Aviation Safety Investigation Report 199302930

Bell Helicopter Co JetRanger III

22 September 1993

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Aviation Safety Investigation Report

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Occurrence Number: 199302930 **Occurrence Type:** Accident
Location: 4 km SSW Mount Hotham
State: VIC **Inv Category:** 3
Date: Wednesday 22 September 1993
Time: 0937 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	0	0	0	2
Total	**3**	**0**	**0**	**0**	**3**

Aircraft Manufacturer: Bell Helicopter Co
Aircraft Model: 206B (III)
Aircraft Registration: VH-FUX **Serial Number:** 2665
Type of Operation: Charter Passenger
Damage to Aircraft: Substantial
Departure Point: Hotham Heights VIC
Departure Time: 0930 EST
Destination: Moorabbin VIC

Crew Details:

Role	Class of Licence	Hours on Type	Hours Total
Pilot-In-Command	Commercial	5000.0	8406

Approved for Release: Tuesday, September 27, 1994

FACTUAL INFORMATION

History of flight

The pilot and his passengers arrived at Hotham Heights at about 1735 EST on 21 September 1993. At the time the temperature was minus three degrees celsius, it was snowing lightly and the visibility was poor due to low cloud. The pilot parked the helicopter facing in a northerly direction in the day car park overnight. Snow deflector baffles were not fitted to the airframe and covers were not placed in the engine air intakes or on the exhaust stacks. Overnight it snowed enough to cover tracks from the previous day. The average windspeed, recorded from midnight, varied from 4 knots to 13 knots, varying in direction from the north through to the west.

Shortly after 0900 on 22 September 1993 the pilot threw a few cupfuls of water from a bucket into both sides of the particle separator which is the air filtering device for the engine air intake. He also threw water onto the tail rotor assembly and the windshield. Throwing water into the particle separator is not standard practice on a daily inspection prior to flight. About ten minutes later the pilot returned to the helicopter, loaded the two passengers, untied the main rotor and started the engine. When the main rotor started to spin, snow was flung off the main rotor blades. The pilot ran the engine for five to ten minutes. Then the helicopter lifted into a hover briefly before it departed to the south west and descended into a valley.

The helicopter wreckage was not located until 1245 on 23 September after a prolonged search. The accident site was on a steep, snow covered, timbered slope in mountainous, alpine terrain about 1,300 ft lower than Hotham Heights. The pilot and the two passengers did not survive.

Flight notification

The pilot had telephoned his wife from Hotham Heights at about 0920 on 22 September to say that he would be departing shortly and that he would arrive at Moorabbin by 1200 local time. By about 1315 the pilot's wife became so concerned that her husband had not arrived that she telephoned a friend who contacted Moorabbin Airport to check on the whereabouts of VH-FUX. It was then realised that the helicopter had not arrived and a search was initiated.

The pilot had not submitted a flight plan to the Civil Aviation Authority (CAA). By telephoning his wife, he had opted for the approved alternative of leaving a Flight Note with a responsible person. The investigation could not determine whether the pilot had acquired a weather forecast before departing Hotham Heights. A post-accident estimate of the fuel on board indicated that it was sufficient for the conduct the flight.

Weather

When the helicopter departed Hotham Heights the temperature was minus 2.2 degrees celsius, the relative humidity was 100% and the wind was 256 degrees at 8 kts. It was not snowing. The mountain peaks and tops of the ridges were covered by seven eighths of cloud which was showing signs of dissipating with the sun shining through in patches. The cloud base was slightly below the level of the Hotham Heights day carpark. Cloud conditions on the ridgeline immediately west of the accident site were probably similar. The valley into which the helicopter descended was reported to be clear of cloud with visibility being about 2 km.

Survival

The pilot survived the crash and died from injuries and/or hypothermia before the helicopter wreckage was located.

The helicopter was equipped with a Narco ELT10 survival beacon and a basic survival kit. The survival beacon was ejected from the helicopter at impact and was damaged. Once damaged, the beacon was incapable of transmitting a distress signal to assist in locating the helicopter.

