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Bell 407 Strikes Water During Rescue Flight Off Australian Coast

The crew planned to drop a life raft to two people aboard a sinking yacht, but the accident report said that the crew had not been trained properly for the night overwater flight and that the operator did not have regulatory approval to drop the life raft.

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FSF Editorial Staff

About 2330 local time April 27, 2001, a Bell 407 struck the Coral Sea near the Great Barrier Reef off the northeast coast of Australia as the pilot maneuvered the helicopter to drop a life raft to the crew of a sinking yacht. The helicopter sank and was damaged substantially; the pilot and a helicopter crewmember — the only people in the helicopter — were not injured.

The Australian Transport Safety Bureau (ATSB) said, in the final report on the accident, that the helicopter "was inadvertently flown into the water. The circumstances indicate that the accident was a result of human performance limitations and an absence of robust organizational defenses."

Pilot Had Flown Hundreds of Search-and-rescue Flights

The pilot of the accident helicopter had a commercial pilot (helicopter) license with a night visual flight rules (VFR) rating, an endorsement that permitted him to navigate at night using nondirectional beacons and a grade one (advanced) flight instructor rating (helicopter). He also had an expired instrument rating. The pilot had 9,593 flight hours, including 46.6 flight hours in Bell 407s. In the 90 days preceding the accident, he had accumulated 44.6 flight hours, with all but five flight hours in Bell 407s; 16.4 of the 44.6 flight hours were accumulated at night. He had a current first-class medical certificate, which required him to wear corrective lenses for distance vision and to have reading glasses in his possession. The pilot said that he had no medical condition that would have impaired his performance and that he was fit and adequately rested for the flight. During the four days preceding the accident, his sleep patterns had been irregular, but the amount of sleep obtained was "sufficient," the report said.

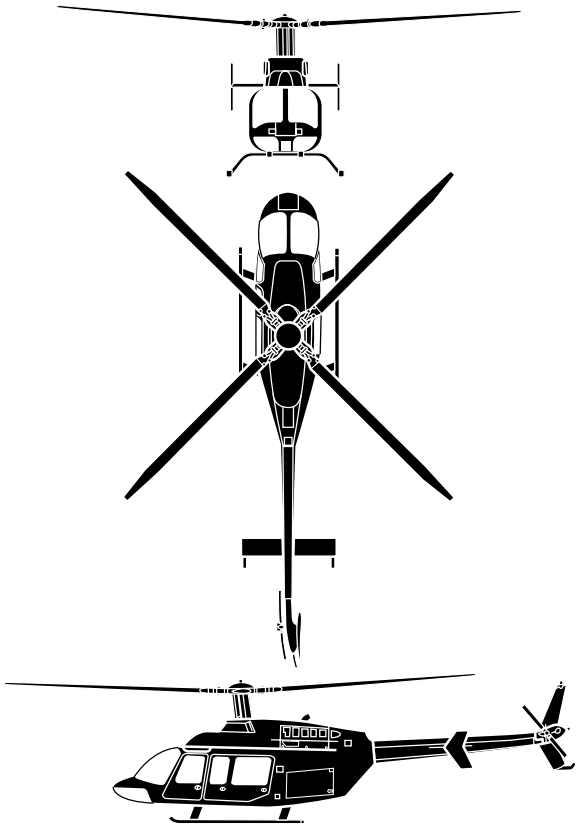
The pilot said that he had considerable experience in conducting search-and-rescue flight operations, that he had flown more than 600 emergency medical services flights, including many at night and many to the reefs in Australia's offshore waters. He said that, more than five years before the accident, when he was a member of the Australian Defence Force, he had received helicopter underwater escape training (HUET). While employed by the operator, he had not received crew resource management (CRM) training.

The crewmember was an ambulance officer and an advanced-care paramedic; he had worked for the operator as a part-time helicopter rescue crewmember for two years. He had not received HUET training or CRM training.

The helicopter was equipped and certified for day VFR operations and night VFR operations. Equipment included a searchlight and a radio altimeter (RADALT) receiver/transmitter, with an indicator unit that displayed the helicopter's height above the surface with a needle-and-dial analog display. Heights between 20 feet and 2,500 feet above the surface were displayed; published specifications said that the displayed heights were accurate between 50 feet and 2,000 feet above the surface.

The helicopter did not have helicopter flotation equipment, automatic stabilization equipment or an automatic pilot, and regulations did not require such equipment.

The report said that helicopters flown to low altitudes over water at night usually have an automatic pilot capable of conducting approaches, hovers and departures while the pilot monitors the operation.



Bell 407

The Bell 407, manufactured by Bell Helicoter Textron and first flown in 1994, was designed to supplement and eventually to replace the Bell 206 JetRanger and Bell 206L LongRanger.

