Aviation Safety Investigation Report 199302216

Bell Helicopter Co JetRanger III

28 July 1993

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Aviation Safety Investigation Report

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Occurrence Number: 199302216 **Occurrence Type:** Accident
Location: 20km NE Gladstone
State: QLD **Inv Category:** 3
Date: Wednesday 28 July 1993
Time: 1043 hours **Time Zone** EST
Highest Injury Level: Fatal
Injuries:

	Fatal	Serious	Minor	None	Total
Crew	1	0	0	0	1
Ground	0	0	0	0	0
Passenger	2	1	0	0	3
Total	**3**	**1**	**0**	**0**	**4**

Aircraft Manufacturer: Bell Helicopter Co
Aircraft Model: 206B (III)
Aircraft Registration: VH-PCR **Serial Number:** 3500
Type of Operation: Charter Passenger
Damage to Aircraft: Destroyed
Departure Point: Gladstone QLD
Departure Time: 1035 EST
Destination: Heron Island QLD

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	Commercial	105.0	1500

Approved for Release: Monday, January 8, 1996

History of the flight

The helicopter carrying one pilot and three passengers departed Gladstone aerodrome at 1035 hours EST on a charter flight to Heron Island. It was equipped with emergency flotation and overwater survival equipment consisting of life vests and a raft.

En route three miles out to sea near Facing Island and when cruising at an estimated 1500 ft, the pilot transmitted a mayday call on the mandatory traffic advisory frequency. He advised that he was returning to Gladstone because the helicopter had experienced a severe jolt in flight. Soon after the mayday call, the pilot advised that he was ditching.

The only survivor, a passenger with no aviation qualifications, was seated in the right rear seat. She recalled that the helicopter airframe gave a kick in flight immediately before the pilot transmitted a mayday. During the descent, she heard the engine making an unusual shuddering noise and saw the nose of the helicopter twitching left to right several times.

The emergency popout floats comprising six float bags were deployed before the helicopter impacted the water at 1043 EST. The severity of the structural deformation and the break-up was consistent with the helicopter impacting the water with high vertical deceleration forces and some forward speed. Only two float bags remained inflated after impact and the helicopter sank in 24 metres of water with the pilot and the front passenger still strapped in their seats. The passengers in the left and right rear seats were thrown from the cabin on impact.

The helicopters buoyant emergency locator beacon was lost at sea and the non-buoyant beacon, which was attached to the airframe, sank with the helicopter. No signal was heard from either beacon. The life raft was found afloat but still packed in its valise. The pilot and the passengers were wearing serviceable life vests which were not inflated. Pathological examination of the three fatalities revealed that the cause of death was drowning.

The helicopter was recovered at latitude 230 16 S longitude 1510 24 E at a position 20 kms NE of Gladstone and about 5 kms from Facing Island, the nearest landmass.

Wreckage Examination

An examination of the wreckage revealed no evidence of airframe or system malfunction which may have contributed to the accident. The gross weight and centre of gravity were within prescribed limits.

A detailed examination of the engine and its accessories revealed that most of the stator vanes of stages three and four of the compressor were missing. Five of the fourth stage stator vanes and all but one of the third stage vanes were fractured in the upper case-half and the majority of the third stage vanes were fractured in the lower case-half. All fracture surfaces were destroyed by secondary damage. Available evidence indicated that the reason for the vane failures was a fracture of one or more of the third stage stator vanes probably resulting from erosion in the upper case-half.

Erosion to the lining of the compressor halves was found to be present around a number of adjacent vanes in the first, second, fifth and sixth stages. The engine operations and maintenance manual requires the removal of the vane assemblies in these conditions. Measurement of the first stage vane showed that it did not meet the chordal and thickness erosion limits specified in the manual and a second stage vane did not meet thickness requirements. Particles embedded in the eroded region of the first stage vanes were high in silicon content. None of the compressor rotor blades were fractured.

The case-halves of the engine compressor were last inspected by a licensed aircraft maintenance engineer at Gladstone on 18 March 1993. The engineer advised that the inspection was performed in accordance with the Allison engine maintenance manual and the compressor was deemed to be serviceable. Between 18 March 1993 and the accident the compressor had operated for 135 hours.

The engine manufacturer requires compressor inspections at intervals not exceeding 300 hours time in service with more frequent inspections required when operating in harsh conditions such as salt water and sandy or dusty environments, where abrasive particles may enter the compressor. No other defect was found with the engine which could have contributed to the engine malfunction.

