AVIATION OCCURRENCE REPORT

DAMAGE TO AIRCRAFT - OVER-STRESS

DEPARTMENT OF TRANSPORT AIRCRAFT SERVICES
BELL 206B JETRANGER (HELICOPTER) C-FDOE
NORDEGG RECREATIONAL CAMPGROUND, ALBERTA
09 JULY 1997

REPORT NUMBER A97W0130

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Summary

After landing the Bell 206B JetRanger helicopter, serial number 381, at a private campground near Nordegg, Alberta, the pilot rolled the throttle to idle, tightened the cyclic and collective friction controls, and briefed the fixed-wing pilot who was sitting in the left seat to hold the left-side dual controls steady. The helicopter pilot then exited the helicopter, without shutting down the engine, and ran approximately 150 feet to a recreational trailer. As he was returning to the helicopter, he stopped briefly to talk to the campground caretaker who was standing approximately 100 feet to the left of the helicopter. Immediately, thereafter, a clunking sound similar to that of an out-of-balance washing machine was heard and the helicopter began to rock fore and aft on the skids. The main rotor disc was observed to be tilted to the extreme forward position. The pilot ran back to the helicopter, ducked under the main rotor disc from the left side, ran around the front of the helicopter, and climbed into the right seat. He immediately attempted to stabilize the helicopter by applying collective and increasing rotor speed. The oscillations diminished initially and then increased dramatically when the weight was reduced on the skids. The pilot then lowered the collective and shut down the engine. When he applied the rotor brake after shutdown a loud “clunk” was heard before the rotor blades stopped turning. Examination determined that the swashplate drive collar set and both main rotor pitch links were fractured. None of the four occupants on board the helicopter sustained injury.

Ce rapport est également disponible en français.

Other Factual Information

Good visual meteorological conditions existed at the time of the occurrence, with clear skies, unrestricted visibility, and light southerly winds. Witnesses estimated the temperature to be 22 degrees Celsius.

The purpose of the flight was to transport two Transport Canada officials and a dependent from the Edmonton City Centre Airport to the Edmonton International Airport to Nordegg to Rocky Mountain House to Red Deer and to Cooking Lake, Alberta to visit general aviation operators.

The flight from the Edmonton City Centre Airport to the Edmonton International Airport and to Nordegg was uneventful. The pilot and passengers reported that the helicopter had a discernable one-to-one vertical vibration in forward flight; however, no other discrepancies were noted. The pilot considered the vibration to be unusual for this helicopter; however, he did not consider the magnitude of the vibration to be cause for concern.

In addition to inspecting a helicopter company that was operating from Nordegg, the pilot decided to stop at the Nordegg Recreational Campground. The private campground was located about two miles north of the town site and consisted of numerous trailer lots that were situated on the perimeter of the old, abandoned town airstrip. The grass airstrip was approximately 1,500 feet long and 300 feet wide. As the flight was behind schedule due to an extended stop at the Edmonton International Airport, the pilot determined that he would save time by landing at the campground rather than driving or walking from the town site to the campground after landing in Nordegg.

After landing, the pilot consulted with the passengers to determine if it was necessary to shut down. Since none of the passengers expressed a desire to get out of the helicopter at the campground, the pilot decided he would not shut down, as it would require only a short time to conduct his personal business and there was an experienced fixed-wing pilot in the left seat.

A simulation of the occurrence determined that the pilot had taken approximately 20 seconds to tighten the friction controls and brief the fixed-wing pilot, and that he was out of the helicopter for approximately 50 seconds. It was estimated that the pilot would have required approximately seven minutes to shut down, conduct business, and restart the helicopter.