Wreckage examination

Examination of the wreckage did not reveal any pre-existing defects which may have contributed to the accident. Damage sustained by the helicopter during the accident, as well as the damage to the trees, indicated that at initial impact the helicopter had a moderate rate of descent, with low rotor RPM and very little forward airspeed. The helicopter impacted the ground on its left side after which it slid about 20 m down a steep slope before coming to rest against tree trunks. It was within its approved centre of gravity and gross weight limits at the time of the accident.

No evidence of significant torsional twisting was found on any of the drive shafts. The main rotor mast was not torsionally twisted. The engine compressor case-half liners suffered minor internal damage consistent with engine RPM being very low at impact. This evidence is consistent with the engine having flamed out before impact.

The engine was successfully test run after the accident in an approved engine test cell.

Radio transmissions

At 0937, Melbourne Flight Service received a radio mayday call. A call sign was not received and the Flight Service officer had no idea who transmitted the words 'mayday, mayday, mayday' but did correctly identify which frequency, from the group of frequencies he was monitoring, on which the call was made. He immediately declared the distress phase and notified the search and rescue mission coordinator (SARMC). As no further radio calls were made to indicate that an aircraft was in distress, the search and rescue phase was cancelled.

The recording of the mayday call was subsequently analysed by BASI and identified as having originated from VH-FUX. The mayday call lasted 2.1 seconds. After voice modulation ceased, there was approximately 0.42 seconds where noise was recorded. A second transmission was made approximately one second later and was approximately 0.23 seconds in duration. The results were compared with the helicopter manufacturer's data and with inflight recordings obtained during inflight trials conducted in VH-FUX on 16 September 1993 when sound and instrument readings were recorded to assist in another accident investigation. A tone which was considered to have been related to aircraft operation was detected and compared with prior recordings of VH-FUX in flight. The tone indicated that the aircraft may have been in an autorotation with the main rotor RPM reducing from 85% to 82% over a 3.3 second period. The normal range for a power off autorotation is 90% to 107%.

Flight in icing conditions

The approved Flight Manual for the Bell 206B states that the helicopter is certified for operations under non-icing conditions. The Flight Manual also states that engine anti-icing shall be selected on for flight in visible moisture in temperatures below plus 4.4 degrees celsius. At the accident site the anti-ice valve on the engine was found on and the anti-ice switch in the cockpit was found in the on position. It is not known when the pilot selected anti-icing on.

In the Antarctic, the pilot had flown helicopters which were fitted with the same type of engine. He would have been familiar with the potential problems associated with ice. Compressor surge/stall has previously occurred in a Bell 206B in similar weather conditions in the Australian alps. In that case, the surge/stall occurred before the helicopter lifted off. Compressor surge/stall is audible. Witnesses who saw and photographed VH-FUX at Hotham Heights prior to and during its departure, reported no unusual engine noise.

Advice was sought from the Allison engine manufacturer. The engine manufacturer raised the possibility of a slug of ice/slush/snow being sucked into the intake causing a flameout. Such flameouts have been known to occur with the Allison 250 C18 and C20 engines fitted to Hughes 369 helicopters (also known as Hughes 500s) during flights in the Antarctic. In the Antarctic occurrences, the engine flameouts occured in flight after about 15 to 20 minutes, but the outside air temperatures were colder than in the Australian alps. The Allison 250 B17, which has the same compressor, has been known to flameout in a Nomad floatplane due to water spray during taxiing. A twin engine Bolkow 105 helicopter also suffered a flameout on both of its Allison 250 C20 engines due to snow/sleet ingestion inflight despite the fact that the anti-ice was operating on both engines. In the case of a slug of ice/slush/snow or water causing an engine flameout, usually no damage is subsequently found in the engine.

Tests And Research

An experiment involving throwing cups of water into a particle separator, which was not fitted to an aircraft, proved that a significant amount of water will pass through the swirl vanes of the particle separator into the plenum chamber. There were no drain holes in the plenum chamber. This area is well sealed off to allow only filtered air to enter the engine.

ANALYSIS

Pre-flight actions

Because the helicopter was parked overnight in falling snow and moderate winds, without compressor intake covers installed, it was quite possible that snow made its way into the particle separator. The pilot probably saw frost/snow in the particle separator prior to starting the engine, which would account for his throwing water into it.

