



## **‘Cardiac Event’ Suspected In Pilot’s Loss of Aircraft Control**

*The investigative report said that ‘some loss of control’ occurred during the final seconds of a charter flight in New Zealand. The cause of the loss of control was not established conclusively, but the report said that the pilot might have experienced ‘the sudden onset of a cardiac event.’*

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*FSF Editorial Staff*

On April 2, 1999, an Aerospatiale AS-350B operated by South-West Helicopters was destroyed when it collided with several trees before striking the ground in the Rowallan Forest in southwestern New Zealand. The pilot and all four passengers on the charter flight were killed.

The New Zealand Transport Accident Investigation Commission said in its final report that the accident was a result of “some loss of control” but that the cause of the loss of control was not established conclusively.

“The pilot’s ability to control the helicopter may have been medically impaired by the sudden onset of a cardiac event,” the report said.

The report also cited the possibility that unrestrained cargo might have shifted in the cabin, interfering with the flight controls or distracting the pilot.

The 47-year-old pilot — who was one of three principals of South-West Helicopters, as well as its operations manager and chief pilot — reported for duty at 0700 local time at the company’s home base in Clifden to prepare the helicopter for several charter flights scheduled for the day, primarily to transport hunters to remote locations in the Fiordland region.

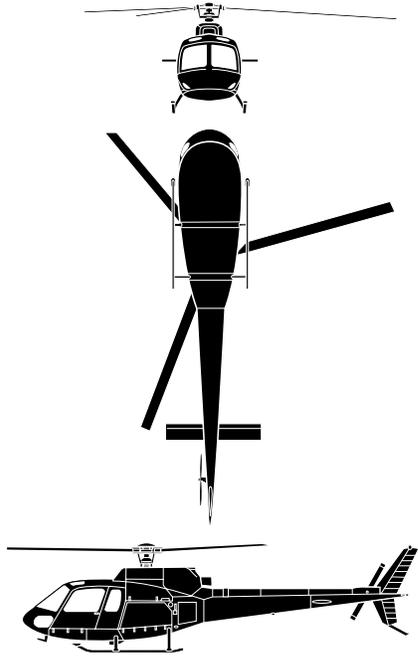


The pilot completed the fourth flight of the day at 1242. Four passengers and supplies for a 10-day hunting trip then were loaded into the helicopter. The pilot intended to fly to Lake Pōteriteri to pick up an inflatable boat that belonged to him and then to continue the flight to Preservation Inlet. Weather at Clifden was clear and sunny, with a light westerly breeze.

“The flight departed at 1255 hours,” the report said. “The pilot made a routine radio call at 1259 ... to the office of another helicopter company in Queenstown [which was] temporarily conducting flight-following for his operation. He reported [his] departure from Clifden ... No further radio transmissions ... were heard.

“At 1301 hours, the helicopter flew into the canopy of the Rowallan Forest in a position [nine statute miles (15 kilometers)] west-northwest of Clifden. It collided with numerous trees before the final impact with the ground at an elevation of 600 feet [above sea level]. There were no witnesses to the flight.”

About 1420, the Queenstown flight-following operator told South-West Helicopters that, after the first radio transmission, there had been no further transmissions by the helicopter pilot.



### Aerospatiale AS-350B Ecureuil (Squirrel)

The Aerospatiale (now Eurocopter) AS-350B is a light utility helicopter with a Turbomeca Arriel 1B turboshaft engine and a rotor of three fiberglass blades that rotate clockwise as viewed from above. Directional control is effected by a two-blade tail rotor on the right side of the tail boom.

Deliveries of the AS-350B began in March 1978, shortly after certification in the United States of the AS-350C, which was powered by a Textron Lycoming LTS-101 turboshaft engine and known as the AStar. The AS-350C was marketed only in North America and was replaced in 1978 by the AS-350D.

The Aerospatiale helicopter division and the MBB (Messerschmitt-Bolkow-Blohm) helicopter division merged in 1992 to form Eurocopter, which markets the AStar and Ecureuil.

The AS-350B has two standard bucket seats at the front of the cabin and two two-place bench seats aft.

The helicopter's maximum normal takeoff weight is 1,950 kilograms (4,300 pounds), or 2,100 kilograms (4,630 pounds) with a maximum sling load. Maximum rate of climb is 480 meters per minute (1,575 feet per minute). The AS-350B has a maximum cruise speed at sea level of 125 knots and a service ceiling of 15,000 feet. Hovering ceiling in ground effect is 8,200 feet; hovering ceiling out of ground effect is 5,900 feet. It has a range with maximum fuel (535 liters [141.3 gallons]) at sea level of 700 kilometers (435 miles).

