AVIATION INVESTIGATION REPORT
A02W0064

COLLISION WITH TERRAIN

VALLEY B AVIATION
ROBINSON R22 BETA HELICOPTER C-FVBG
MANNING, ALBERTA 20 nm W
08 APRIL 2002

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Summary

The Valley B Aviation Robinson R22 Beta helicopter, registration C-FVBG, serial number 2534, was on a round robin flight from Manning, Alberta, to several local natural gas well sites to document instrument readings. At approximately 1525 mountain daylight time, Rescue Coordination Centre (RCC) Trenton, Ontario received an emergency locator transmitter (ELT) signal from the area, 20 nautical miles west of Manning, and notified all area operators. The aircraft was found 90 minutes later. It had struck the ground on the perimeter of one of the well sites, 11-6. The pilot was fatally injured and the helicopter was substantially damaged.

Ce rapport est également disponible en français.

Other Factual Information

The Robinson R22 Beta helicopter was manufactured in 1994 and imported into Canada in 2000. It had accumulated approximately 1318 hours time in service. The helicopter was equipped for visual flight rules (VFR) operations, and was used mainly to access natural gas field well sites for servicing, when other modes of transport were impractical.

Records indicated that the helicopter was certified, equipped, and maintained in accordance with existing regulations and approved procedures. The helicopter had no known deficiencies before the first flight of the day, and was being operated within its weight and centre of gravity limits. There was useable fuel on board of the proper grade and quantity to complete the flight.

On the day of the occurrence, the pilot, a part owner of the company, had set out at 1000 mountain daylight time (MDT)[1] to obtain readings from nine well sites and one gas plant. The pilot called the company dispatch at 1130 and again at 1440, according to flight following records. The 1440 call indicated that well lease site 11-6 and the "Buick" gas compression plant were the last two sites that needed to be visited. He also indicated that there were some wind gusts that afternoon. The call did not specify his current location, or in which order he would be visiting the well site and gas plant. Paper work obtained from the wreckage showed that all nine well sites and the gas plant were attended by the pilot.

The pilot had approximately 1625 hours of helicopter experience, mostly in R22 and R44 helicopters. He had flown approximately 2 hours on the day of the accident, 4 hours total in the last 7 days, and 7 hours total in both the last 30- and 90-day periods.

The closest weather reporting facility to the accident site was Peace River, Alberta, 40 nautical miles (nm) to the southeast. The 1500 weather in Peace River was reported as follows: winds 220°T at 9 knots, visibility 15 statute miles (sm), a few clouds at 3500 feet above ground level (agl), temperature minus 4°C, dew point minus 15°C, and altimeter 29.95. At 1600, the winds and clouds were essentially the same with the temperature minus 3°C and the dew point at minus 14°C. The graphic area forecast depicted no significant weather for the Peace River area at 1800; however, the Peace River Airport experienced reduced visibilities of 2 sm in light snow showers with an overcast ceiling of 2000 feet. Satellite imagery of the area taken at 1634 showed cloud cover in the Peace River area, with the edge of the clouds in the approximate location of the accident.

Local pilots described the weather in Manning, 20 nm east of accident site, and at the accident site as mid- to high-level clouds, no significant winds, and the temperature around the freezing mark. There was no observed snow or rain on the wreckage or the ground when the helicopter was found. The 1500 and 1600 Peace River temperatures and dew points were outside of the ranges which could induce carburetor icing[2].

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[1] All times are MDT (Coordinated Universal Time minus six hours) unless otherwise stated.

[2] *Aeronautical Information Publication*, AIR 2.3, 20 April 2000

Postmortem examination and toxicology screening of the pilot did not reveal any indication that incapacitation or physiological factors affected the pilot's performance. The pilot had sustained significant injuries to the left side of his torso. The aircraft seats were equipped with a combined seat belt and inertia reel shoulder strap with a single latch. The female portion of pilot's belt latch was found impacted through a sheet metal panel between the seats, with a clean entrance hole. There was no indication that the male portion of the combined belt was attached to the latch at the time of impact.

The helicopter had crashed in the northwest corner of a well site. Several tree tops were observed to have been struck and broken. A tree, approximately 60 feet tall and 35 feet behind the wreckage, held a nearly intact tail rotor and tail cone section about 2 feet long. The remainder of the hull was forward of this on the edge of the site, in an upright position, with the engine section deeper in the ground than the cabin. The bottom portion of the tail rotor warning stinger was found approximately 40 feet forward and to the right (about 45°) of the main wreckage. The forward portion of the tail boom had two main rotor strike indications. Each M/R blade also had a bent leading edge and paint residue from the tail boom. Most of the windscreen/canopy was shattered into various pieces and spread forward of the main cabin. A section of tail boom that held the rotating beacon had been hit with a main rotor blade and was approximately 50 feet in front of the cabin. The tail rotor drive shaft was to the right of the wreckage approximately 150 feet. (See Appendix A).

A comprehensive examination of the aircraft wreckage was carried out, initially at the accident site and later at the TSB wreckage examination facility in Edmonton, Alberta. The engine and various other components were examined at Transport Canada approved overhaul facilities in Edmonton and at the TSB Engineering Branch in Ottawa. It was determined that there were no defects of any components that contributed directly to the accident.

