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EMS Helicopter LOFT Study Shows Experience Influences Pilot Performance during Inadvertent Flight into IMC

Only four of 28 commercial EMS helicopter pilots, when encountering unexpected instrument meteorological conditions in a simulator, received the highest possible score from instructors. But a majority of pilots followed basic guidelines in coping with the unexpected.

Joel S. Harris
FlightSafety International

The pilot peered into the darkness, flying the helicopter under visual flight rules (VFR) on a night emergency medical service (EMS) mission, while using a dimly lighted roadway as a ground reference. Suddenly, the roadway lights appeared to flicker. Realizing that he was encountering low clouds (scud), the pilot began a descent from his cruise altitude of 800 feet (244 meters) above ground level (AGL).

At 600 feet (183 meters) AGL, the flickering stopped and the road was again in view. The pilot wondered if he should continue or abort the flight. He decided to continue, believing that the clouds were only temporary. Again, the roadway lights appeared to flicker. He began a level 180-degree right turn. Pressing the intercom button, he told a medical crew member to "call the hospital and tell them we are aborting because of weather."

Before he completed the sentence, the pilot lost all outside visual references as the helicopter entered a cloud. He hoped that the helicopter might break out, as he scanned the instruments. Although instrument-rated in helicopters, he was not current. He scanned the attitude indicator. "That thing can't be right," he thought. "We're not in a 60-degree bank."

The pilot applied pressure to the cyclic to roll the aircraft level. He scanned the altimeter and was surprised to find that his aircraft was descending through 300 feet (91.5 meters). His left hand squeezed the forced trim release on the collective and he began to add power, bringing the torque indicator to 100 percent of available engine power. Taking a deep breath, he surveyed his situation. The aircraft was climbing at 1,500 feet (457.5 meters) per minute and passing through 700 feet (213.5 meters). The helicopter was level, the heading was approximately 120 degrees from his original course and he was flying in solid instrument meteorological conditions (IMC). "Miami [Florida, U.S.] approach, this is Life Guard Two Alpha Bravo, inadvertent IMC, requesting a clearance back to Miami." "Two Alpha Bravo, roger, squawk indent, and sir are you IFR [instrument flight rules] equipped and capable?"

Fifteen minutes later, the aircraft broke out at 500 feet (152.5 meters) on the glide slope with less than one-mile (1.6-kilometers) visibility during the instrument landing system (ILS) approach. The landing was uneventful.

The scenario was typical of a series of short line-oriented flight training (LOFT) simulated missions that pilots flew during a study conducted by Life Lion Aeromedical Service, Pennsylvania [U.S.] State University College of Medicine and FlightSafety International. The aim of the study was to gather information to reduce the number of EMS helicopter accidents.

A recent study disclosed that EMS turbine helicopter accident rates have dramatically declined in recent years and for the period 1987–1993 were lower than accident rates for all turbine helicopters.[1] Nevertheless, the rate for EMS turbine helicopter accidents in which there was at least one fatality (fatal accident rate) remained higher during that period than for all turbine helicopters. According to the study, one-half of EMS fatal accidents during the seven-year period were weather-related and occurred during missions conducted under VFR. In addition, although only 37 percent of EMS missions during that period occurred at night, 72 percent of the fatal accidents occurred at night.

Pilots selected to participate in the study were told that they were to evaluate an EMS helicopter pilot LOFT scenario. They were asked to provide an anonymous critique of the training value of the LOFT, and to recommend improvements. The pilots were not told, however, the other purpose of the LOFT — to gather data to establish a correlation between pilot ratings and how recently the pilot had had instrument experience, vs. performance before and during unplanned entry into IMC.

LOFT differs from other, more traditional training because it is designed to closely approximate a line flight. During simulator LOFT sessions, except for information about the operation of the simulator, instructors do not assist, critique, instruct or answer questions. The instructor plays the role of air traffic control (ATC), company dispatcher or medical crew member during the flight.

The pilots flew the study's LOFT missions in full-motion and -visual Sikorsky S-76 or Bell 212/412 simulators. They were asked to fly the missions in a simulator that did *not* represent the aircraft that they currently flew. This was thought to reduce bias caused by simulator experience in a particular type or model. All pilot participants were employed as full-time EMS helicopter pilots by commercial operators, under U.S. Federal Aviation Regulations (FARs) Part 135.

