Transportation Safety Board of Canada | Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A05P0038

DUAL ENGINE POWER LOSS AND HARD LANDING

VANCOUVER ISLAND HELICOPTERS LTD.
BELL 212 (HELICOPTER) C-FWDV
BLUE RIVER, BRITISH COLUMBIA
24 FEBRUARY 2005

Canada

Aviation Occurrence Report

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Summary

The pilot of a Bell 212 HP helicopter (registration C-FWDV, serial number 30973) was carrying out heli-skiing operations in the Blue River area of British Columbia. After taking off from the top of a glacier, at about 8000 feet above sea level, the pilot made a downwind approach to land at a pick-up area at the toe of another glacier. When the helicopter was at about 150 feet above ground level, and at about 30 knots air speed, the pilot increased the collective pitch to slow his rate of descent, but the engines (Pratt & Whitney Canada PT6T-3DF) did not respond. The low rotor rpm warning sounded and the rotor rpm decreased. The pilot lowered the collective and confirmed that the rpm beep was full up and the engine throttles were fully open.

The pilot flew the helicopter toward a snow-covered, frozen lake. The sink rate could not be arrested as the rotor rpm had not recovered, and the helicopter landed hard, yawed right about 90° and remained upright. The deep snow absorbed some of the impact forces, but the helicopter was substantially damaged. After the landing, the rotor rpm appeared to start accelerating and the pilot shut the engines down immediately. The pilot, the only person on board, was not injured.

Ce rapport est également disponible en français.

Other Factual Information

The helicopter had incorporated Supplemental Type Certificates, which relate to the Engine PT6T-3DF installation. In this application, the Twin-Pac® is not fitted with Pg air accumulators.

The outside air temperature was between 0°C and -5°C and the emergency landing altitude was about 6100 feet above sea level. The sky was overcast and the visibility was good. The descent profile was shallow because the proposed landing area was one valley over and only about 2000 feet below. While pilots may use the rpm beep trim switch to prevent engine over-speed during a steep descent, the accident flight did not require its use. In addition, when the pilot noted the loss of rotor rpm, he checked, by pushing forward on the beep trim switch, that the rpm was beeped high. The helicopter's gross weight was about 8200 pounds, 3000 pounds below the maximum gross weight. The lack of engine response occurred in a flight regime where the pilot's options were limited. There was insufficient altitude and air speed to put manual governor operations into effect.

After the accident, fuel was drained from the fuel cell sumps; the fuel was clean and appropriate. The helicopter was later inspected in a controlled environment. All of the engine controls were intact and functioned properly, and the rpm trim was beeped all the way up. The airframe fuel filters were inspected and contained clean fuel. The torque control unit (TCU) was removed and inspected, and, based on a simple test, the TCU ports appeared to be closed. The oil magnetic chip plugs from the engines and combining gearbox (C-box) were inspected. Only the C-box centre plug contained metal chips. The C-box oil filter was removed and inspected; it contained silver and iron particles. The engine power turbine (PT) sections and the C-box were rotated backwards, and they appeared to turn normally. When the drive shaft was rotated forward, the PT sections did not turn, indicating that the free wheel units (one-way clutches) were functioning.

The Twin-Pac® – the two engines and the combining gearbox – was removed from the helicopter. The TCU was reinstalled, and the Twin-Pac® was installed in an approved engine test facility, and several test runs were carried-out. The engines did not operate as they should. Both engines' rpm oscillated and the engines would not accelerate on demand. When the engines were operated in a manual mode, as opposed to automatic governor mode, they operated normally. The TCU was disconnected and the problem remained. The power turbine (Nf) governors were replaced with similar governors that had about 400 hours of in-service use. With these installed, the engines operated normally, with or without the TCU connected.

It was determined that the Nf governors on the accident helicopter were not rigged normally, in that their control arms were statically positioned at 74° and 73°, as opposed to standard positions of about 85° or 90°. The accident Nf governors were reinstalled on the Twin-Pac® with their control arms set to 90°. The engines were run again, and they operated normally. The substitute Nf governors were then installed again, but rigged at 74° and 73°. When run in this configuration, the rpm oscillated and the engines would not accelerate on demand. This time, however, oscillations occurred at a higher rpm. In this configuration, the engines ran normally when run independently.

The accident governors were bench tested and they did not function properly. With the control arms set at 75°, both governors bled Pg air at 11.9 inches Hg when Pg air should bleed at between 6.8 and 7.8 inches of Hg. The governors were disassembled and inspected. Both had in-service wear, both showed wear on the bushings on which the control arms pivot, and there were indications of uneven seating of the port valves. The wear was excessive, given that the Nf governors had only 823 hours of time in service and the overhaul life is 4500 hours. Returning these governors to service would have required that some parts be replaced. It is noteworthy that many similar governors used in this application are removed from service at about 1600 hours because of fluctuating torque, and that they have shown similar wear.

A review of the helicopter's maintenance records and discussion with the operator's personnel revealed that maintenance personnel had replaced the TCU in an effort to resolve torque fluctuations. A replacement TCU had been requested by the operator, but none was readily available. Pratt & Whitney Canada suggested using a new version of the TCU that was approved and being used on -3B engines, with good results, by another operator. The company provided instruction on how to install the new TCU. However, the new TCU had not gone through the approval process for use on the -3DF engines installed on the accident helicopter. This new TCU was different from the one removed in that it had its Pg constant bleed ports capped and, therefore, blocked. This affected the Nf (turbine speed) on both engines, so the control arms were adjusted to bring the Nfs into the normal range. While this rigging change was required, the change was not incorporated in any of the approved maintenance manuals. The new TCU stabilized the torque somewhat, and it remained installed for about 150 hours of flight time before the accident.

