AVIATION OCCURRENCE REPORT

FUEL EXHAUSTION

CANADIAN HELICOPTERS LTD.
AEROSPATIALE AS 350B ECUREUIL (HELICOPTER) C-GVMS
CANMORE, ALBERTA 25 nm SW
19 OCTOBER 1995

REPORT NUMBER A95W0194

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

The Aerospatiale AS 350B Ecureuil helicopter had been chartered to sling equipment and materials from the Haig Glacier, Alberta, to the nearby Haig camp, and from the camp to the Ranger Creek staging area located on the Smith Dorian Highway. During the third trip from the glacier to the camp, the pilot observed the fuel low-level warning light illuminate. The fuel quantity gauge indicated there was 18 per cent fuel remaining. The pilot dropped the load at the camp, returned to the glacier, and transported another load to the camp. The fuel quantity gauge was now indicating 11 per cent. At that point he was asked to relocate one sling load at the camp. He moved the load, picked up a net containing 900 pounds of empty propane bottles, and proceeded to the staging area to refuel. About five minutes later and approximately one and one-half miles from the staging area, the pilot noticed that the fuel pressure was fluctuating and that the fuel quantity gauge indication had dropped to three per cent. Immediately thereafter, at an altitude of approximately 300 feet above ground and an indicated airspeed (IAS) of 55 miles per hour (mph), the engine (Turbomeca Arriel 1B) flamed out. The pilot instantly lowered the collective and released the sling load. He attempted to increase airspeed to the recommended autorotative speed of 70 mph and selected a landing area on the highway. When it became evident that he would not reach the highway, the pilot flared the helicopter to land in a creek. The helicopter struck the creek bank at a high rate of descent and slow forward speed. The pilot was seriously injured, and the helicopter was substantially damaged. The emergency locator transmitter (ELT) did not function, and it took about seven hours to effect the pilot's rescue.

Ce rapport est également disponible en français.

Other Factual Information

The pilot departed Canmore at 1444 mountain daylight time (MDT) and arrived at the Haig camp approximately 15 minutes later, with the fuel quantity gauge indicating 30 per cent fuel remaining. The camp was located at approximately 9,000 feet above sea level (asl). Because of the high altitude, the pilot intended to sling lighter loads from the glacier to the camp until he had the minimum fuel necessary to transport the net load from the camp to the staging area. The staging area was located approximately six miles from the camp, at about 6,000 feet asl. When he arrived at the camp, he shut down the helicopter, removed and stowed the right side doors, and attached the longline. He commenced slinging at about 1600, and the accident occurred at 1700.

The right side of the helicopter and the main rotor blades struck the near vertical creek bank. The impact buckled the cabin floor, severed the tail boom, and fragmented the canopy. The pilot sustained two broken legs, seven fractured ribs, and several upper body lacerations as a result of the accident. Because of his injuries, he was unable to extricate himself from the cockpit, and remained in his seat until he was found. Approximately seven hours after the occurrence, a ground searcher located the accident site, in darkness, when he walked to the edge of the road above the wreckage.

Good visual flight rules weather conditions existed at the time of the occurrence. The temperature was approximately minus six degrees Celsius.

The pilot had 6,600 hours of flight experience, with approximately 5,000 hours on Bell 206B helicopters, and about 220 hours on the Aerospatiale AS 350B. The Bell 206B fuel quantity indication system utilizes a fuel quantity gauge only. The AS 350B fuel quantity indication system utilizes a fuel quantity gauge that is supplemented with a fuel low-level warning light.

The helicopter fuel tank remained intact during the accident. Following the recovery of the wreckage, the fuel tank was drained and found to contain 11 litres of fuel. The flight manual stated that 11 litres of fuel was unusable.

The helicopter was fitted with a float-operated resistor-type fuel quantity transmitter that also activated the amber, low-level fuel warning light. Post-crash testing of the fuel quantity indication system determined that 61 to 70 litres of fuel remained in the tank when the low-level fuel light illuminated, and that the fuel quantity gauge indicated 18 per cent at that time. The fuel quantity transmitter was removed for further examination. Testing determined that there was some friction resistance in the transmitter float assembly, which resulted in indication errors of up to six per cent.

