How to Avoid Helicopter Wire Strikes

FAA study of wire-strike accidents between 1994 and 2004 found 41 of 124 of those involving civil helicopters were fatal. Combined, the accidents resulted in 65 fatalities, 45 serious injuries and 42 minor injuries.

These accidents included helicopters striking a power line, static wire, telephone wire, cable or a supporting structure such as a tower. Notably, 86% of the fatal accidents occurred in clear weather with good visibility.

Even the “slightest” wire strike is likely to cause immense damage. The FAA’s report found that from 1994 to 2003, U.S. Army helicopters were involved in 34 wire-strike accidents that ended up costing $87.5 million, or an average of $2.57 million per accident.

The NTSB determined that the probable causes of the 124 civil aircraft accidents in the study included inadequate visual lookout (38 accidents) and failure to maintain sufficient clearance with the obstacle (59 accidents). Other reasons (for the remaining 27 accidents) included improper judgment, failure to maintain a proper altitude, inadequate preflight planning, failure to see and avoid wires, intentional buzzing and selection of an unsuitable area for landing.
The helicopter emergency medical services (HEMS) operational environment is literally a spiderweb of wires, and its statistics provide additional insight into the many ways they can ensnare an aircraft. To compose the Flight Safety Foundation’s 2001 report, “Human Error Cited as Major Cause of U.S. Commercial EMS Helicopter Accidents,” I examined the 87 accidents and 56 incidents involving U.S. commercial EMS helicopters between 1987 and 2000. Of those, 15 accidents and 12 incidents involved wire strikes. Since EMS helicopters often respond to events on roadways surrounded by obstacles and wires, it isn’t a surprise that the majority of HEMS wire strikes occur during the approach/landing and takeoff/Departure phases of flight.

The HEMS wire-strike stats were nearly evenly split between day and nighttime events. Since such operations are conducted 24/7, pilots have the added challenge of attempting to see poorly marked wires at night. That fact puts considerable doubt into the efficacy of the admonishment to “exercise better see-and-avoid.”
The helicopter wire-strike problem is global. For example, the Australian Transport Safety Bureau’s study, “Wire-Strike Accidents in General Aviation: Data Analysis 1994 to 2004,” found that 117 wire-strike accidents and 98 wire-strike incidents were reported in that period.

It is a myth to think that more time in the cockpit will make you safer in the wire environment. The FAA’s report found the average age of pilots involved in civilian helicopter wire-strike accidents was 43.5 years, with 78% of the accidents involving pilots between the ages of 40 and 59, and with an average flight experience of 3,575 hr.

And the threat is growing constantly. Society’s demand for constant connectivity means that thousands of new telecommunications antennas and power transmission towers, along with thousands of miles of wire, are going up every year. In addition, wind generators and meteorological evaluation towers (METs) are being erected at record rates. The slender METs are nearly impossible to see and are often supported by equally nearly invisible guy-wires. Because these towers often stand just under 200 ft. in height, they are not required to comply with FAA obstruction-marking requirements, making them even more difficult for helicopter pilots to see-and-avoid.

The near invisibility of wires results from a number of factors in addition to their size. These include atmospheric conditions, cockpit ergonomics, viewing angle, sun position, visual illusions, pilot scanning abilities and visual acuity, flight deck workload, and the camouflaging effect of nearby vegetation, among others. Even the condition of the aircraft’s transparencies, whether pitted, deteriorated with age, or dirty from dust or bug strikes, will significantly affect the pilot’s ability to see wires.

Only the tail boom of a Hughes 369E remains after the distracted pilot flew into five powerlines. Credit: Kimberly Henneman
Optometrist Warren DeHaan with Aviation Vision Expert Services, Boulder, Colorado, notes, “Depending on the lighting situation and background, lines can be obvious or invisible, and change from moment to moment.”

A thorough review of pertinent aeronautical charts and a high-level recon has been (and will remain) an essential task before entering into a low-altitude task such as firefighting or landing at an accident scene to pick-up a victim. However, not all wires and towers are charted, nor can aviation charts keep up with the expanding wires environment. While a full 360-deg. high reconnaissance is considered a standard practice for assessing a landing place or low-level working zone, a tiny wire can quickly pass out of view within seconds.

