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Helicopter Impacts River After Smoke Disorients Pilot During Fire-fighting Operations

When the pilot encountered significantly reduced visibility at low altitude, all visual cues were lost to the noninstrument-rated commercial pilot, the official Canadian accident report said.

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The Bell 205A-1 helicopter was being flown in forest fire–suppression operations in Canada when the pilot encountered reduced visibility caused by thick smoke over the Churchill River. The pilot executed a right turn to return for landing, but the helicopter descended while in the turn, the main-rotor blades struck the water and the helicopter impacted the river.

The pilot and four passengers escaped the helicopter and were rescued. Three other passengers drowned after suffering incapacitating head injuries in the June 28, 1996, accident. The pilot was seriously injured and the helicopter was destroyed.

The Transportation Safety Board of Canada (TSB) concluded that the cause of the accident was that "the pilot lost the visual cues required for flight" and that "the helicopter descended while in the turn and struck the water before the pilot was able to regain adequate visual reference."

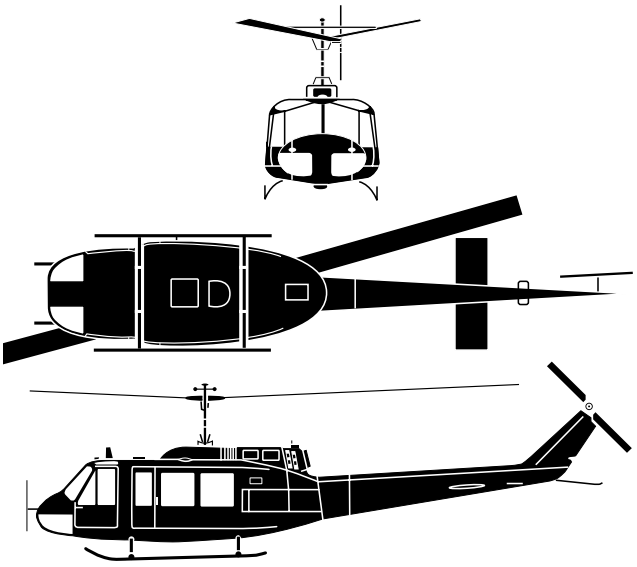
The helicopter was being operated by Northern Mountain Helicopters under contract with the Manitoba Ministry of Natural Resources (MNR). It departed Leaf Rapids, Manitoba, with seven passengers (six fire fighters and a natural resources officer [NRO]) and their equipment on board.

"The [accident] helicopter was one of six helicopters that were being operated out of a temporary heliport at a fire base that had been established on the golf course adjacent to ... Leaf Rapids," the report said. "The [accident] flight was the first flight of the day for the pilot and the first flight to depart from the heliport that morning." The accident occurred at 0935 local time.

The mission was to transport the fire-fighting team to a location about 12 kilometers (7.5 miles) northeast of Leaf Rapids, the report said. "The plan established between the pilot and the NRO prior to departure was to take off and try to reach their destination, but to turn around and return for landing should visibility be insufficient."

Takeoff was uneventful, and the helicopter headed north from Leaf Rapids, following a highway at an altitude of between 75 feet and 100 feet (22.8 meters and 30.5 meters) above ground level (AGL) and at an airspeed of about 40 knots (74 kilometers per hour), the report said. A few minutes later the helicopter began to cross the Churchill River near a road bridge.

"Immediately after crossing the river's north shore, and while in the vicinity of the bridge, the pilot noted that the visibility was deteriorating and initiated a right turn to return to better conditions," the report said. "The pilot lost visual reference while in the turn over the river. The pilot immediately checked the flight instruments and noted that the vertical speed indicator showed that the helicopter was descending at 200 feet per minute [61 meters per minute]. The pilot attempted to stabilize and maintain control of the aircraft while trying to regain visual references; however, the main-rotor blades struck the surface of the water."



Bell 205

The Bell 205 military general purpose turboshaft helicopter first flew in 1961. The 205A-1 is a 15-seat commercial version of the military model 205, also known as the UH-1 Iroquois.

The 205 has a maximum takeoff and landing weight of 4,309 kilograms (9,500 pounds) and a service ceiling of 12,600 feet (3,840 meters). It has a maximum level cruising speed of 110 knots (204 kilometers) per hour and a maximum no-reserves range of 276 nautical miles (511 kilometers).

Source: *Jane's All the World's Aircraft*

After the helicopter main-rotor blades struck the water, they severed the tail boom, the report said. "The main-rotor mast sheared, and the main rotor separated from the aircraft. The forward section of the tail boom was torn from its fuselage mounts."

The report added: "The fuselage initially contacted the water on the left side in a nose-down attitude. The fuselage tumbled after the initial impact and struck the water again on the right rear of the fuselage. The fuselage broke behind the front landing-gear attachment point and to the rear of the cockpit. The wreckage separated into four major sections: the rear tail boom and tail rotor, the forward tail boom, the main-rotor assembly and the fuselage. The helicopter wreckage came to rest in about [10.7 meters (35 feet)] of water, [about 30.5 meters (100 feet)] from shore."