Design features were developed based on the Bell 206L-4 LongRanger, with the cabin 7.0 inches (17.8 centimeters) wider than the LongRanger's cabin and the cabin window area 35 percent larger. The standard cabin layout accommodates five passengers, in two rearward-facing seats and three forward-facing seats, and a crew of two.

The Bell 407 has a Rolls-Royce 250-C47B turboshaft engine and an all-composite four-blade main rotor. The standard maximum normal takeoff weight is 5,000 pounds (2,268 kilograms).

Maximum cruise speed at sea level is 128 knots. The maximum certified altitude is 20,000 feet. Hovering ceiling in ground effect is 12,200 feet, and hovering ceiling out of ground effect is 10,400 feet. Maximum range is 330 nautical miles (611 kilometers), and endurance is three hours 42 minutes.♦

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

Operator's Certificate Did Not Permit Dropping Lifesaving Equipment

The operator had an air operator's certificate (AOC) that had been issued by the Australian Civil Aviation Safety Authority (CASA) three months before the accident. The AOC allowed the operator to conduct search-and-rescue operations. The AOC did not, however, specifically state that lifesaving equipment could be dropped from the helicopter; a statement to that effect was required by Civil Aviation Orders 29.5. CASA said that the operator had not sought certification to conduct such operations.

Australian Civil Air Regulation (CAR) 215 requires that operators' operations manuals include information, procedures and instructions to "ensure the safe conduct of the flight operations."

The report said that the operator's operations manual contained no information about procedures for dropping a life raft and inadequate information about night operations, including minimum heights above water at which the helicopter could be flown at night, maximum descent rates and procedures for descending the helicopter below minimum descent altitudes over water at night, "except as provided for in an exemption to CAR 174B provided by CASA." That exemption said, "The aircraft may only descend below 1,000 feet above the highest terrain within 10 [nautical] miles [19 kilometers] after ground definition is established by use of the … searchlight using wide beam or the aircraft is established within three [nautical] miles [six kilometers] of destination."

The operator's operations manual and the CAR 174B exemption required that the searchlight be operated at its maximum beam width when the helicopter was being flown below 500 feet, as indicated by the RADALT. The report said that during an approach to landing, the searchlight "was not to be manipulated in azimuth or elevation below 200 feet RADALT altitude. Azimuth checks of the approach path were to be effected by yawing the aircraft. The RADALT warning was to be set to 200 feet."

The report said that neither the accident crew nor the operator's other personnel had received training in life-raft-deployment techniques, "including the patterns to be flown, rigging of equipment, crew interaction and release parameters."

In addition, the report said, "Neither the pilot nor the crewman had previously dispatched a life raft from a helicopter at night, and [they] had not received training from the operator in that procedure."

The operations manual said that overwater flights more than 50 nautical miles (93 kilometers) from "a landmass suitable for landing" were permitted under some conditions, including if the flights were conducted under VFR procedures or night VFR procedures.

"There was very little information on restrictions or precautions when flying at night in remote areas or over water on dark nights, or considerations of the criteria for deciding whether to conduct operations involving long distances over water at night," the report said.

"There was only a very brief and general section in the operator's operations manual pertaining to search-and-rescue operations. There was some additional information in the manual detailing considerations for long overwater flights. Such considerations included the statement that 'the Bell [206] LongRanger is not ideally suited to long flights over water. Pilots are to use common sense regarding retrievals from any point more than 50 [nautical] miles [93 kilometers] from a place suitable for landing.'"

The report said that, although the Bell 206 and the Bell 407 have "a common heritage," their performance and handling requirements are significantly different.

The operator did not require its pilots to possess a current command instrument rating for helicopters.

The report also said that the operator "did not have a formal risk-management procedure to provide guidance to crew to assess risks associated with missions that may have been considered outside normal operations or a decision-making protocol for determining task acceptance or rejection."

Pilot Responded to Call for Assistance

On the night of the accident, Australian Search and Rescue (AUSSAR) had requested that the accident helicopter be dispatched to assist in the rescue of two people who were stranded on a yacht that was sinking near the Great Barrier Reef, about 150 nautical miles (278 kilometers) from the helicopter's base in Rockhampton. Their life raft had drifted away. The captain of a fishing vessel was in communication with the yacht's crew, but he told AUSSAR that he could not rescue them because of the proximity of the reef.

The accident pilot told AUSSAR that he could not recover the people from the yacht at night but that he would drop a life raft to them.

The pilot and a rescue service volunteer crewman filled the helicopter's fuel tanks before the 2145 departure from Rockhampton. Another rescue helicopter, a Bell 412, had departed about 2115 from Brisbane, about 325 nautical miles (602 kilometers) southeast of Rockhampton.

