During final approach, the AS 350B3 pilot could not move the cyclic.

BY MARK LACAGNINA

EMS Control Loss

Investigators were unable to determine why a loss of control occurred during an emergency medical services (EMS) flight the night of Dec. 14, 2004, in Apache Junction, Arizona, U.S. The final report by the U.S. National Transportation Safety Board (NTSB), issued in late April 2007, discussed four previous control system discrepancies encountered by pilots of the Eurocopter AS 350B3 and a phenomenon called "hydraulic servo transparency."[1] However, the report contained no analysis of the findings of the investigation.

The helicopter was operated by Petroleum Helicopters Inc. (PHI). The pilot was on duty at the company's EMS crew facility at Williams Gateway Airport in Phoenix at 2200 local time when she was assigned to pick up an accident victim at a shopping mall about 9 nm (17 km) away, and to transport the patient to a hospital.

The pilot held a commercial rotorcraft pilot certificate and had 4,604 flight hours in helicopters. After being hired by PHI in October 2001, she accumulated 80 flight hours as pilot-in-command (PIC) of AS 350B3s, 300 flight hours as PIC of Messerschmitt-Bolkow-Blohm BO-105s and 300 flight hours as PIC of Bell 206Ls. She also had 2,631 flight hours as a Robinson R22 flight instructor.

The pilot conducted preflight checks of the helicopter and had the engine running when two medical crewmembers arrived for the flight. The helicopter departed from the airport at 2229.

Parking Lot Approach

Police and firefighters secured a landing area in a mall parking lot. Fire trucks were positioned at all four edges of the designated landing area. The pilot circled the area several times and discussed obstructions, including tall light poles and power lines, with ground personnel.

Visual meteorological conditions prevailed, and a local weather-observing station was reporting variable winds. However, the pilot said that the winds were calm at the landing site. She maneuvered the helicopter to conduct an approach from the northeast.

After clearing power lines on final approach, the helicopter was about 100 ft above ground level and had been slowed to 20 to 25 kt when the nose gently rose and moved right. The pilot said that when she used cyclic control to correct the movement, the helicopter rolled left "significantly and violently" and began to spin. The report said that the pilot, who was wearing a non-noise-canceling headset, remembered seeing the hydraulic system warning light illuminate but did not hear the aural warning.

The pilot saw shopping-mall buildings nearby and applied full-left cyclic control to avoid colliding with them. "She then grabbed the cyclic with both hands and pulled back and right, but it did not move," the report said. "The anti-torque pedals appeared to work and stopped the spin." Two witnesses said that they heard a hissing sound, similar to the bleeding of airbrake pressure in a large truck, as the helicopter descended.

The helicopter struck the landing area in a steep nose-down and left-side-down attitude at 2237. The left side of the nose section was crushed, the left landing skid failed, the main rotor blades fragmented, and the tail boom was broken at the attachment point with the fuselage. One medical crewmember was killed; the other medical crewmember and the pilot received serious injuries.

A substantial amount of fuel was spilled onto the parking lot, but there was no fire. "The engine continued to run after the ground impact, and [the surviving medical crewmember] and multiple rescue personnel moved numerous switches in the cockpit in an attempt to shut down the engine, hence all postimpact switch positions were unreliable [for investigation purposes]," the report said. Firefighters stopped the engine by spraying fire-suppressant foam into the intake.

Control Discrepancies

The accident helicopter was manufactured in 1999 and had accumulated 2,496 hours of service. The report said that during the three months preceding the accident, four flight control discrepancies had been reported. The reports cited stiffness of the flight controls, excessive control inputs required for normal flight and unwarranted activations of the hydraulic system warning light and horn.

"The most recent write-up was one month prior to the accident," the report said. "The company maintenance department's corrective actions included cleaning the control system bearings, replacing the hydraulic system actuators and repairing damaged electrical wiring and cannon plugs."

Postaccident inspections and functional testing of the helicopter's hydraulic system components found no indication of preimpact failure or malfunction. "The hydraulic system accumulators were found to still have an unquantified amount of pressure," the report said.

Servo Transparency

The report said that NTSB investigators discussed the hydraulic servo transparency phenomenon with Eurocopter engineers and flight test pilots. The phenomenon, also called "control reversability," can occur during maneuvers that result in increased loading on the helicopter and rotor system. The load thresholds vary according to helicopter speed and gross weight, and atmospheric density altitude.

"As explained by Eurocopter, when the helicopter reaches a threshold G-loading for the phenomenon onset, the hydraulic system does not have enough pressure available to move the main left lateral, right lateral and fore/aft servos against the dynamic forces being fed back from the rotor system into the controls," the report said. "At the onset of servo transparency, the flight controls essentially go from boosted to manual reversion, where they remain until the G-loads decrease below the onset threshold values."

Eurocopter's chief test pilot for the AS 350 program told the NTSB that when the phenomenon begins, the pilot typically feels the collective control moving down and the cyclic control moving right.

"Eurocopter personnel stated that the transparency phenomenon is nonviolent and transitory, lasting only 2 to 3 seconds, at most, due to the 'self-correcting actions of the pilots' to reduce the G loads and/or the natural static and dynamic stability response of the helicopter," the report said. "They also stated that the controls are fully operable throughout the entire transparency event; however, the force required to effect movement of the flight controls against the rotor system dynamic feedback loads would increase significantly."

Test Switch Guarded

The AS 350 has 36 backlighted, push-on/pull-off switches on its systems control pedestal. Among them is the hydraulic system test — "HYD TEST" — switch, which is located next to the landing light switch. "Depressing the switch shuts off the hydraulic pump for preflight system checks, in part to ensure that the pressure accumulators for the servo channels are pressurized and working," the report said.

The "HYD TEST" switch in the accident helicopter was found in the "OFF" position, which is the correct position for normal flight.

Postaccident test flights were conducted to determine the time intervals between selection of the "HYD TEST" switch to the "ON" position and loss of lateral hydraulic servo accumulator assistance to flight control inputs. The times varied from 45 seconds during a straight-in approach at 80 kt using excessive control inputs, to 3 minutes 30 seconds during a straight-in approach at 80 kt with minimal control inputs.

The report noted that after the accident, PHI designed, fabricated and installed guards over the "HYD TEST" switches in its fleet of Eurocopters. In November 2005, Eurocopter issued Service Bulletin 67.00.32, which presents procedures for installing a protection flap over the pedestal switches, and in January 2006 began incorporating the protection flap in production helicopters.●

Eurocopter AS 350B3

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Note

1. U.S. National Transportation Safety Board accident report LAX05FA053.