The helicopter pilot held a valid Airline Transport Pilot Licence (ATPL), and was certified and qualified for the flight in accordance with existing regulations. He had acquired approximately 6,760 hours of flight experience, including 4,700 hours in rotorcraft, and 943 hours in the Bell 206 type helicopter. He had commenced his flying career with the Canadian Armed Forces and had instructed on helicopters for several years. He reported that as an instructor, he had frequently exited helicopters prior to shutdown on training flights in order to let the student complete the shutdown alone. He had flown Transport Canada helicopters for approximately six years, and related that he was used to having a qualified helicopter pilot occupy the left seat on Transport Canada flights, as Transport Canada helicopter pilots frequently conducted training and other flights in pairs. He had received Transport Canada Crew Resource Management (CRM) training, and had provided CRM and decision making instruction to commercial pilots in the past. He reported that he had not previously exited a Transport Canada helicopter without first shutting down the helicopter's engine.

The fixed-wing pilot held a valid ATPL, and had accumulated approximately 12,000 hours of fixed-wing flying experience. He had attended Transport Canada CRM training. He had never received helicopter training and, prior to this flight, had not ridden in a Bell 206 for approximately 10 years. He reported that he had pushed the cyclic forward, after the helicopter started to oscillate, in order to prevent the helicopter from becoming airborne.

Part 602.10 of the *Canadian Aviation Regulations (CARS)* states that, no person shall leave an engine of an aircraft running, unless a pilot's seat is occupied by a person who is competent to control the aircraft. The regulation permits a pilot to leave an aircraft with an engine running provided that there are no passengers on the aircraft, that precautions have been taken to prevent the aircraft from moving, and that the aircraft is not left unattended. Exiting a running helicopter during ground operation is considered an acceptable practice by some helicopter pilots.

The *Transport Canada Aircraft Services Directorate Helicopter Flight Operations Manual* states, "Except during authorized flight training, no person other than a qualified Department of Transport pilot shall manipulate the flight controls during flight." The *Operations Manual* did not address the manipulation of the flight controls while the helicopter was on the ground with the rotors turning. On 10 August 1993, an Operational Memorandum pertaining to "Changing Crew Seats" was issued and stated that, "At least one crew seat equipped with flight controls must be occupied by a qualified pilot at all times that the helicopter is running." This memorandum did not define pilot qualifications.

The pilot filed a visual flight rules(VFR) flight itinerary with the Edmonton Flight Service Station (FSS). The flight itinerary was completed using an outdated Transport Canada Flight Plan/Notification form. The pilot did not indicate any intermediate stops on the flight itinerary, and did not include Nordegg in the route information. The nearest town to Nordegg to be referenced in the flight itinerary was Rocky Mountain House, Alberta; which is located approximately 50 miles to the east. The estimated elapsed time; which must include the time for the planned stops, was recorded as three hours and thirty minutes. It was estimated that the flight, including the planned stops, would have required approximately nine hours to complete.

The helicopter had been manufactured as a Bell 206A in 1969 and had been upgraded to a Bell 206B JetRanger II. Logbook entries indicated the helicopter had been maintained and certified in accordance with existing regulations. The swashplate drive collar set attaches to a splined area of the mast and forms part of the swashplate drive link assembly. The mast assembly had been replaced approximately 15 hours prior to the occurrence. No maintenance or material preoccurrence discrepancies were identified during a detailed examination of the mast, the swashplate, and the collar set. The transmission isolation mount, the transmission mount plate and support, and the transmission pin assembly sustained overload damage that was consistent with severe mast bumping. The pitch horns on the rotating upper swashplate had sustained damage due to cowling contact, and the collar set and pitch link fractures were overload in nature.
The Bell 206B helicopter is fitted with an underslung, semi-rigid, teetering, two-blade main rotor system. The teetering design allows the main rotor blades to flap to compensate for asymmetrical lift during flight. One static stop is mounted on either side of the main rotor hub to physically limit the amount of blade flapping. A condition known as mast bumping occurs if the static stops contact the mast, due to excessive blade flapping, during ground operations or in flight. During ground operations with the rotor turning, the main rotor may be affected by wind gusts and flap to its limits resulting in a light static stop to mast contact. In such an event, mast bumping may manifest itself as a light shudder felt throughout the helicopter. The more extreme the flapping,