The pilots were given a minimum 30-minute preflight briefing during which the LOFT mission was explained. After the briefing, the pilots were given a one-hour familiarization period in the simulator. During this period, they learned the cockpit layout on a "need-to-know" basis and were shown "how to fly the simulator." Each participant then made a series of practice takeoffs and landings in a VFR traffic pattern, until becoming comfortable flying the simulator.

This was followed by the LOFT scenario, which typically lasted no longer than 30 minutes to 45 minutes. After the LOFT, pilots were asked to critique the sessions in writing and to give oral critiques of their own performances.

During the preflight briefing, the pilot was told to depart on a VFR inter-hospital patient transport flight under the following circumstances:

- You are the pilot-in-command and have two medical crew members on-board;
- It is a night mission to a hospital approximately 25 miles (40.2 kilometers) from the departure point. A lighted road, which you may follow, connects the departure point with the destination;
- The current weather is 1,200 feet (366 meters) overcast and three miles (4.8 kilometers) visibility. Winds are calm and the altimeter setting is 29.90. Temperature is 59 degrees F (15 degrees C) and dewpoint is 55. [In some scenarios weather criteria were adjusted to ensure that the pilot would accept the flight if his operations specifications called for higher night VFR minimums.];
- Treat this flight as an actual EMS mission. Make no assumptions about the instructor's expectations. Do what you would do in "real life"; and,
- The instructor will not critique your performance. You will, however, be asked to critique the training value of the LOFT mission.

Pilots were also told that the autopilot was inoperative and could not be used during the mission. This ensured that pilots who regularly used autopilot-equipped aircraft would not have an advantage over pilots who did not.

The LOFT session began with the pilot receiving a simulated call for a medical transport. The instructor initially set the ceiling and visibility slightly higher than the weather reports, but lowered them during the flight. Reactions to changing circumstances were recorded on a rating sheet; the pilot's name was not recorded. To avoid instructor bias, pilot ratings and qualifications were not completed on the form until after the LOFT mission was completed.

Twenty-eight pilots participated in the study. The number of instructors was limited to three. The study, which has not been published, was conducted over several months. Pilots were scored in 27 categories, and each participant was assigned an overall score, on a scale of 1 to 5, with 1 being the best possible score.

Figure 1 (page 3) shows the percentage of pilots receiving each of the five possible overall scores. Four of the 28 pilots (14 percent) received the highest score. Ten pilots (36 percent) received scores of 2. Twelve pilots received scores of 3 (42 percent). One pilot each received a score of 4 or 5. (A score of 5 was given only if the pilot "crashed" the simulator).

When pilots receiving overall scores of 1 or 2 were grouped together, those 14 pilots represented the top-performing half

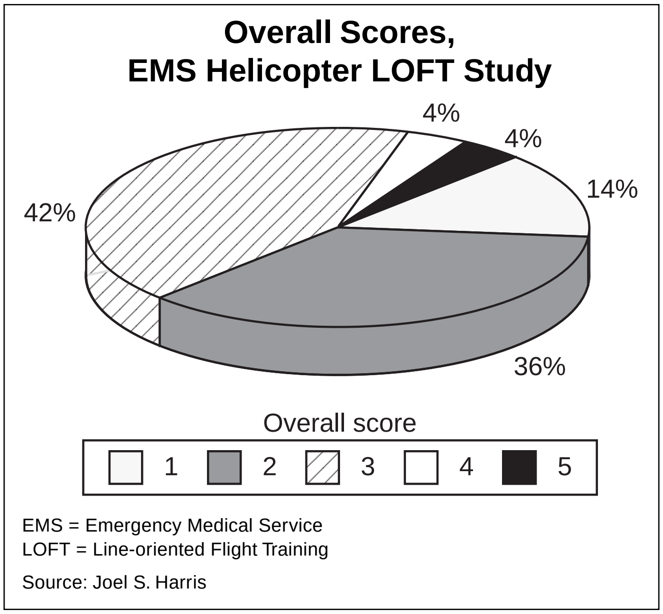

Figure 1

of study participants. Grouping the 14 pilots together who scored 3, 4 or 5 formed the lower-performing half of the study participants. These two groups are referred to as Group 1 (top half) and Group 2 (bottom half).