Damage to the aircraft was determined to have resulted from the impact, the report said, and no evidence of mechanical failure was found.

The report said that "just after the [accident], the water surface was observed to be flat and calm, creating a mirror-like effect that would have resulted in a virtually monochromatic visual environment devoid of an identifiable horizon." The report remarked that "during VFR [visual flight rules] flying, pilots rely on cues from the natural horizon and the earth's surface to maintain the desired attitude of the aircraft. When these visual cues become obscured by environmental conditions, such as smoke, a pilot can quickly become disoriented with respect to the position and attitude of the aircraft relative to the ground or water.

"On entry into IMC [instrument meteorological conditions], a pilot must revert to flight instruments to determine and maintain proper aircraft attitude. For pilots who are not current in conducting instrument flight, success in overcoming the effects of spatial disorientation is rare."[1]

[U.S. Federal Aviation Administration (FAA) Advisory Circular (AC) 60-4A, *Pilot's Spatial Disorientation*, said that "if neither horizon nor surface references exist, the attitude of an aircraft must be determined by artificial means from the flight instruments. Sight, supported by other senses, allows the pilot to maintain orientation. However, during periods of low visibility, the supporting senses sometimes conflict with what is seen. When this happens, a pilot is particularly vulnerable to disorientation. ... Spatial disorientation to a pilot means simply the inability to tell which way is 'up.'"[2]]

The report continued: "Spatial disorientation can be so overpowering that, even for pilots who are 'instrument rated, current and proficient in helicopters, success at coping with inadvertent instrument flight is not guaranteed.'[3] Part of the reason is that, once visual reference is lost, it can take as much as 35 seconds to re-establish full control of the aircraft by reference to instruments;[4] of that 35 seconds, at least five seconds are spent recognizing that a hazard exists, determining the necessary corrective action and initiating a response."

The report noted that descending at the rate of 200 feet per minute from an altitude of about 75 feet, "the helicopter would have taken only about 23 seconds to hit the water's surface. Since the pilot was not current in instrument flying, and the helicopter was not equipped for IFR [instrument flight rules] flight, and there was a lack of identifiable outside visual references, the pilot had little chance of making a successful recovery."

The pilot, 45, held a commercial pilot's certificate and had logged a total of 4,250 flying hours, of which 3,400 were on type. He had flown 130 hours in the 90 days before the accident. "The pilot completed his initial helicopter pilot training with the U.S. military" in 1972, the report said.

"[The pilot] received instrument flight training and had a limited amount of instrument flight experience during his subsequent military [flying] career [in Vietnam]. The pilot was issued a Canadian commercial pilot license in 1980, having accumulated [about] 1,970 hours of flying experience. He did not have an instrument rating and did not maintain currency in

instrument flight." No evidence was found that abnormal physiological factors affected the pilot's performance, the report said.

The report said that there were "no aviation weather briefing facilities available locally," although fire teams obtained weather information from Environment Canada. Pilots were also able to obtain Transport Canada's flight service by telephone, but "it was not determined whether any pilots had done so." There were no Environment Canada weather observation personnel in Leaf Rapids, the report said.

The accident flight was being conducted under VFR, which requires that visual reference with the ground or water be maintained, the report said. "At the commencement of the flight, the visibility of [about] three-quarters of a mile exceeded the minima required for VFR flight [not less than 0.8 kilometer (0.5 mile) when operating in uncontrolled airspace below 700 feet (213.5 meters) AGL] ... .

"The smoke from the forest fires in the region created a wide area of partially obscured conditions with no clearly defined ceiling," the report said. "Witnesses reported that, immediately after the [accident], visibility in the river valley near the [accident] site was [about 183 meters (200 yards)]."

The helicopter was equipped with "basic instrumentation for VFR flight and was not certificated or equipped for single-pilot flight in IMC … . As a result, neither the pilot nor the aircraft was certified or equipped to continue the flight in IMC; the only option available to the pilot was to attempt to maintain VFR."

The helicopter was not equipped with a cockpit voice recorder or a flight data recorder, and neither was required by regulation, the report said.

The helicopter was equipped with the personal restraints required, and the restraints were used, the report said. "The pilot used the available shoulder harness and lap belt. The NRO in the other cockpit seat used the lap belt only, although a shoulder harness was available. The seats in the passenger cabin were equipped with lap belts only. All the passengers used the lap belts. The pilot was wearing a protective helmet; however, none of the other occupants was wearing a helmet.

"When the aircraft struck the water, the damage to the aircraft caused the doors and emergency exits to open. As the aircraft sank, occupants who were not incapacitated by the impact forces were able to release their safety harnesses and float to the surface. The passenger in the left-front cockpit seat, and two of the passengers who were seated in the center-rear and right-rear portions of the cabin, did not survive. These three passengers were found in their seats with their lap-belt safety harnesses still [fastened]. Postmortem examinations indicated that each of them had suffered head injuries during the impact sequence, which resulted in their incapacitation; unable to release their safety harnesses, they subsequently drowned. There were no other life-threatening injuries found."

