C-0701-15 series military manuals and schedules which are applicable to the Scout helicopter.

A 150-hour Check was completed on the aircraft on 17 September 2001, at 5035.7 airframe hours, and this was concurrent with inspections for the renewal of the Permit to Fly. The aircraft was flown on a 20-minute air test on the same day, with no problems being reported.

At the time of the accident, the helicopter had flown 20 hours since the 150-hour Check, with no reported defects, and there were no significant deferred defects outstanding on the aircraft. The aircraft had a valid Flight Release Certificate and held a current Permit to Fly, which was valid until August 2002.

Engineering investigation

The aircraft wreckage was examined in a hangar at Draycott Farm where it was being stored. An external examination of the aircraft did not identify any obvious reason for the engine problem. The compressor and turbine, as visible, were free from damage and rotated freely. The engine was dry motored using the starter and the ignitor was audibly checked to be functioning.

Prior to the arrival of the AAIB, the owner had reportedly started and briefly run the engine before placing the wreckage in the hangar. The owner had also taken a sample of fuel from the LP fuel filter. A significant amount of yellow-stained water was found at the bottom of this sample and the fuel was very cloudy in appearance, Figure 1. The presence of water was confirmed by using a water testing kit but, unfortunately, this sample had not been retained for examination by the AAIB.

Fuel samples were taken by the AAIB from the fuel boost pump drains and the centre tank sump drain. The sample taken from the centre sump drain contained an estimated 1 to 2 cc's of water, and this exhibited a similar yellow colouration to that in the sample taken by owner from the LP fuel filter. A further fuel sample was taken at the LP fuel filter location, which was obtained by briefly running the boost pumps. This sample was slightly cloudy, indicative of the presence of a small amount of water in suspension. This was confirmed using a water testing kit. Fuel samples were also taken from the bowsers at Draycott Farm and Cambridge Airport and sent for independent laboratory analysis. The results of the laboratory analysis indicated that the water content in the fuel samples from the Draycott Farm and Cambridge Airport bowsers was not excessive. The sample taken from the centre tank sump was confirmed to have a significant amount of water present. The yellow-coloured water was found to contain a quantity of fibrous matter, which was identified to be fungal fragments, although no living microbial contamination was found. It was not possible to

establish from where the water had originated, but the yellow colouration and fungal fragments indicated that the water had been present in the fuel for a considerable time.

During the 150-hour Check, fuel samples were taken from the boost pumps, centre tank sump and LP fuel filter and were visually checked for water. The samples were reportedly found to be satisfactory but the fuel tank was not drained as there was no requirement to do so.

Enquiries revealed that two other helicopters had been refuelled from the same bowser at Cambridge Airport on the same day, shortly before G-BXSL but neither experienced any subsequent problems of fuel contamination. One of these helicopters was the air ambulance aircraft which attended the accident site.

The integrity of the seal on the external fuel filler cap on G-BXSL was checked and was found to be sealing adequately, such that it would have prevented rainwater from entering the fuel tank.

Draycott Farm and Cambridge Airport bowsers

The fuelling procedures for the Draycott Farm bowser include a visual check for water at the delivery point prior to each refuel and a visual check for water in the main sump. This is performed weekly. The most recent fuel delivery prior to the accident was on 13 November 2001, when 14,000 litres of AVTUR were loaded into the bowser from an approved supplier. Water checks were carried out on the fuel prior to loading and the results were found to be acceptable.

The bowser at Cambridge has a capacity of 18,000 litres and when the three helicopters were fuelled on 19 November, it contained 17,560 litres of fuel. The bowser sump and filter drains are checked for water each morning. The filter drain sample is tested with a water testing kit and, if the fuel samples are satisfactory, the bowser is considered acceptable for use and the control sheet for the bowser is signed and stamped to indicate that the bowser is fit for service. Similar checks are carried out each morning on the bulk fuel installations at Cambridge Airport from which the bowser is refilled.

Scout Maintenance schedule

The pilot's Check List or Flight Reference Cards (FRCs) for the Scout helicopter (document reference AP101C-0701-14A)[1] as they are known, do not contain a daily check for water in the fuel, such as would be required if the aircraft was maintained to the CAA Light Aircraft Maintenance Schedule (Helicopters) (LAMS (H)). The reason for this is that under the military schedule, this was an engineering task, covered by task 045202 of the Technical Flight Servicing Schedule (TFS) (document reference AP101C-0701-5B1). The task card instructions require the draining of 1/2 pint of fuel from each boost pump drain valve and 4 pints from the centre tank sump drain valve, for a visual check for water or sediment contamination. Under the military schedule, the TFS tasks were required to be completed every 7 calendar days.

The pilot of G-BXSL, and pilots of other Scout helicopters, when canvassed, were unaware of the requirement to sample fuel from the centre tank sump drain. They were also unaware of the existence of the TFS and there was no requirement to perform any such fuel sampling in the pilot's documentation. Notwithstanding this, the pilots had been performing regular fuel contamination checks by taking samples from the boost pump drains, from which fuel could be drawn using the normal commercially-available fuel tester used by the majority of private pilots. The relative inaccessibility, and different appearance of the centre tank sump drain valve, would be likely to

deter pilots from taking samples from the centre tank sump drain, in the absence of any other information.

It was established that in military service a special tool was used to enable fuel to be drained from the centre tank sump drain in a controlled manner and avoid a deluge of fuel being released from the drain valve. However, this tool was no longer available. The sampling of fuel from the centre tank sump is further complicated by the fact that the Scout helicopter is relatively wide and has a very low ground clearance so that it is necessary to crawl underneath the aircraft to reach the centre sump drain valve.

The investigation established that the TFS maintenance tasks, and the need for the centre sump drain tooling, had been overlooked in the implementation of the maintenance programme for G-BXSL and other Scout helicopters under the care of the maintenance organisation. These tasks were therefore neither being carried out by the pilots, nor the engineers from the maintenance organisation. Although the organisation had shown attention to detail in managing the maintenance of the aircraft, and the maintenance work itself had been carried out to a high standard, it was considered to be a genuine oversight that this maintenance requirement had not been implemented. In doing so, however, the conditions of the AAN, the Permit to Fly, the content of A.P. 101C-0701-5A1 and the requirements of BCAR A/B 3-7 (when recommending the renewal of the Permit to Fly) were not complied with.

In the case of G-BXSL, the Permit to Fly was validated upon the recommendation of the approved maintenance organisation; the helicopter was not surveyed by the CAA at that time.

Preventative actions

In response to the AAIB findings, the maintenance organisation conducted a review of the TFS maintenance tasks with the intention of including the appropriate tasks in the pilot's FRCs. This was to include the fuel contamination checks, along with instructions for carrying out the tasks. The Aircraft Technical Log sheets were also amended to include columns for recording the results of the fuel sample checks from the boost pump and centre tank sump drains. Plans were also in place for the manufacture of centre tank sump drain valve tools.

Conclusions

Visual examination of fuel samples taken from the LP fuel filter, and analysis of fuel from the centre tank sump, confirmed the presence of excessive amounts of water in the fuel system. This could have accounted for the loss of performance of the engine which led to the accident. The water had been present in the fuel for a significant period of time but analytical techniques did not identify the source of the water. Effective fuel quality sampling procedures were being used for both the Draycott Farm and Cambridge Airport bowsers but, due to an oversight, the required routine fuel contamination checks were not being performed on fuel from the centre tank sump drain.

[1] Note. This type of helicopter would not actually be permitted to be maintained in accordance with LAMS(H) as this document does not apply to Permit category or turbine powered helicopters.