"The … crew [of the accident helicopter] reported that during the transit to the search area at 7,000 feet, they conducted the operator's standard overwater passenger briefing and [discussed] the intentions for descending to locate the yacht," the report said. "The pilot reported that he briefed the crewman that he intended to descend to 50 feet and hover-taxi past the yacht at about 25 knots, keeping it on the left side of the helicopter. The crewman was to drop the life raft short of the yacht and then drape a 100-foot [31-meter] length of rope that was attached to the activation line of the life raft across the yacht for its crew to haul in the life raft."

The pilot said that during the search for the yacht, he flew the helicopter several times from west to east, over the line of surf breaking at the edge of the reef, then turned to fly the helicopter from south to north. He observed the yacht about 1.0 nautical mile (1.9 kilometers) from the helicopter and initiated a descent from 1,500 feet to 200 feet above the ocean surface. After the helicopter descended through 200 feet, he reset the RADALT altitude warning from 200 feet to 50 feet.

"When the helicopter was about 600 meters [1,969 feet] from the yacht, the crewman called the RADALT as passing through 200 feet, then 150 feet," the report said. "On this call, the pilot reduced speed to 50 knots and noted that the rate of descent was 700 feet per minute. During the latter stages of the approach, the pilot's attention was directed totally outside, using the searchlight set to maximum beam width for external illumination. He was satisfied that the approach was progressing well. The crewman then called 50 feet, and very soon after, the helicopter impacted the water."

The pilot said that the helicopter's airspeed at impact was between 45 knots and 50 knots and that he had issued no instructions to the crewman about opening the door or deploying the life raft. The helicopter's doors were closed, the crewman said.

The crewman said that, when he called the altitude reading of 50 feet, he estimated that the helicopter was about 400 meters [1,312 feet] from the yacht. He said that he heard the pilot say "good" in response to the altitude call and then "everything went black."

The helicopter sank and came to rest inverted, and both crewmembers exited. The pilot, who was wearing a life jacket but had not inflated it, returned to the helicopter to retrieve the life raft.

After radio transmissions from the helicopter crew to the fishing vessel ceased at 2345, the crew of the fishing vessel told the crew of the second rescue helicopter to search not only for the yacht and its crew but also for the accident helicopter and its crew. About 0140, during the approach to drop a life raft to the people on the yacht, the crew of the second rescue helicopter observed the accident helicopter and the life raft. Just after daybreak, the wreckage of the helicopter was found about 200 meters (656 feet) from the yacht, and the crew of the second rescue helicopter recovered the two people from the yacht and the crew of the accident helicopter.

Other Pilots Described Dark-night Conditions at Accident Site

The report said that visual meteorological conditions (VMC) prevailed at the accident site, with scattered clouds at 2,000 feet and winds from 120 degrees at 10 knots. Astronomical data showed that 13 percent of the moon's visible area was illuminated and that the moon set at 2025.

The pilot of an airplane that had been sent to the area to determine the location of the yacht's emergency locator transmitter (ELT) said that at 2006, visibility was good, the sky was clear and only a small sliver of the moon was visible. The crew of the second rescue helicopter said that en route to the search area, they had observed broken clouds at 2,500 feet, no moon and extensive haze from the sea; they described visibility as poor.

The pilot of the accident helicopter had not reported flying through clouds during the helicopter's descent from 7,000 feet.

The report said that aviation regulations did not require a pilot on a VFR flight to consider the amount of light or the amount of external visual reference available.

"The pilot was not required by the regulations to consider the amount of celestial illumination, amount of terrain lighting and/or the presence of a visual horizon," the report said. "Aviation weather forecasts did not provide information on the amount of celestial illumination, nor were they required to do so. This information, however, was available from a variety of other sources."

Pilots were not required by regulation to demonstrate night VFR competency during regular flight reviews or to demonstrate recent instrument flight proficiency before conducting night flights.

The report said that conditions at the accident site — the expanse of water beneath a near-moonless night sky with the celestial horizon at times obscured by clouds — were "conducive to spatial disorientation."

"Spatial disorientation refers to an individual's failure to sense correctly the position, motion or attitude of the aircraft or of [himself or herself]," the report said. "When spatial disorientation occurs, pilots experience great difficulty processing, believing, seeing or interpreting the information on the flight instruments due to the erroneous information provided by their senses. In addition, the risk of spatial disorientation is high during instrument meteorological conditions (IMC) and night flying in either VMC or IMC."

Research on visual illusions during night helicopter approaches and research on visual-illusion accidents indicates that, in dark-night conditions, pilots have difficulty evaluating the helicopter's closing speed, rate of descent and glide path. The research indicates that unaided visual approaches at night may be as difficult as night instrument approaches.

Other conditions also can affect distance judgment, including haze and/or mist and the dimming and reduction in color contrast of objects viewed at a distance.