Figure 2 shows how these two groups fared when comparing their ratings and currency of experience. Note that 93 percent of both groups were IFR-rated in helicopters. Those in Group 1 were more likely to be IFR-current under Part 61.57, more

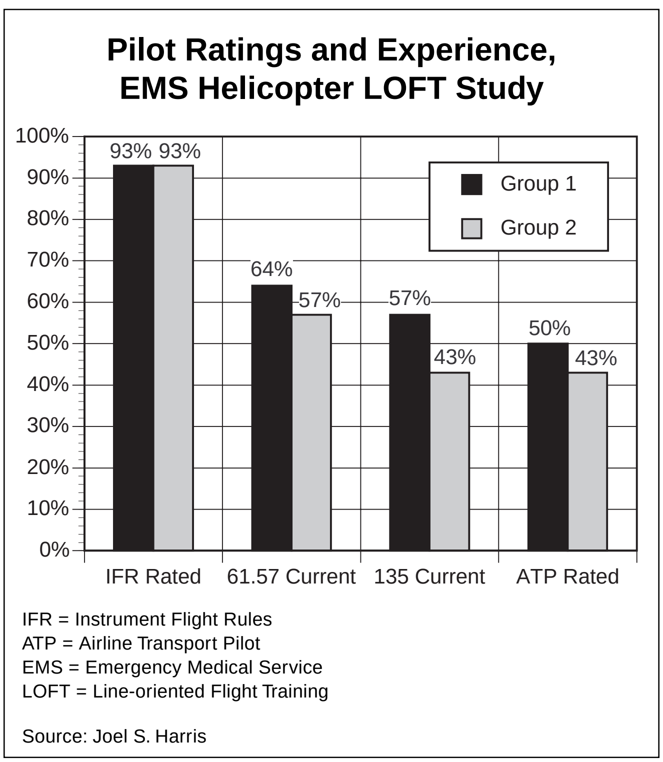

Figure 2

likely to have passed a Part 135.297 IFR check ride in the previous six months and more likely to hold an airline transport pilot (ATP) rating in helicopters.

Figure 3 shows the flight hours for the two groups. Those in Group 1 had an average of 663 more total flight hours than those in Group 2. Group 1 participants also had an average of more than twice the instrument flight hours as those in Group 2.

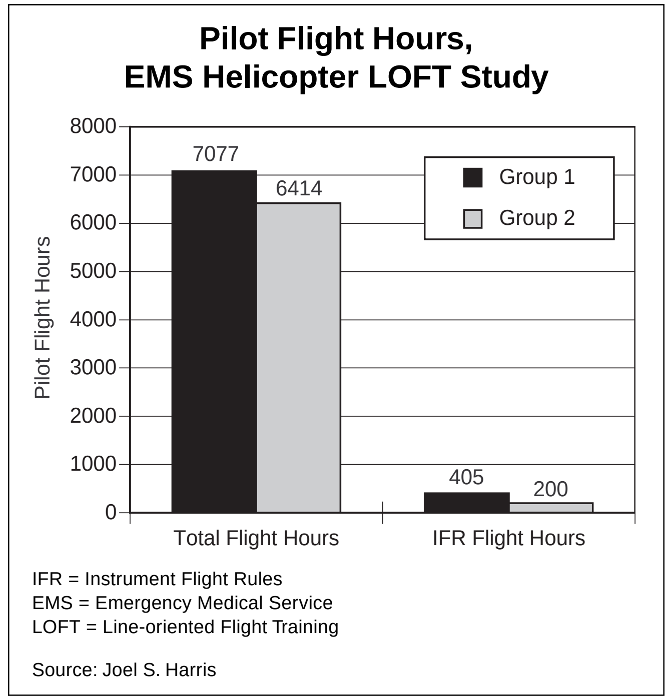

Figure 3

Figure 4 (page 4) indicates the percentage of pilots in each group who:

- **Descended.** The pilot began a descent after encountering scud at the initial cruise altitude. Most pilots descended after encountering scud, but fewer pilots in Group 1 descended.