All times are MDT (Coordinated Universal Time minus six hours) unless otherwise noted.

The maintenance manual states that when the low-level fuel warning light illuminates, the fuel quantity indicator pointer should be above 10 per cent, and that there must be more than 60 litres of fuel remaining in the tank. The fuel quantity transmitter cannot be adjusted in the field. It is common knowledge among flight crews that resistor-type fuel quantity indicating systems cannot be relied upon to indicate the exact amount of fuel in the tank, especially at a low fuel state.

Aerospatiale Service Letter (SL) No. 867-28-88 advises operators that, although the resistor-type fuel indication system provides an accurate reading of fuel remaining in the fuel tank, it is not a defect-free measurement system. Eurocopter SL No. 1190-28-93 states that there have been a number of reports from operators of incorrect operation of the fuel gauging system. Eurocopter AS 350 Service Bulletin (SB) No. 28.12 R1 identifies that a capacitor-type fuel gauging system is available to increase the reliability of fuel quantity measurement, and to render the low-level warning independent of the measurement. The SB also states that this modification is of particular interest for all operators required to work with low fuel levels, as in slinging, by providing perfect information redundancy. AS 350 SB No. 28.02 provides for a new fuel tank installation that reduces the unusable fuel from 11 litres to 1.25 litres. The helicopter had not been modified in accordance with either SB.

Eurocopter SL 1215-28-94 advises flight crew to check that the fuel gauge reading corresponds to the quantity of fuel added at each refuelling. The pilot reported that he verified the fuel quantity gauge indication once a day, after the first refuelling, by observing the fuel level in the translucent tank relative to quantity markings on the side of the tank.

The AS 350B Flight Manual states that when the low-level fuel warning light illuminates, the remaining usable fuel allows approximately 25 minutes of flight. The light may illuminate with only 50 litres of usable fuel in the tank. At a typical fuel consumption of 160 litres per hour, this would provide less than 20 minutes of flight time. The view among pilots was that there was 20 minutes of fuel remaining when the light flickered, and the normal procedure was to land as soon as possible after the light began to flicker.

Canmore is located near Banff National Park in the Canadian Rockies. Canmore-based helicopter pilots are frequently assigned to 20-minute tourist sightseeing flights, and the pilot had flown numerous local tourist flights in the past. The AS 350 tourist flights normally departed with as little as 25 per cent fuel in order to keep the helicopter within the gross weight and density altitude limitations.

On C-GVMS, the low-level fuel warning light illuminated when the fuel quantity gauge was indicating 18 per cent, whereas on the other AS 350B helicopter based at Canmore, the light illuminated at 12 per cent. The pilot had noted this in the past, and had discussed the condition with maintenance personnel. He was advised that the fuel quantity indication system on C-GVMS had recently been checked, and

that the indications were accurate.

The fuel quantity indication check had been accomplished in June of 1995 when the helicopter had been refuelled from the empty state. An attending company aircraft maintenance engineer had requested that fuel be added in 53-litre, or 10-per cent increments, in order to verify that the fuel quantity gauge indications corresponded to the amount of fuel in the tank. He reported that the fuel low-level warning light illuminated at 18 per cent, and that the tank contained 96 litres or 18 per cent fuel at that time.

Although not considered a factor in the accident, it was determined during the investigation that the current AS 350B Canadian Type Approval, the current Federal Aviation Administration (FAA) AS 350B Type Certificate Data Sheet, and the AS 350B flight manual were not in agreement regarding the helicopter's total fuel capacity.

Existing regulations state that the amount of fuel carried on board a helicopter at the commencement of any VFR flight must be sufficient to fly to the place of intended landing and thereafter for 20 minutes at normal cruising speed.