Wires aren’t consistently visible all of the time. Changing sunlight patterns can obscure them. Older wires may be difficult to see because their color often changes with age. For example, as copper wires oxidize, they turn a greenish color that makes them difficult to distinguish from grass and trees in the background. A wire that is perfectly visible from one direction may be completely invisible from the opposite. The exact location of specific wires may change throughout the day because of fluctuating ambient temperatures, which may cause wires to sag or tighten. Sagging wires may also be blown by the wind.

Dr. DeHaan further notes, “The pilot has to aim his eyes in the right direction, then perceive there is a wire, then project his flight path and make a decision whether there is a collision potential, then make a decision on the evasive action, then move the controls. It takes time for the aircraft to respond. This can take 5 or 6 sec.”

Honeywell’s HTAWS greatly improves situation awareness by providing precise display and alerting of terrain. Credit: Honeywell
He adds, “Pilots notoriously have the misconception that they will see wires in time flying at wire level, and you can’t count on it.”

The FAA’s safety study of wire strikes points out that the pilot’s view of the outside can be affected by the vibratory environment of the cockpit. For example, the human eyeball and intraocular structures have natural frequencies in the 20- to 90-Hz range. Most helicopters have structural frequencies in the 20-Hz range. This means that a pilot’s visual performance will deteriorate after prolonged exposure to certain vibrations.

Robert Feerst, president of Utilities Aviation Specialists Inc., Crown Point, Indiana, and a widely recognized expert on this topic, emphasizes that pilots “need to know what the enemy looks like,” which includes how to identify the hazards associated with wires. He points out that normal mainstream aviation education does not teach these important points.
The FAA’s study stresses that pilots need to be exposed to techniques of recognizing different types of wires, including powered and guy wires, and to anticipate their location. They need to identify the power grid system and determine wire direction from the orientation of the insulating connectors on various towers.

How can flight crews forecast the presence of wires long before they actually see them? Observing hardware such as insulators can help flight crews predict wire patterns. Insulators point in the direction the wire is going, which is especially valuable when the power line makes a turn. Sagging conductors on a high-voltage power transmission line may be easier to see.

However, when operating in the low-altitude environment, a helicopter pilot is busy controlling the aircraft, handling navigation and communication, and avoiding obstacles, all of which strains the available sensory and perceptual resources available for wire detection and avoidance. The workload strain is amply illustrated by a typical HEMS mission to an accident scene.

Such flights are usually launched quickly, often with little or no advance notification and little time for flight planning. Many HEMS flights are conducted at night, and sometimes in marginal weather. The condition of the landing zone will likely be uncertain. Unlit wires and towers, lack of suitable lighting and other visual illusions are highly probable. The pilot will be unfamiliar with the landing zone and ground personnel may not have properly prepared and scouted it, and there will likely be numerous ground vehicles, emergency responders and bystanders. During takeoff and landing operations, the pilot must assess the effects of adverse winds, debris, obstacles and congestion. That’s quite a workload.
Atmospheric conditions, cockpit obstructions, the viewing angle and sun position can completely obscure high-power electrical transmission wires and supporting structures, as in this wildfire incident. Credit: Patrick Viellette

Incidentally, being aware of a wire is still no guarantee of avoiding it. According to “Surviving the Wires Environment,” a training video cosponsored by the FAA, the Helicopter Association International (HAI) and Southern California Edison, 40% of the pilots who have hit wires knew it was there. One astute interviewee commented, “You will let your guard down momentarily, and that is what will get you!”

Feerst is an adamant advocate of CRM in the wire environment. He points out that flight nurses and any other crewmember should be acting with the pilot as a team, and be thoroughly versed in procedures and inflight communications. Southern California Edison invests six months of training for its utility crews and pilots. The former are integrated into the flight activity and participate in decision making and planning on weather, fuel stops, winds, lighting condition, known hazards, how to mitigate the hazards, and how to call out clearings. Says Feert, “Everybody has to be speaking the same language.”