The Twin-Pac® had been installed for about 823 flight hours. The engines and the governors were new when they were installed. A well-known, approved overhaul and repair facility reported that the average time on these types of governors when they are received for repair due to wear was about 1600 hours.

Pratt & Whitney Canada and Bell Helicopters Textron worked with the industry in autumn 2002, in an effort to resolve problems with TCUs. It was found that the Nf governors performed better and torques were more stable without the TCUs. Bell Helicopters Textron did not approve the removal of the TCUs, but worked with Pratt & Whitney Canada to approve a TCU with the constant bleeds blocked. These TCUs, with blanked off (Pg) orifices, have been in limited use since January 2003 (Pratt & Whitney Service Bulletin 5463) for the PT6-3B engines with specific, serial-numbered, reduction gearboxes. Pratt & Whitney Canada worked on approvals for these modified TCUs for all Twin-Pac® installations in spring 2005.

Except for the TCU, the engine controls on the Bell 212 operate independently. The engines deliver power to the main-rotor transmission through the combining gearbox. In the event one engine loses power, the other engine can deliver its full power for an emergency landing. The TCU is a simple apparatus that limits combined engine torque and, in some models, balances torque. The TCU's purpose is to protect the helicopter from over-torque when both engines are operating. Anecdotal information suggests that many operators adjust their TCUs to allow pilots a margin of error, preferring to change drive components in the event of an over-torque than have their helicopters crash with unabused drive components.

During the time of the Twin-Pac® tests, there was no accumulation of metal on the magnetic chip plugs. Anecdotal information suggests that metal (silver and iron) particles can be expected in the combining gearbox oil during normal operation.

Analysis

The engine test runs demonstrated that there were anomalies in the engine controls, specifically the engine rpm governors and the TCU. No other anomalies were found, so this analysis is limited to the engine controls.

Because the acceleration and oscillation problems did not appear on the subject governors when the control arms were rigged in the normal range of 85° to 90°, it was concluded that the rigging, prompted by a non-standard TCU, affected the operation of the governors. However, it is recognized that the Nf governors operated for about 150 hours before the engine power delivery problem and accident. This may be explained by the different control arm position elevating the effect of normal deterioration of the governors.

The coincidence of the subject governors malfunctioning at the same time, despite their independence, may be explained by their equal time in service. Also, the fact that the substitute governors appeared to operate normally when they were run independently, and that they oscillated when the engines were run-up together, indicate rpm and torque oscillations on each engine may have aggravated the other governor's weaknesses due to wear. Since both engines drive a common transmission, oscillations in one engine would demand the other engine to try and compensate.

Findings as to Causes and Contributing Factors

1. The installation of a non-standard TCU required that the engine Nf governors be rigged abnormally. The non-approved rigging amplified the effect of normal-type wear in the governors; the governors did not function properly, resulting in inadequate power from both engines upon pilot demand.

2. Rpm and torque oscillations probably aggravated the opposing engine rpm governors' weaknesses due to wear and caused malfunctions at the same time.

3. The loss of power in both engines occurred at a critical time of flight, resulting in a hard landing.

Finding as to Risk

1. In-service wear causes the governors to malfunction before reaching their overhaul life of 4500 hours; the average time in service before they are removed for repair is about 1600 hours.

Safety Action

On 22 April 2005, Aviation Safety Advisory A050009-1, *Dual Engine Power loss - Power Turbine Governor Malfunctions*, was sent to Transport Canada and copied to Pratt & Whitney Canada, Honeywell and Rolls-Royce. The letter identified the aforementioned findings and noted that PT governors used in similar applications have shown premature wear, with many being removed from service because of fluctuating torque. The advisory suggests that the current approved TBO for these governors is too long, and that Transport Canada, in cooperation with Honeywell, Pratt & Whitney Canada and Rolls-Royce, may wish to review the TBOs approved for these governors.

Transport Canada responded to the advisory on 21 July 2005, indicating that a review of Service Difficulty Reports on Honeywell Nf governors as installed in Rolls-Royce 250 C20, P&WC PT6T engines, does not indicate a chronic problem with the time between overhauls.

On 22 April 2005, Aviation Safety Advisory A050010-1, *Dual Engine Power Loss - Power Turbine Governor Rigging*, was sent to Pratt & Whitney Canada and copied to Transport Canada and Honeywell. This letter also identified the aforementioned findings and noted that although the accident governors operated with the control arms at 74° and 73° for about 150 hours before the power losses, it is apparent that the engine oscillation and acceleration problems were present only when the governor control arms were rigged in the 75° range. The advisory suggests that because power turbine governors are essential engine controls, which can cause critical power losses when they malfunction, Pratt & Whitney Canada, in cooperation with Honeywell, may wish to review the effects of having to rig the PT6 power turbine governor control arms in the 75° range.

Transport Canada responded to the advisory on 21 July 2005, indicating that the Department would not be taking any action regarding the advisory pending new information indicating aircraft certification concerns.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 06 September 2005.