"There are substantial difficulties with judging the approach glide path to a small illuminated area at night, particularly over an [unlighted] area such as water," the report said. "The 'black hole' phenomenon is particularly relevant to approaches over the sea because the intervening area is dark. The black hole effect can provide an illusion of height. Therefore, the pilot may perceive that the aircraft is higher than it actually is. In addition, the effect can entice pilots into keeping the visual angle of an approach constant by fixating on a source of light. The approach path will be too steep at first and then flatten out and result in a touchdown short of the nominated point. …

"These false perceptions are considered to be very powerful. Even when pilots are aware of the black hole effect, they may reject their instrument indications and believe the false impressions of glide path and height that the effect induces. The [accident] pilot reported that he was aware of the black hole effect. The pilot also reported that he did not feel disorientated at any stage during the approach or at any other time during the flight."

The report said that, because of the difficulty in estimating distances at night, the pilot probably had begun the descent while the helicopter was actually farther from the yacht than he had believed.

Report Says High Descent Rate Was "Inappropriate"

"However, even if the descent point was twice the distance he thought, then the rate of descent at about 50 [knots] to 60 knots would have been about 700 feet per minute, which correlates with the pilot's report that the helicopter was descending at 700 feet per minute passing 150 feet," the report said. "A descent

rate of 700 feet per minute at 150 feet above the water was very high."

The report said that the pilot probably would not have been able to stop the rate of descent at 50 feet without application of a significant amount of power. An examination of the wreckage revealed that low power was being applied to the tail rotor when it struck the water and that significant power probably had not been applied before the impact.

"The high rate of descent flown during the latter stages of the approach was an inappropriate technique applied by the pilot," the report said. "That was probably the result of the inadequate operator procedures and the pilot's lack of recency and proficiency in overwater night operations."

The pilot said that during the descent, he had diverted his attention outside the helicopter to conduct a visual approach, using the searchlight for illumination.

"He had noted visual perception problems during the passes over the yacht," the report said. "Although the pilot did not feel disorientated, he may have been experiencing the 'fishbowl' effect and some associated subtle disorientation and distortion of visual cues during the approach."

The fishbowl effect is a result of a distortion of the helicopter's searchlight beam (often a reflection or scattering of the light) by atmospheric particles over water. The accident pilot said later that using the searchlight "seemed to make conditions a little blurry, like looking through a milk bottle."

The report said that "some form of visual illusion [probably] adversely influenced the pilot's handling of the helicopter during the latter part of the approach toward the yacht."

"Although the pilot was using the searchlight to assist him to make a visual approach, the pilot lost situational awareness and did not visually comprehend the high rate of descent or the amount of power and control movement required to arrest the rate of descent," the report said. "The pilot's loss of situational awareness was probably due to the lack of visual cues in the dark-night conditions and the lack of ground definition in the beam of the searchlight."

The pilot's decision to descend to 50 feet over the water in dark night conditions without assistance from these systems was questionable, especially because the operator did not have regulatory approval to drop the life raft, the report said.

The report characterized as "arguably risky" the decision to fly the single-engine helicopter over water for an extended distance without a flotation system.

"The pilot appeared to have an inadequate understanding of the risks associated with the flight as it was planned, especially considering the lack of regulatory approval, and his limited equipment, procedures, training and experience," the report said. "The absence of clear organizational protocols for task-acceptance or [task-]rejection may have influenced the pilot in accepting a task that involved a high risk."

Because the operator had no formal risk-management policies or procedures, the pilot "was placed in a position where decisions were made without guidance as to what the operator considered acceptable risks," the report said.

The report said that the findings of the investigation were the following:

- "The pilot was appropriately licensed and medically fit to conduct the flight;
- "The crew was not adequately trained to conduct the flight;
- "The operator did not have regulatory approval to drop articles from the helicopter by day or night;
- "The operator's operations manual did not contain the required information or procedures for the pilot to conduct dropping of equipment from the helicopter;
- "The operator's procedures, training and supervision were not adequate for the pilot to accept a night search-and-rescue operation over water;
- "The crew was not adequately prepared for an emergency egress when the helicopter entered the water; [and,]
- "The helicopter was considered capable of normal flight prior to impact with the water."

The report said that significant factors in the accident were the following:

- "The operator's procedures were not appropriate to accept, plan and conduct an overwater, night search-and-rescue flight;
- "The helicopter was not adequately equipped to conduct a night, overwater search-and-rescue flight;
- "The conditions at a very low height above the water surface were conducive to visual illusions; [and,]
- "The helicopter entered a high rate of descent on approach to the stranded yacht."♦

[FSF editorial note: This article, except where noted, is based on the Australian Transport Safety Bureau final report on occurrence no. 200102083. The report comprises 10 pages.]

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