One sure way of reducing your risk of a wire strike is to remain clear of them. The FAA’s safety study recommends that FAR Part 91 helicopter pilots avoid cruising below 750 ft. whenever the mission allows. Many other safety organizations concur with that recommendation. This advice generally works except in the canyon environment where wires stretch across the chasm.

Likewise, it is easy to forget that those 2,000+ ft.-tall television broadcast antennas have guy wires anchored from 1,600 ft. to 2,000 ft. from the base of the structure. The KVLY-TV transmitting mast located halfway between Fargo and Grand Forks, North Dakota, is 2,063 ft. tall and has an extensive network of guy wires to provide structural support to the massive skeleton spread over 160 acres.
Learning how to scan for wires effectively, what you can and can’t see and why, tactics for flying in the vicinity of wires, and learning the effectiveness of today’s obstruction marking schemes are just a few of the important topics that must be studied by those flying in the wire environment.

“Surviving the Wires Environment” makes a compelling argument that a “short course” on this topic is woefully insufficient. There is no substitute for an all-inclusive training course. One can take a look at the training curriculums provided by Utilities Aviation Specialists (http://www.helicoptersafety.com) for a good gauge of the comprehensiveness offered by respected organizations in this field. It is strongly recommended that pilots and crews who work in close proximity to utility infrastructure undergo formal and more-detailed wire-strike safety training.

Among the recommendations within the August 2011 Compendium Report from the International Helicopter Safety Team (IHST) was the installation of equipment to detect wires and alert the pilot. Among the best known of such advances is Safe Flight Instrumentation Corp.’s Powerline Detection System (PDS), a light, relatively simple warning device that we got to flight test at HAI’s Heli-Expo 2015. (See “Flying with Safe Flight’s PDS” sidebar.)

Other devices that use lasers or radar to scan the surroundings for the presence of obstructions are also available. However, the 2008 FAA report, “Safety Study of Wire-Strike Devices Installed on Civil and Military Helicopters,” deemed those systems to be comparatively heavy (between 35 and 60 lb.) and expensive (more than $100,000).

**Honeywell**’s HTAWS is designed specifically to prevent collisions with ground, water and obstacles such as towers and tower guy wires. The system uses GPS and a proprietary, ever-expanding database that currently includes over 120,000 man-made obstacles. In addition, its Mark XXII EGPWS, designed for IFR-equipped helicopters with a radio altimeter, includes alerts for tower guy wires. The HTWAS weighs about 4 lb. It features a “Low-Altitude Mode” to curtail warnings while retaining a view of surrounding terrain and obstacles when flight crews are operating in low-level tasks such as utility wire maintenance.

Sandel Avionics’ HeliTAWS is also a multi-hazard avoidance system for helicopters that alerts against wires, terrain and obstacles. The system features a proprietary “WireWatch” feature to provide advance warning of transmission wires whether they are powered or not. The sunlight-readable, high-resolution 3.29 x 3.29-in. display features 3-D terrain, obstacles, traffic overlay, TCAS interface and radio altimeter descent altitude callouts. The map has a range of 0.5 nm to 20 nm full
scale. Transmission lines are listed as an optional feature requiring contact with Sandel for regional availability. The 2.7-lb. system also features a mode to eliminate false alarms.

The final line of defense to protect the flight crew from a wire strike is provided by the Wire-Strike Protection System (WSPS). (See sidebar.) According to the FAA study, “There appears to be convincing evidence supporting the effectiveness of WSPS” in the military statistics. However, for reasons discussed in the sidebar, many civilian helicopters don’t have the structural design characteristics to integrate such a protective system.

As if avoiding a wire strike’s damage to one’s aircraft and possible life-threatening injuries isn’t reason enough to develop and employ a comprehensive risk management program, the cost of causing a power outage to customers of the transmission wire and the repair of the wire could be enormous.

Admonishing pilots for years to avoid hitting wires and to maintain a better visual lookout has been ineffective in solving the problem. A busy pilot’s sensory, perceptual and cognitive capabilities will always be imperfect in the high-risk wires environment. As with so many other complex aviation safety problems, the wire-strike issue requires multiple layer solutions involving training, vigilance, teamwork and advanced technology.

*This article appears in the October 2015 issue of Business & Commercial Aviation with the title "Wire Wary."*