- **Adhered to the "four Cs."** Pilots generally adhered to the four Cs after inadvertently entering IMC. (In order of priority, *control* the aircraft; *climb* to a safe obstruction-clearance altitude; turn to a *course* that will avoid obstacles or toward better weather, and finally, *call* for assistance.) Only 50 percent of Group 2 followed these guidelines, but 93 percent of Group 1 adhered to them.

- **Declared an emergency.** This shows the percentage of each group that declared an emergency after inadvertently entering IMC. A majority of both groups declared an emergency with ATC.

- **Upheld commercial practices.** This is the percentage of each group that, in the judgment of the instructor,

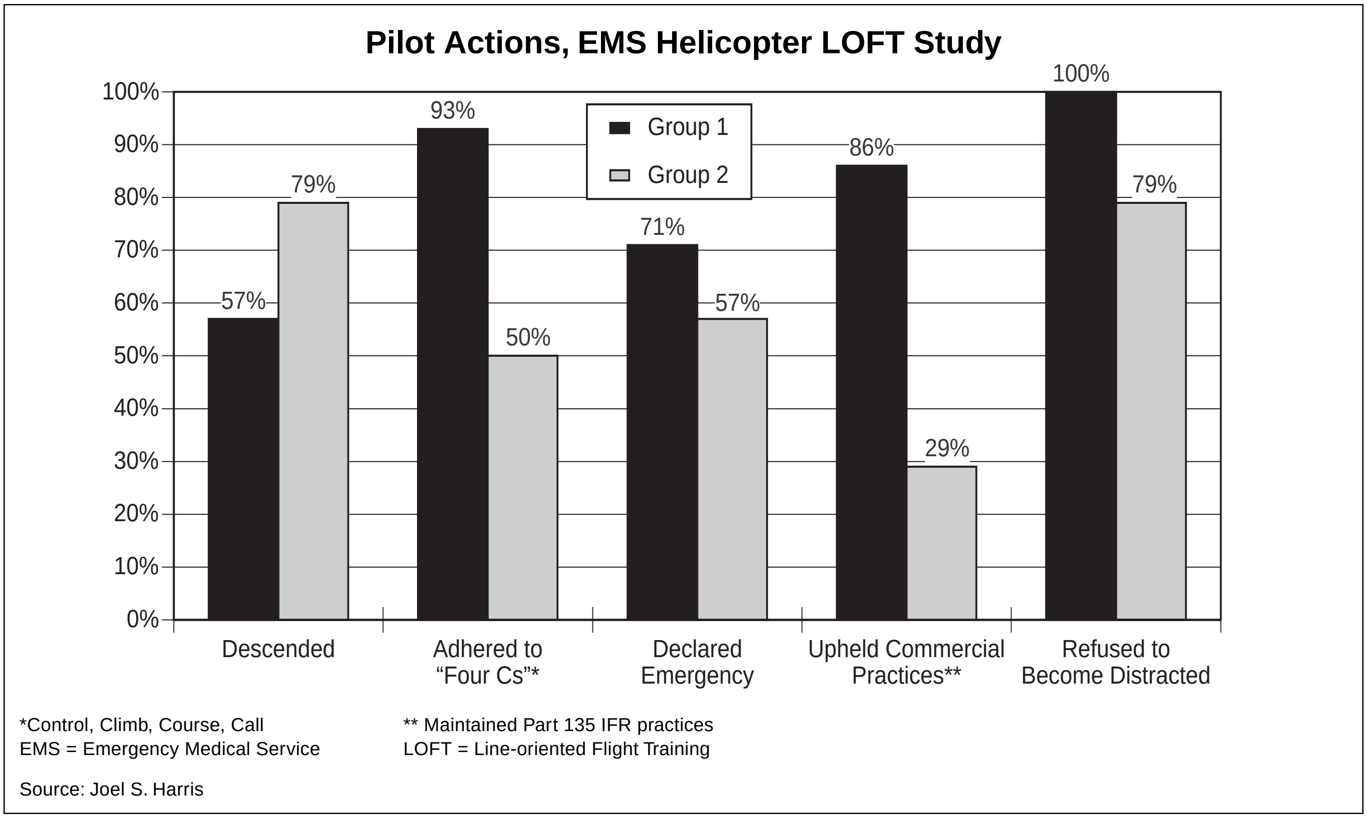

Figure 4

maintained Part 135 IFR practices after inadvertently entering IMC. The large disparity between groups is understandable — those who could not maintain Part 135 IFR practices were not likely to have received an overall score that placed them in Group 1.