The operator's company policy required pilots based at Gladstone to record relevant engine power trend parameters on each day a helicopter flew. From 18 June 1993 until 26 July 1993, pilots recorded thirty-one sets of engine power trend figures for VH-PCR and this trend monitoring showed no degradation of power in the engine and gave no warning of an imminent compressor failure.

Pilot Information

The pilot held a Commercial Pilot Licence (Helicopters) with a valid class 1 medical certificate. He had been rostered off duty for the three days immediately prior to the accident and he had adequately rested prior to the flight which was conducted within his normal duty period. He had no known medical problems at the time of the accident.

The pilot received endorsement training on Bell 206 helicopters during February and March 1993. This training involved five hours of dual instruction, followed by 4.6 hours of operations in-command-under-supervision, flying a Bell 206 between Gladstone and Heron Island. His most recent dual check was on 31 May 1993 at Gladstone in a Bell 206. Since 1989 he had accrued over 1000 hours as co-pilot of twin engine helicopters engaged in offshore operations. His total experience as pilot-in-command was 254 hours of which 95.4 hours had been flown in Bell 206 helicopters.

The pilot did not hold a helicopter utility float endorsement nor was there a legal requirement in Australia for the pilot to hold such an endorsement for over-water operations in a helicopter equipped with emergency popout floats. Popout floats are designed for emergency use only and do not inflate until activated by the pilot. Practice autorotative descents in helicopters equipped with emergency popout floats are not normally carried through to termination onto the water and popout floats are not normally inflated during such practice descents. In contrast, utility floats are expected to be permanently inflated when fitted to a helicopter. They are more robust and are designed for regular landings onto water, including termination onto water following a practise autorotative descent.

No evidence was found to indicate that the pilot had flown a helicopter with inflated floats or that he had received any training in simulated engine-off touchdowns onto water. He had successfully undergone helicopter underwater escape training on 31 July 1991.

Weather

Forecast weather was for south-south-easterly winds at 10 to 15 kts turning more easterly in the afternoon with a sea swell up to one metre.

The crew of a company helicopter which arrived overhead the survivor and the floating wreckage about 20 minutes after the accident reported that the sea surface at the accident site had about half a metre swell with occasional white cap waves. Visibility was in excess of 40 km and the wind was blowing from the east-south-east at about 10 kts. The crew considered the sea surface conditions to be suitable for a safe ditching.

Rotor RPM

The low rotor RPM warning system fitted to a Bell 206B helicopter consists of a warning light on the instrument panel and an audible tone from a cockpit speaker. It is activated when the rotor RPM is less than 90% and the collective pitch lever is raised above the fully down position.

Seven radio transmissions made by the pilot were recorded on the AVDATA logging recorder at Gladstone. The recorded information was examined and the results were compared with the helicopter manufacturers data and with inflight recordings obtained during subsequent flight tests in a Bell 206B.

During the first three transmissions, when operations appeared normal for taxiing and departure from Gladstone, rotor RPM remained constant at approximately 99.5% (98-100% being normal). Throughout the remaining transmissions including the mayday and declaration of ditching, the main rotor RPM appeared to range from 81.6 % to a maximum of 96.6% and then decrease to 75.9% over a period of approximately 28.4 seconds. The last transmission occurred 19.6 seconds later and was approximately one second in duration and it was not possible to determine the rotor RPM during this transmission. An audible tone, which may have indicated the low rotor RPM aural alert, was also heard during periods of the fourth and fifth transmissions and continuously during the sixth and seventh transmissions.

Inflight yaw

Difficulties associated with maintaining balanced flight would be increased by fluctuations in torque. It is also more difficult to maintain balanced flight with inflated floats than with standard high or low skid landing gear, or with emergency floats stowed. The survivor's description of the nose of the helicopter moving left to right during the descent was consistent with torque fluctuations.

Descent over water

The helicopter was equipped with a radar altimeter and after the accident, the warning light on the radar altimeter was found set to activate at 200 feet above terrain or water. The check captain who gave the pilot the Bell 206B endorsement advised that he had verbally explained the operation of the radar altimeter to the pilot. However, during the endorsement and subsequent training, they did not practice power terminations over water or land by reference to the radar altimeter. The engine malfunction occurred when the helicopter was over water with no other visual cues (such as land mass or trees) to assist the pilot with depth perception for flight termination onto the water. It could not be determined if the pilot used the radar altimeter to assist with judgement of ditching on the day of the accident.