The helicopter was fitted with a NARCO 10 ELT. Several ELT signals were picked up by the Search and Rescue Satellite (SARSAT) following the accident; however, the signals were of very short duration, and the system was unable to pinpoint the accident site. A company helicopter flew over the wreckage about two hours after the accident. The pilot did not hear an ELT transmission and, because of lighting conditions, did not see the downed helicopter. The injured pilot saw the search helicopter but was unable to signal his location. Examination determined that the ELT did not function properly because of a faulty transistor.

Analysis

The pilot commenced slinging with a reported fuel quantity indication of 30 per cent, which would normally provide approximately one hour of flight time. When the low-level fuel warning light illuminated, the pilot believed, based on the fuel quantity gauge reading, that there was still 18 per cent, or about 35 minutes of fuel remaining. He considered this sufficient to move two more sling loads at the camp and to transport one net load six miles to the staging area. Post-crash testing determined that there could have been as little as 50 litres of usable fuel in the tank when the warning light illuminated. The fuel quantity gauge should have indicated this amount as 10 per cent, which would normally have provided less than 20 minutes of flight time during slinging. An in-flight check of fuel gauge indications against fuel consumption and flight time might have alerted the pilot to the fuel gauge discrepancy.

The pilot was accustomed to flying the helicopter at a low fuel state as he frequently conducted short tourist flights. Five thousand hours of flying experience on the Bell 206B, which does not have a low-level fuel warning light, may have conditioned him to consider

the fuel quantity gauge more accurate than the warning light. This would have been reinforced by his understanding that the fuel quantity indications had recently been checked by a company maintenance engineer and found to be accurate.

It would appear, from the amount of safety information published by the manufacturer, that problems with the resistor-type fuel quantity indication system on the AS 350B helicopter were well recognized. As helicopters are frequently operated at a low fuel state, manufacturers should endeavour to ensure that the installed fuel indicating systems are the most accurate available.

The AS 350 flight manual states that if the amber, low-level fuel warning light illuminates, the remaining usable fuel allows approximately 25 minutes of flight, when in fact less than 20 minutes of flight time may be available.

The flame-out occurred at low altitude and low airspeed. The pilot immediately released the load, initially selected the nearby road as a forced landing site, and attempted to increase the airspeed to that recommended for autorotation. The ensuing rapid loss of altitude precluded successful autorotation to the road, and resulted in the helicopter striking the creek bank at high vertical speed.

The malfunctioning ELT resulted in a long delay in the rescue.

The following Engineering Branch report was completed:

LP 158/95 - Emergency Locator Transmitter Examination.

Findings

1. The engine flamed out due to fuel exhaustion.

2. The pilot continued to operate the helicopter for some time after the fuel low-level warning light illuminated.

3. The fuel quantity gauge was reading up to six per cent high.

4. The low-level warning light illuminated at 18 per cent on this helicopter, whereas it illuminated at 12 per cent on the other AS 350B based at Canmore.

5. The pilot was comfortable operating the helicopter at a low fuel state because he frequently conducted short tourist flights.

6. The pilot was slinging at low altitude and 15 miles per hour below the best autorotational airspeed when the flame-out occurred, which precluded a successful autorotation.

7. The ELT did not function properly because of a faulty transistor, and as a result, the rescue took about seven hours.

8. Less than 20 minutes of usable fuel may be available following

illumination of the amber, low-level fuel warning light; however, the AS 350B flight manual states that approximately 25 minutes of usable fuel is available.

Causes and Contributing Factors

The engine flamed out because of fuel exhaustion. Contributing to the occurrence were the pilot's decisions to rely on the fuel quantity indication at a low fuel state and to continue to operate the helicopter with the fuel low-level warning light illuminated.

Safety Action

Immediately following this occurrence, Canadian Helicopters maintenance personnel checked the fuel quantity indication systems on the remaining 21 company-operated Aerospatiale AS 350 helicopters. As a result of this inspection, two fuel quantity transmitters were found to be unserviceable and were replaced.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Zita Brunet and Maurice Harquail, authorized the release of this report on 19 June 1996.