- **Refused to become distracted.** Instructors, playing the role of ATC, a company dispatcher or a medical crew member, attempted to distract the pilot during a critical phase of flight. A pilot was judged not distracted if a "sterile cockpit" was maintained in compliance with Part 135.100. In the study, 100 percent of Group 1 refused to be distracted from the primary task of flying the aircraft. In some scenarios, pilots simulated switching off the intercom, thus disabling a persistent "crew member" from communicating.

The benefits of a sterile cockpit during inadvertent IMC were positive. For example, one pilot entered a 60-degree bank and descended from 800 feet to 400 feet (122 meters) while carrying on a nonessential discussion with the medical crew member. Another pilot entered an unusual attitude while talking to ATC immediately after inadvertently entering IMC. (The "four Cs" places *call* as the last priority, after aircraft control has been established.)

Figure 5 (page 5) indicates the performance scores assigned to the two groups (on a scale of 1 to 5, with 1 being the best) in the following categories:

- **ATC communications.** Adequacy was judged by proper terminology, assertiveness and brevity.

- **IFR approach.** Pilots were graded on the quality of IFR approaches that they performed. After inadvertently entering IMC, each pilot (except the one who crashed) was vectored for an IFR approach. They were offered a choice between a precision or a nonprecision approach. Those accepting a nonprecision approach found the weather to be below minimums at the missed-approach points, and in most scenarios the pilots subsequently performed ILS approaches. (In one scenario, the pilot went 200 feet [61 meters] below MDA [minimum descent altitude] during a VOR [very high frequency omnidirectional radio range] approach, broke out and landed visually.)

- **Crew resource management (CRM).** Pilots were scored on single-pilot CRM skills. Pilots who used medical crew members for tasks that the pilot could not perform while flying the aircraft in IMC were given higher scores. Pilots who maximized assistance from ATC were also graded higher. Better cockpit organization prior to departure was scored higher. The greatest disparity between the two groups on this chart, aside from the overall score, occurs in CRM.

- **Overall score.** Overall score is a subjective evaluation by the instructor, taking into account all factors. Only

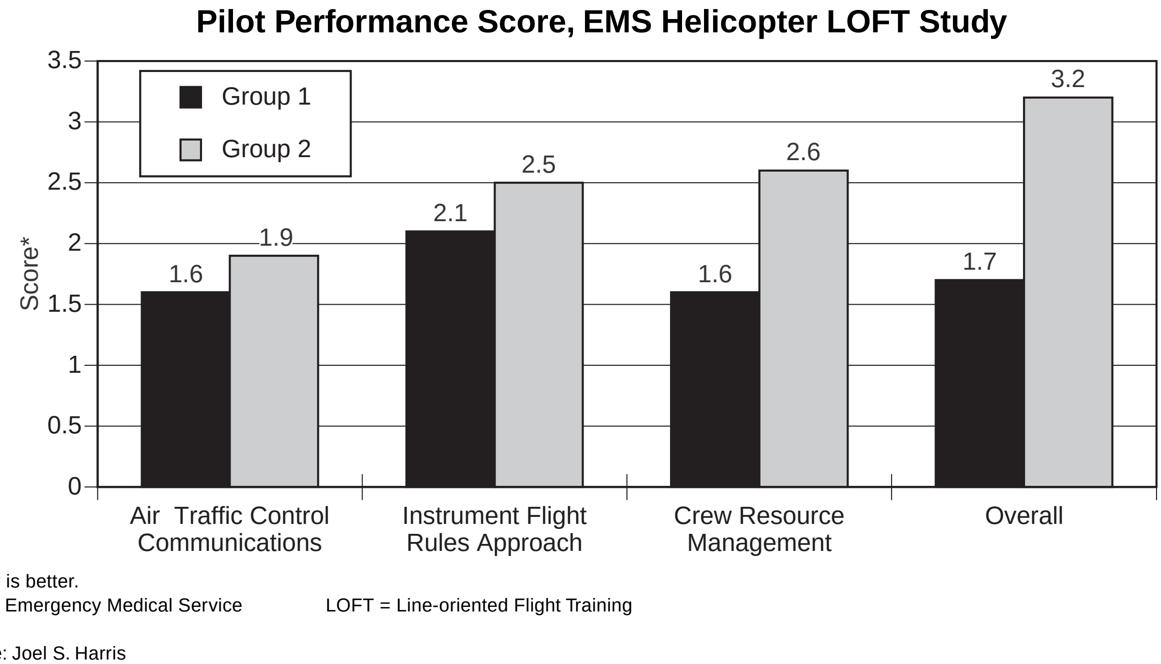

Figure 5

two of the 28 participants scored in the lowest two categories. Twenty-six of 28 pilots scored at least 3.