the more severe the shudder. Mast bumping will also occur during ground operation, if the cyclic is incorrectly positioned or is moved sufficiently to tilt the rotor disc to an extreme position. If the static stop to mast contact is severe, pronounced helicopter oscillations may develop and the helicopter can sustain substantial damage. The appropriate corrective action is to immediately reposition the cyclic, toward or near the neutral position so that the rotor disc resumes a flat position. On the ground, at idle RPM, the rotor disc is less stable and more susceptible to larger deviations due to flapping.

The Bell 206 is also fitted with cyclic and collective friction controls that allow the pilot to set the force required to move the flight controls, in order to reduce the tendency for pilot induced oscillation or collective creep in flight. The cyclic and collective friction controls are not intended to be used as control locks. The pilot had left the hydraulics selected on prior to leaving the helicopter, and testing determined that five to six pounds of force was required at the grip to move the cyclic from a neutral to a forward position with the cyclic friction control tightened and hydraulic power applied.

The transition from fixed-wing to helicopter flying requires the acquisition of new skills and fixed-wing responses may not accomplish the desired reaction in a helicopter. The helicopter cyclic is the equivalent of the fixed-wing control wheel; however, cyclic response is extremely sensitive and rapid in all flight regimes; whereas, control wheel response diminishes at low airspeeds. A fixed-wing pilot may hold a control wheel fully forward during ground operation, in strong winds, in order to keep the aircraft firmly on the ground.

Information regarding two similar Bell 206B occurrences was obtained during the investigation. In one case the helicopter was being run up by a student pilot. At about 80% N1, the helicopter began to bounce and vibrate, and the rotor disc was observed to be tilted in an extreme forward position. The helicopter eventually bounced approximately 120 degrees to the right, and a line supervisor ran to the cockpit and shut the engine down. Examination determined that the transmission isolation mount, the support plate, and the pin assembly had sustained substantial damage, and that the collar set had fractured due to overload. The second incident occurred when a trainee pilot was being checked out by a company check pilot. The trainee pilot had conducted a landing at a remote staging area and the check pilot had exited the helicopter to recover some sling gear that had recently been left at the site. When the check pilot was approximately 100 feet away, the helicopter began to rock violently fore and aft. As the check pilot ran back to the helicopter, he observed that the tip path plane was in the full forward position. The check pilot entered the cockpit and immediately shut the helicopter down. Examination identified that the transmission isolation mount, the support plate and the pin assembly had sustained substantial damage. In both cases, it was determined that the cyclic had been moved to an extreme forward position.
Decision making is the process of choosing between alternatives, by selecting or rejecting the available options. The process is mostly subjective and is often error-prone. The quality of decision making is affected by factors such as knowledge, cognitive heuristics (mental rules of thumb), stress, training, motivation, and attention level. According to normative approaches, optimal decision-making involves identifying all possible courses of action, evaluating the risks and benefits of each course of action, assessing the likelihood of those risks and benefits, and selecting the best course of action based on the integration of all information. In fact, decision-making is affected by a number of cognitive heuristics and biases in human logic; which can degrade the process.

One such heuristic is called a framing bias. Research has shown important differences between the way people make risky decisions with positive and negative outcomes. When people must make a choice between two actions where either outcome is expected to be positive, people tend to avoid the riskier choice. Conversely, if

the choice is expected to result in somewhat negative outcomes, people tend to take the riskier choice. Government regulations and company procedures are often formulated to prevent predictable human actions or decisions that compromise safety.