However, some of the water thrown into the particle separator by the pilot, plus some of the overnight snow, probably accumulated in the plenum chamber. It is unlikely that the pilot would have been able to see into the plenum chamber, if he tried to check for the presence of snow or water, because the perspex viewing ports would have been covered in frost. Also, it is normally difficult to see clearly into the chamber except in very bright sunlight or with the aid of a bright torch. The pilot was not seen using a torch and ambient light at the Hotham Heights carpark was diminished by the foggy conditions.

Pilot decisions

The pilot probably elected to depart from Mount Hotham because the cloud on the high ground was just beginning to dissipate and the valleys appeared clear. As there was no evidence of compressor surging/stalling, it is likely that the pilot turned on the engine anti-ice soon after starting the engine. He then ran the engine for some time, probably to warm it and to determine that there was no intake ice forming. With the rotors turning for several minutes before takeoff, the pilot should have been able to feel whether or not the helicopter was vibrating as a result of ice/frost accumulation on the rotor blades.

Had the weather conditions caused the accumulation of significant airframe icing before departure, particularly on the rotors, the pilot and the passengers would probably have felt significant airframe vibrations soon after the engine was started. Such vibrations would have prompted the pilot to shut down the engine and postpone the departure. Also, if the aircraft had suffered serious airframe icing after departure, it would more likely have crashed under power, which was not the case.

A likely scenario is that the pilot, while flying in the valleys, saw a possibility of tracking north west and attempted to track in that direction in the hope of clearing the alpine area sooner than if he persisted in the valleys. In so doing, the pilot is likely to have flown at reduced airspeed as he approached the ridgeline which was slightly north west of the impact site. The evidence indicates that there probably was low cloud on or near the ridgeline as well as associated reduced inflight visibility.

Engine flameout

Given the weather conditions which prevailed in the Mount Hotham area at the time of the accident, there are two likely reasons for a flameout of the helicopter's Allison 250 C20 engine - compressor intake icing or a slug of ice/slush/snow being ingested into the compressor intake.

If the pilot had left the anti-ice switch in the off position for some time, ice could have built up on the engine compressor intake and caused the engine to surge/stall or even flameout. However, the pilot's actions after start, and the lack of any evidence of surge/stall at that time, make this less likely.

The helicopter probably encountered a slightly higher outside air temperature as it flew in the valleys. Also, the particle separator may have warmed up slightly as a result of engine heat soak, particularly if the helicopter was flying at low forward airspeed. An increase in temperature probably caused a large enough slug of ice/slush/snow to dislodge from the plenum area and the particle separator and enter the engine compressor intake causing an instant flameout. The helicopter was not fitted with the optional autoreignition system which relights the engine very quickly in the event of a flameout.

Because of the low height above the ground the pilot would not have had time to restart the engine. The combination of a flameout, low height, low airspeed, mountainous terrain, and tall trees resulted in a very heavy landing. The low height and lack of time would also account for the pilot not managing to transmit his call sign during the mayday call.

Survival

Had the Emergency Locator Transmitter (ELT) beacon been capable of transmitting a distress signal, it is possible that the signal would have been intercepted by the monitoring satellite or by an overflying aircraft. The time taken to locate the helicopter could have been significantly shorter in duration, which may have increased the pilot's chances of survival.

CONCLUSIONS

Findings

1. The pilot parked the helicopter outdoors and did not fit it with engine intake covers.

2. The helicopter was exposed to blowing snow and freezing conditions overnight.

3. The engine anti-ice switch was found in the on position.

4. The helicopter was not fitted with the optional engine auto-reignition system.

5. The ELT fitted to the helicopter was damaged during the impact and could not transmit a distress signal.

6. The pilot survived the initial crash impact but died from injuries and/or hypothermia before the helicopter was located.

Significant Factors

The following factors were considered relevant to the development of the accident:

1. The helicopter was parked overnight, without engine intake covers being fitted, in conditions of blowing snow.

2. The pilot may not have inspected the plenum chamber for snow or water accumulation before takeoff.

3. An engine flameout occurred at a low height over terrain unsuitable for a forced landing.

SAFETY ACTION

The issues relating to the ELT survival beacon raised in this report are being considered in the light of this and several other occurrences. They will be the subject of a future Bureau of Air Safety Investigation report.