Warning and caution lights

The filaments of the globes in the warning and caution panel were inspected. The engine out warning filaments showed some signs of stretching including a broken filament. The low rotor RPM filaments showed definite evidence of stretching including a broken filament.

This indicates that electrical power may have been present in the filaments during the impact sequence. It is probable that the engine-out and low-rotor RPM warning systems activated during the descent.

ANALYSIS

Introduction

The two main factors considered relevant to the development of the accident were the failure of the engine compressor in flight and the ensuing termination of the autorotative descent. The pilots report of a severe jolt, as well as the kick and engine shuddering described by the survivor, were consistent with symptoms of an engine compressor failure.

Low rotor RPM during the descent

The analysis of the AVDATA tape recording revealed a rotor RPM lower than prescribed operating limits. During the sixth transmission, rotor RPM reached 75.9% and at such a low RPM level the helicopters rate of descent would have been considerable. It is possible that the pilot was trying to ascertain the extent of available power and any attempt to increase power by raising the collective pitch lever, would probably have increased the likelihood of compressor surging or stalling. This would cause corresponding torque fluctuations and the damaged engine would not have been able to produce sufficient power to maintain rotor RPM within limits.

Sustained low rotor RPM

At the operating weight at the time of the occurrence, the normal rate of descent during an autorotative descent would be approximately 1,500 ft/min. If the pilot had maintained the collective lever in a slightly raised position for several seconds, including the period of the descent through the last 100 ft, the main rotor RPM would have decreased to a less than desirable level with a descent rate considerably greater than 1,500 ft/min. With main rotor RPM reaching a low of 75.9%, the inertia retained in the rotor would be considerably reduced. If the pilot then attempted to reduce the rate of descent near the sea surface by increasing collective pitch, the rotor would not have been capable of producing sufficient lift to arrest the abnormal rate of descent. Left unchecked the remaining rate of descent would have ensured a hard landing on the water.

High collective pitch pull increase

The pilot may have achieved a stable autorotative descent, but before he had descended to the height where autorotation would normally be terminated, he may have experienced problems with depth perception. If collective pitch was increased with the helicopter too high above the water, the rate of descent would reduce initially, but then increase considerably as rotor RPM decreased. This would result in a hard impact with the water.

CONCLUSIONS

Findings

1.The pilot was suitably licensed and qualified to undertake the flight, and there was no evidence that he was suffering from any illness or incapacity during the flight.

2.Prior to the accident, the pilot had been briefed on the operation of the emergency popout floats of the Bell 206B. There is no evidence that he had flown any helicopter with inflated floats before the accident flight.

3.There was no requirement for pilots operating emergency flotation equipped helicopters to satisfy the water endorsement criteria of the flying training syllabus.

4.The helicopter was equipped for overwater operations and the pilot and passengers wore approved life vests. The life raft and vests were found to be not inflated after the accident.

5.The helicopter was fitted with emergency flotation equipment which was inflated by the pilot before the helicopter impacted the water.

6.The fuselage was severely broken up and deformed in a manner consistent with high vertical deceleration forces.

7.The weather and sea conditions should not have precluded a safe ditching.

8.The helicopter's gross weight and centre of gravity were within prescribed limits.

9.The engine compressor failed and the engine then lost power in flight to a degree that the pilot was forced to ditch the helicopter.

10.The main rotor RPM decreased to 75.9% during the descent.

11.The cause of the compressor vane failures was a fracture of one or more of the third stage stator vanes resulting from erosion in the upper case-half.

12.Regular engine power trend monitoring records revealed no degradation of engine power and gave no warning of an imminent compressor failure.

13.The compressor had operated for 135 hours time in service since the last compressor case-half inspection.

14.No airframe defect was found which may have contributed to the accident.

Significant factors

1.The engine compressor failed due to the fracture of one or more of the third stage stator vanes. Erosion in the upper case-half of the compressor may have contributed to the failure.

2.For reasons which could not be determined a safe autorotative landing onto the water was not made.

SAFETY ACTIONS

Safety action implemented by helicopter operator

Since the accident, the operator has trained its Gladstone based helicopter pilots in operations with utility floats fitted, including complete touchdown autorotations onto water.

Recommendation

As a result of the investigation into this occurrence, the Bureau has made the following recommendation R940236:

The Bureau of Air Safety Investigation recommends that the Civil Aviation Safety Authority review the requirements for pilots operating helicopters fitted with emergency flotation equipment. The review should consider the applicability of a requirement to satisfy the water endorsement criteria of the flying training syllabus.