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

An emergency locator transmitter signal was detected along the route of the accident helicopter's flight at 1449, and two helicopters were commissioned for a search. The accident helicopter was located at 1853. Rescuers found no survivors.

The pilot had received his private pilot license (helicopter) in 1978 and his commercial license in 1980. He had flown in the same area and from the same home base since 1982. He completed conversion training to the AS-350 in August 1990. He had accumulated 14,817 flight hours, including more than 5,000 flight hours in AS-350s. Since 1990, he had been employed periodically to fly AS-350s in support of a seismic survey in Burma.

The pilot held a Class 1 medical certificate, but abnormalities had been observed since 1974 in electrocardiograms (ECGs) conducted during routine aviation medical examinations. Nevertheless, the abnormalities were determined to be within normal limits. In 1987, however, a change was observed in his ECG, and he was examined by a consultant cardiologist, who determined that the pilot was fit to fly.

The report said that subsequent annual ECGs were "variable." In 1998, abnormalities again were observed, and the pilot was referred to a cardiologist for a stress ECG (conducted while he was exercising) to detect problems that might not have been apparent in ECGs that were conducted while he was at rest.

"This showed no abnormalities and an above-average performance for his age and resulted in his being assessed as fit," the report said.

The helicopter was manufactured in 1980 as an AS-350D. The helicopter was imported to New Zealand in 1988 and modified to an AS-350B configuration. (The modification involved replacing the helicopter's Lycoming LTS-101 engine with a Turbomeca Arriel 1B engine.)

The helicopter had accumulated 8,211 hours in service, and the Turbomeca Arriel engine had accumulated 5,571 hours. Maintenance documents showed that scheduled maintenance had been recorded, that significant defects had been rectified, that there were no outstanding airworthiness directives and that all finite-life components were within their appropriate limits.

The last scheduled maintenance, a 100-hour inspection, had been completed March 31, 1999, two days before the accident, when the helicopter's total time in service was 8,207 hours. No inoperative equipment or deferred defects were recorded on the aircraft technical log, but the high-frequency radio was reported to be "intermittent."

Because items were scattered and lost at the accident site, the loading of the helicopter could not be determined, but — using standard passenger weights in the calculations — the helicopter was estimated to have been at its maximum allowable weight of 1,950 kilograms (4,300 pounds) and within its allowable center of gravity (CG) range. Nevertheless, the report said, the items that were scattered over the accident site might have added 100 kilograms (220 pounds) to the total weight, and distribution of those items between the rear cabin and the side locker would have caused "a small forward shift of the CG."

Any overloading “probably was not significant,” the report said, because standard practice was for the pilot to check engine torque and control positions as indicators of acceptable loading when the helicopter was lifted to hover before departure.

There was no evidence that a cargo net, or any other form of cargo restraint, was used in the rear cabin, despite a requirement in the company operations manual that cargo “be properly secured with restraints having sufficient strength to eliminate the possibility of shifting under all normally anticipated flight and ground conditions.”

Flight recorders were not required in the helicopter, and none was installed. Nevertheless, investigators recovered data stored by the helicopter’s global positioning system (GPS). The data provided a record of all flights on the day of the accident, as well as several flights the previous day.

The data showed that, during the accident flight, the helicopter initially followed the track flown on several previous flights between Clifden and Lake Poteriteri. During the 24 seconds before the accident, however, the helicopter deviated to the right with a track change of about 40 degrees and a decrease in groundspeed to 75 knots from about 90 knots.

Searchers found the helicopter on its right side against the base of a tree. The tail boom, left skid and a large portion of the three main-rotor blades were separated from the fuselage. The cabin floor had collapsed upward, “consistent with a severe collision with the ground in an approximately upright, 45-degree, nose-down attitude,” said the report. The occupants were in their seats with their seat belts fastened.

Along the last 100 meters (328 feet) of the helicopter’s flight path were numerous trees that had been damaged by the rotors or by structural collision.

“The first tree with identifiable main-rotor slash damage was about 100 feet (31 meters) tall,” said the report. “The track from this tree to the [accident] site was 300 degrees magnetic, with a vertical angle of 31 degrees down from the slash marks. [Damage to the trees] suggested that the track profile through the trees was initially nearly level but progressively steepened to become nearly vertical at the end. The attitude of the helicopter could not be determined from the slash marks.”

The distance that the helicopter traveled through the trees and the flat angle of its path “was not consistent with an autorotative descent, which would have been the only option in the event of an engine failure,” the report said.

Pieces of wreckage also showed evidence of tree-strike damage.