Canadian regulations require that occupants keep lap and shoulder harnesses fastened at all times in helicopters engaged in "special-purpose operations," which includes external load operations, the report said. "Passenger-carrying helicopter flights in support of forest fire–fighting operations, such as in this [accident], are not considered a 'special-purpose operation,'" the report said.

In its analysis, the TSB concluded that "while it could not be proven that the wearing of shoulder harnesses or helmets would have changed the outcome for those passengers who did not survive this [accident], there is sufficient evidence to indicate that the use of shoulder harnesses and protective headgear improves chances of survival."

The report said that "while examining commercial VFR-into-IMC accidents, it became clear that a number of major users of Canadian aviation charter services stipulate additional safety criteria when they contract air charter services … ."

"Oil companies, many air ambulance services and a number of agencies and departments from various levels of government have examined their flight operations requirements and determined the need to specify particular standards for the safety of their personnel ... ," the report said. "These higher standards can be specified in the contract signed with the helicopter operator. The contract in effect at the time of the [accident] placed exclusive responsibility for safety standards with the helicopter operator, and only specified compliance with applicable regulations."

The TSB also examined safety issues involved when two management structures are involved, in this case a helicopter charter operator and a government agency. The report cited a study by the U.S. National Transportation Safety Board (NTSB)[1] that concluded that "when two management structures are involved in an operation, they can have objectives that conflict and adversely affect safety. …

"The NTSB study advocates the establishment of compatible management policies and procedures" when two management structures are involved, the report said. "The intent is for all operational personnel from both organizations to be operating to the same standards and limits. The NTSB study highlights the *de facto* management role that on-scene personnel have with helicopter pilots.

"This role places an onus on fire-management organizations to establish a safety philosophy that includes flight operations. To a great extent, a similar philosophy and policies were already embodied in the 'MNR Fireline Notebook'; however, personnel were not assigned to safety-related positions on the fire team."

The "MNR Fireline Notebook" offers examples of safety guidelines and duties that can be assigned relating to the deployment of aircraft in fire-fighting operations. They include naming of a "fire-safety boss," who is required to monitor all safety aspects of the fire-fighting operations, the report said.

The notebook also calls for designating a "helicopter officer," whose safety checklist includes requirements "such as the need to check that tailgate safety sessions [among] the helicopter officer, ground crew and pilots are conducted each shift ... as well as the need to monitor whether seat belts and shoulder harnesses are always being worn by pilots and passengers ... ."

Although the notebook states that job positions can be combined when necessary, "the criteria governing when these positions may or may not be filled are not defined," the report said. "The positions of fire-safety boss and helicopter officer were not staffed on the fire team involved in the [accident]."

Following the accident and effective for the remainder of the 1996 fire season, the MNR issued internal operational guidelines for fire-fighting flights, the report said. The guidelines require "persons on board such flights to wear seat belts, shoulder harnesses (where available) and helmets or hard hats secured with a chin strap, except when performing duties that require the removal of any or all of these items.

"In addition, in its future long-term contracts with helicopter operators, [the MNR] will require that approved shoulder harnesses be supplied at all normally occupied seat locations ... ."

The report said that the MNR also "amended its operational guidelines to ensure that on any overhead fire team mobilized to manage large fire outbreaks, the role of fire-safety officer is assigned to a specific and suitably trained individual. The fire-safety officer's responsibilities include complying with the items outlined in the ["MNR Fireline Notebook"] helicopter-officer checklist and ensuring that both pilots and other fire staff operate under the same standards and limits while on site."♦

Editorial note: This article is based on the Transportation Safety Board of Canada Report no. A95C0139, Dec. 2, 1996. The 12-page report includes one figure and appendices.

References

1. U.S. National Transportation Safety Board (NTSB). *Safety Study: Commercial Emergency Medical Service Helicopter Operations*. Report no. NTSB/SS-88/01. 1988.
2. U.S. Federal Aviation Administration (FAA). Advisory Circular 60-4A, *Pilot's Spatial Disorientation*. Feb. 9, 1983.
3. NTSB, *op. cit.*
4. FAA, *op. cit.*

Further Reading from FSF Publications

Harris, J.S. "Spatial Disorientation Blamed for Fatal Helicopter Accident in Poor Weather." *Helicopter Safety* Volume 22 (September–October 1996).

Harris, J.S. "Every Helicopter Pilot Must Be Prepared for Inadvertent Entry into Instrument Meteorological Conditions." *Helicopter Safety* Volume 22 (March–April 1996).

Harris, J.S. "Crew Resource Management Applies to Single-pilot Flight Operations." *Helicopter Safety* Volume 21 (September–October 1995).

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