Analysis

The helicopter was maintained and certified in accordance with existing regulations and there was no evidence that a pre-occurrence mechanical discrepancy contributed to the occurrence. The abandoned airstrip was large enough for a Bell 206 landing and departure, and good visual meteorological conditions, with light winds, existed at the time of the occurrence. The analysis will therefore discuss the decision by the pilot-in-command to leave the helicopter engine running with a pilot who was not qualified on helicopters at the controls, and on the effect of applying fixed-wing knowledge to helicopter operation.

The pilot's decision to land at the private recreational campground was based on his desire to conduct some business at his trailer. After landing, the pilot had two options with regard to exiting the helicopter. In both cases the possible outcomes were negative. One choice was to shut the helicopter down, as required by existing regulations, and lose approximately seven minutes of time. This was the less risky choice; however, the flight was already behind schedule, and the known outcome was a further loss of time. The second choice was to leave the helicopter running, have the fixed-wing pilot monitor the controls, and thereby lose less time. This was more risky in that the outcome could be far more disastrous; however, the risk probabilities were unknown. Considering that the entire trip, including stops, would have required approximately nine hours to complete, the additional time that would have been lost by shutting down was relatively insignificant.

Given that this was personal rather than official business, and that the real purpose of the flight was to visit operators, it is probable that the pilot wished to minimize any inconvenience to the other two Transport Canada officials. The fixed-wing pilot (and the other Transport Canada official) had sufficient aviation experience to encourage a multi-person decision-making environment; however, they were relatively unfamiliar with helicopters. As well, an atmosphere of cooperation and congeniality existed and the decision to leave the helicopter running was never challenged. The pilot had the final authority in the decision making process and while he may have realized that option one was safer, he chose option two, because the perceived outcome was more desirable. His decision to leave the helicopter in the care of the fixed-wing pilot may have been reinforced by his previous experiences of exiting a running helicopter to permit students to shut down on their own, with no adverse consequences, and by the willingness of the fixed-wing pilot to accept the responsibility of holding the flight controls. The pilot overestimated the fixed-wing pilot's helicopter skills and underestimated the likelihood of a negative outcome.

It could not be determined why the helicopter initially began to oscillate; however, it is probable that the condition occurred due to a combination of factors, including the excessive flapping of the main rotor due to a wind gust, and/or an inadvertent movement of the cyclic from the centre position. The fixed-wing pilot responded by moving the cyclic forward; which induced severe mast bumping. This action was the misapplication of a normal fixed-wing corrective action. The mast bumping was sufficiently intense to damage the transmission isolation mount, the transmission mount plate and support, and the transmission pin assembly, and to permit the rotating swashplate pitch horns to contact the surrounding cowling. When the swashplate rotation was restricted due to pitch horn interference with the cowling, the collar set failed in overload. The

main rotor pitch links subsequently failed due to overload when the flailing drive link assembly jammed and further restricted the swashplate rotation.

Had a search been required in order to locate the helicopter, the search effort may have been hampered because pertinent information was missing from the flight itinerary.

Findings

1. The helicopter was maintained and certified in accordance with existing regulations.

2. The fixed-wing pilot who occupied the left seat was not qualified on helicopters.

3. After the helicopter began to oscillate, the fixed-wing pilot applied an inappropriate corrective action, and induced severe mast bumping, by moving the cyclic control forward.

4. The swashplate collar set failed in overload, because of swashplate to cowling contact.

5. The pilot did not provide the correct information on the flight itinerary.

Causes and Contributing Factors

Because the pilot-in-command decided to leave the helicopter running with an unqualified pilot at the controls, the helicopter was damaged when the unqualified pilot applied inappropriate cyclic control inputs to counteract excessive flapping of the main rotor blades.

Safety Action

Following this occurrence, the operator issued a directive to all its helicopter pilots which requires that a crew seat equipped with flight controls must be occupied by a qualified helicopter pilot at all times that the helicopter is running. Unless these conditions are met, the pilot-in-command may not disembark from the helicopter while it is running. This new directive is particularly explicit about the necessary qualifications of the pilot at the controls.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 07 July 1998.