On six of the 28 rating sheets, instructors commented on unusual airspeed. Four comments concerned pilots maintaining a very high airspeed in marginal VFR weather conditions, prior to inadvertently entering IMC. Instructors commented twice on low airspeed after inadvertently entering IMC, and in one scenario a pilot allowed airspeed to decrease to 30 knots while in IMC.

Bank angle was also a frequent source of comments. On eight sheets, excessive bank angle was noted, in one scenario as high as 60 degrees. On six rating sheets, instructors commented on pilots either not being set up for an approach at the time of the final vector, or that pilots set the wrong final approach course on the HSI (horizontal situation indicator).

Other comments included:

- "Very hard time controlling aircraft, nearly crashed."
- "Although highly organized … pilot failed to monitor altitude and flew into ground while turning and descending to avoid IMC."

More positive comments included:

- "Used crew member very effectively to help set up for approach."
- "Other than not declaring an emergency, excellent job."
- "Textbook-perfect performance. The way it should be done."

The post-LOFT critiques completed by the pilots consisted of 11 questions (Table 1). Pilots were asked to grade each of the 11 questions using a score from 1 to 5, with 5 being the best. All 28 pilots completed critiques and the scores were

Table 1
Average Scores, Pilot-rated EMS Helicopter LOFT Critique

	Score*
Were the flight profiles realistic?	4.4
Did the session hold your interest?	4.9
Were you busy enough?	4.8
Did the session include logical abnormal and emergency procedures?	4.5
Were the situations that were presented thought-provoking?	4.6
Did you receive an adequate briefing?	4.9
Were ATC procedures realistic?	4.8
Did the session provide a learning experience?	4.8
Were CRM issues stressed?	3.6
Is there a positive transfer from this session to your operational flying duties?	4.7
Do you prefer LOFT training?	4.6

CRM = Crew Resource Management
EMS = Emergency Medical Service
LOFT = Line-oriented Flight Training
ATC = Air Traffic Control
* 5 = Best

Source: Joel S. Harris

averaged for each category. The lowest scores were for the question, "Were CRM issues stressed?" Many single-pilot operators apparently do not recognize CRM in single-pilot operations. Nevertheless, single-pilot CRM was an important element in scoring pilot performance.

In a survey conducted by *Hospital Aviation*, June 1986, EMS helicopter pilots reported unintentional flight into IMC an average of 1.3 times per year.[2] Although improvements in EMS aviation have reduced the frequency of unintentional flight into IMC, accident statistics suggest that it remains a serious problem.

The Pennsylvania State study was encouraging because a majority of the pilots demonstrated competence when inadvertently encountering IMC. But Rick O'Neal, director of operations at Life Lion Aeromedical Service, cautioned: "Funds weren't available for a truly random sampling of pilots. Most of the pilots in this study are regularly training at FlightSafety [International], and are therefore not representative of the industry as a whole. Our industry needs to find the funds for conducting more and better research if we hope to solve the safety issues that confront us."[3]

The goal of a zero accident rate in EMS operations cannot be approached without a pilot force that is 100 percent competent to deal with inadvertent weather encounters.♦

References

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2. U.S. National Transportation Safety Board, *Safety Study — Commercial Emergency Medical Service Helicopter Operations*, p. 13. Report no. PB88-917001. January 1988.

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About the Author

Joel S. Harris holds an airline transport pilot certificate and a flight instructor certificate with ratings in both helicopters and airplanes. He is an FAA-designated pilot proficiency examiner, FARs Part 135 check airman and safety counselor. He is a program manager at FlightSafety International's West Palm Beach Learning Center in Florida, U.S., and has given more than 10,000 hours of flight, simulator and ground school training to professional helicopter pilots.

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