The alternator, an Electrosystems model ALY-842OLS, had 1318.6 hours in service, and was examined at an overhaul facility. There was no structural damage to the alternator, but the brushes were worn well beyond the service limit marks, almost to the point of non-existence. One of the brushes had slipped out of position because of its extreme wear, and the alternator was not producing any power to the electrical system at the time of the accident. The aircraft was equipped with an amber alternator warning light which illuminates to indicate low voltage and possible alternator failure. The manufacturer's Pilot's Operating Handbook, Emergency Procedures, Section III, pages 3 to 8, requires that the pilot turn off all non-essential electrical equipment, turn the ALT (alternator) switch to OFF and back ON after one second to reset the over-voltage relay, and if the lamp is still illuminated, to land as soon as practical. It continues, stating that "continued flight without a functioning alternator can result in loss of the electronic tachometer, producing a hazardous flight condition".

The ALT switch and switches for the strobe lights, radio/navigation equipment, and cabin heat blower were found in the ON positions. The position of any of these before the crash sequence could not be determined. The alternator is operated in an "on condition" basis. There is no requirement by the regulatory authority or the manufacturer to inspect or replace this component at a specified time, other than when it fails. It could not be determined when the alternator ceased providing power.

The aircraft electrical system operates at 12 volts. A thorough analysis and testing of the engine/main rotor tachometer indicator, engine governor, and battery relay were carried out by the manufacturer to determine how these components functioned in a continuously dropping voltage environment. Tests showed that with a constant 104 per cent input signal (engine and main rotor speed), the indicator maintained accurate output indication down to approximately the 8-volt level, then indicated progressively lower than 104 per cent as voltage continued to drop.

The engine governor is designed to maintain the engine RPM in a range from 97 to 104 per cent. Similarly, with a low voltage power input, it will also command the engine to increase as power voltage nears 8 volts and less. The battery relay from the accident aircraft was tested and could maintain battery voltage to the main buses until 1.8 volts was reached. Approximately 48 hours after the crash, the battery no load voltage was measured at 2.5 volts. The battery and individual cells were not damaged. Battery charge state immediately before the accident could not be determined.

The R22 helicopter has a low-inertia rotor system. The main rotor of a helicopter with a low-inertia rotor system can lose energy quickly as the collective is raised and the power required exceeds the power available. This can lead to an aerodynamic stall of the rotor blades and a loss of lift, if the pilot fails to initiate immediate corrective action. Air rushing upward through the blades further increases their angle of attack, resulting in more drag, further slowing the rotor speed. Excessive main rotor RPM decay can occur rapidly and recovery at low altitude is virtually impossible.

The design of the accident helicopter rotor head incorporates three hinge points. The hub is mounted to the shaft with a teeter hinge that allows both blades to flap together as if one. There are coning hinges (located below the teeter hinge) that allow each blade to flap independently, especially when a low-rotor-rpm condition exists. This could cause an out of balance and hazardous flight condition. The National Transportation Safety Board prepared a Special Investigation Report (PB96-917003) regarding 31 fatal accidents in R22/44 helicopters. This study found that, at normal main rotor speeds, the divergence from the blades normal plane of rotation to where a fuselage strike occurred resulted in bent or sheered masts and main rotor spindle tusks. The main rotor mast and spindle tusks on C-FVBG showed no evidence of bumping or damage; however, one blade showed some deformation of the droop stop.

Examination of the wreckage showed upward bending of one main rotor blade, which indicated the rotor was at low speed later in the crash sequence. The damage to trees at the crash site also suggested very little rotation of the rotor prior to ground contact of the cabin. This near stoppage was probably caused by the two tail boom strikes.

Analysis

The initiating event in the accident sequence could not be determined. It is most likely that the pilot was departing the accident site and, for unknown reasons, lost control of the aircraft. The damage patterns are consistent with low rotor speed and erratic blade movement that resulted in main rotor strikes of the tail boom.

Investigation of the aircraft wreckage and components found no indication of any mechanical malfunction that may have initiated or contributed to the accident sequence. Weather was not considered to be a factor.

It is possible that the alternator failure may have distracted the pilot from a low-rotor-speed situation; this could not be determined.

It is unlikely that the pilot was wearing his lap-belt/shoulder harness at the time of the accident. It is probable that using the available restraint properly would have lessened his injuries and increased the chance of survival.

The following laboratory reports were completed:

LP 032/02 – Instrument Analysis
LP 033/02 – Exhaust Stack Analysis, Temperature Determination

Findings as to Causes and Contributing Factors

1. Low rotor speed and an erratic blade movement resulted in two blade strikes on the tail boom and the break up of the helicopter. The reason for the low rotor speed could not be determined.

Other Findings

1. The alternator was not producing power for an undetermined time prior to the accident.

2. The pilot was not wearing the available lap-belt/shoulder harness at the time of the accident.

Safety Action

A Safety Information Letter (No. A020020-1) was sent to Transport Canada on 25 July 2002. The deficiency identification addresses the lack of any requirement to inspect alternators on Robinson helicopters.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 30 January 2003.

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A - Diagram of the Accident Site