“The main-rotor blade damage was massive and similar on all three blades, consistent with numerous blade strikes on trees while under power and at normal rotational speed,” the report said. “The starflex arms in the main-rotor head had 45-degree

fractures. The orientation of these fractures indicated that the blue [blade] and yellow [blade] were being driven by engine torque, while the red arm fracture was consistent with inertia forces from the red blade. The tail rotor and drive shaft showed no rotational damage, consistent with little or no rotation when tail-boom separation occurred, and indicating that the main transmission had been slowed or stopped by the main-rotor blade strikes.”

Investigators confirmed the mechanical integrity of the engine controls, flight control systems and the hydraulic system and servos. The pre-impact positions of the controls could not be determined, but the dynamic components rotated normally, with no drive-shaft failure except at the tail-boom separation. Chip detectors from the engine, oil tank, hydraulic system, main transmission and tail-rotor gearbox were free of deposits. The fuel tank was 45 percent full, and samples from the tank and from fuel filters showed that the Jet A1 fuel was normal and uncontaminated.

“The evidence from the wreckage of the helicopter indicated that no mechanical defect had occurred with its control systems, its dynamic components or with the supply of engine power to the rotors,” the report said. “There was no indication from the pilot’s last radio call, made within two minutes of the accident, that anything was unusual about the flight.”

All five occupants suffered multiple severe injuries when the helicopter impacted the ground, but examinations showed that the pilot did not receive injuries to his hands and feet — injuries that are typical if a pilot is holding the flight controls during impact.

“Expert medical opinion ... was that a cardiac event may well have occurred, leading to symptoms causing the pilot to lose control of the helicopter,” the report said. “Symptoms may have been a slower or irregular heart rhythm causing faintness or possibly loss of consciousness but not immediate severe heart failure or cardiac arrest. It was also considered possible that a transient blood clot in a coronary artery could have precipitated changes in heart rhythm and may have caused chest pain.”

The pilot’s history of abnormal ECGs indicated that he had “an intermittent minor defect in the conducting and electrical activity of his heart muscle,” the report said. “These abnormalities, even in the absence of any cardiac symptoms and where a stress ECG was normal, doubled his risk of sudden incapacitation from a cardiac event. This event would typically have been an irregular heart rhythm.”

Because there was no evidence that mechanical problems or weather conditions were factors in the accident, the report said, “the likelihood is that some event occurred in flight within the cabin to distract the pilot or to reduce or compromise his control over the helicopter. Possible events included distraction by a passenger, movement of cargo stowed in the rear cabin, and impairment or incapacitation of the pilot following a cardiac event.”

There was no evidence of distraction by a passenger, but if there had been a problem, the pilot's experience would have prepared him "to cope with a passenger problem without distraction," the report said.

The report said that there was no evidence of any movement of cargo, but the absence of a cargo-restraint system might have allowed cargo to fall onto the collective control lever, fuel control or switch panel, distracting the pilot or interfering with the controls.

The absence of injuries to the pilot's hands and feet "could have been the result of symptoms following a cardiac event, but it might also have [resulted from] a pilot reaction following the first collision with the trees," the report said.

The GPS track plot, which showed a deviation during the last 24 seconds of the flight, also "could be consistent with a cardiac event occurring some 30 seconds prior to impact and causing the pilot to suffer impairment and diminished ability to control the helicopter or perceive its flight path," the report said. "A more complete incapacitation was unlikely, because it would probably have led to a more rapid and severe deviation from track than that recorded."

Company records showed that the pilot had worked six hours without a break, despite the company flight operations manual's requirement that pilots take a 30-minute break after working for four hours. Nevertheless, the report said, the pilot

probably was accustomed to extended periods of work without a break, and any added stress or fatigue as a result of his failure to take a break probably was slight.

The report also said that the pilot had not prepared a passenger list, despite the company operations manual's requirement that the pilot-in-command generate such a list. The name of the hunting party was found "after some delay" in the pilot's diary, the report said, and law enforcement authorities determined the names of individuals in the group.

Based on the findings of the investigation, the report recommended that the chief executive of South-West Helicopters:

- "[Establish] a practical means of meeting the company's requirements for cargo restraints and [ensure] that it is complied with; [and]
- "[Establish] a practical means of meeting the company's requirements for passenger lists and [ensure] that it is complied with."

The chief executive said that the company had adopted a system to secure cabin cargo with nets and tiedowns, as well as flight-following procedures to satisfy the requirements on passenger lists.♦

[Editorial note: This article, except where specifically noted, was based entirely on the New Zealand Transport Accident Investigation Commission's Report 99-003. The report comprises 11 pages.]

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