Heliprops
Helicopter Professional Pilots Safety Program
PROMOTING AERONAUTICAL PROFESSIONALISM & SAFETY

The International Helicopter Safety Team (IHST)

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"The goal of the IHST is to reduce the helicopter accident rate 80% by 2016. It is not a complicated goal, however, it is an ambitious one!"

A Bit of History

The IHST came to life in a meeting at the American Helicopter Society International headquarters in early 2004 with participants from the Helicopter Association International, the FAA, helicopter manufacturers and others interested in the reduction of helicopter accidents. In order to get the movement going, the first International Helicopter Safety Symposium was held scheduled for everyone to meet in Montreal, Canada in September 2005. Industry interest and attendance was overwhelming.

Within the calendar time frame of 2001 to 2005, statistical analysis revealed that fatal helicopter accident numbers (not rate) were basically flat. The numbers were not getting better, but they were not getting worse. However, the helicopter industry in the United States was still suffering with around 30-35 fatal accidents per year. The concept of manufacturers, operators and regulators working together was not a new strategy.

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MEET THE AUTHOR

Dave is the VP of Flight Safety at Bell Helicopter. Prior to his current role, he was Manager for the FAA Rotorcraft Directorate in Fort Worth, Texas. Additionally, he served as Co-Chair of the International Helicopter Safety Team (I.H.S.T.). Dave achieved a 33% reduction in the number of U. S. fatal helicopter accidents through a comprehensive analysis and outreach to different business segments. His accident reduction methodology has been shared with several foreign authorities for implementation.

A former U. S. Army Pilot, Dave served as an instructor pilot, instrument flight examiner, maintenance test pilot and experimental test pilot. His aviation experience includes over 4,000 hours of fixed and rotary wing accident-free flying on 125 different models. He holds an FAA Airline Transport Pilot rating as well as: single/multi engine land/seaplane and helicopter commercial pilot, and CFI ground.

Dave graduated from the University of Tennessee Space Institute with an MS and earned his BS from Embry Riddle Aeronautical University. He also graduated from the USN Test Pilot School.

Dave resides in Fort Worth with his wife Diane. They have three sons.

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Helicopter Ditching and Underwater Egress Training

(In A Worst Case Scenario, You Must Be Prepared)

EDITOR'S NOTE

I first met Jon Ehm at the Port City Air/New Hampshire Helicopters Fly-In, Portsmouth International Airport, New Hampshire in June of this year. Jon was a guest speaker. As I listened to him talk about water survival, it occurred to me that most helicopter pilot's water survival training was painfully inadequate.

Therefore, I am very pleased to have Jon Ehm write this article especially for the HELIPROPS readers. I hope it will stimulate pilots and crewmembers to seek the proper survival training for over water flight operations in helicopters.

MEET THE AUTHOR

For the last five years Jon has instructed life saving techniques with Survival Systems USA Inc., in Groton, Connecticut, USA. He teaches aircraft ditching, underwater egress, and surface water survival techniques.

Jon's military clients include the U.S. Marines Corps, Soldiers and Sailors across the United States in locations such as Hawaii, North Carolina, California, Connecticut, Alabama and Okinawa, Japan. He trains rotary and fixed wing pilots, crewmembers and passengers, both commercial and private.

The last thing you remembered was a flash of blue. Then impact and the water rushed in. Now it is quiet, and you find yourself strapped in your seat upside down and it is dark. The violent motion has stopped; you are holding your breath. Nothing you have trained for up to this point has prepared you for this experience, the inrush of cold water and the overwhelming sense of disorientation. Your actions in the next few moments determine if you are going to survive. Do you know what to do to get out? Additionally, do you know what to do in order to live long enough for help to arrive?

Underwater egress training prepares you to react appropriately during and after a water landing. It teaches you how best to protect yourself during the initial crash, including how to locate and open your emergency exits and to survive at the surface.

Like most emergency procedures, preparing for underwater egress and surface water survival begins long before you leave the ground. Communication in the form of safety briefings is a key element. As uncomfortable as it may be, the conversation about what everyone does in the event of a ditching must take place before the emergency unfolds. The time for discussion is not when you are sinking.

Communication verifies that everyone knows where the emergency exits are and how they work. Moreover, communication ensures that everyone knows the location of the appropriate safety and survival equipment for the water environment, life raft, personal flotation devices (PFD), flashlights, fire extinguishers and first aid kits.

There are three distinct phases of ditching events categorized by what your actions are during each phase.

- Impact Phase: the helicopter strikes the water and submerges. During this phase, you must protect yourself from injury.
- Egress Phase: you are actively working on getting out and up to the surface. Now you focus on opening exits and making a timely egress and ascent.
- Surface Water Survival Phase: you survive long enough for rescuers to find you and remove you from the water.

During the Impact Phase, injury is the primary hazard. It follows that during this time you should predominantly focus on preventing injuries. There are several pieces of aircraft equipment designed to minimize injuries, from frame elements and self-sealing fuel tanks to crash attenuating seats and restraints. Generally, aircraft safety equipment has been engineered to protect you from rapid deceleration forces. Used with the proper procedures, this equipment enhances your overall survivability and prevents injuries so that you are in the best shape possible when you begin the Egress Phase.

You may wonder what things you should take care of if you have time to prepare for the crash. First, establish communications and initiate a mayday call, activate the ELT and follow the emergency procedures relevant to the type of problem you are encountering. Communicate to everyone on board the aircraft. They stand the best chance of survival if they can prepare for the ditching as well.

Next, you want to secure loose articles. Things as innocuous as a mobile phone or a pen can cause injury when accelerated by the force of the impact. Don your PFD. In an underwater egress scenario, it is likely that you will have only what you are wearing for use during the Surface Water Survival Phase. Without a PFD, you will tread water or cling to flotsam (the part of the wreckage of the "ship" and its cargo found floating on the water) until rescued. This will drastically reduce the amount of time you can survive. If you are flying the aircraft and cannot properly don your PFD, stuff it in your clothing, insuring the PFD comes with you during your egress.

Properly situate yourself in the seat, verify release mechanism for your seat belt, adjust restraints, and lock the inertia reels. Review your reference points and the jettison mechanism for your emergency exits. Open exit while still in the air if possible, hinged exits and exits that run on a track may not function properly after the ditching. Do NOT jettison exits that completely disconnect from the airframe unless explicitly told to do so by the pilot in command as the exit may interfere with a controlled descent.

Assume an appropriate brace position for the direction you are facing and the type of harness you are using. The movement of the water is very powerful, it adds to your disorientation and has the potential to injure you, as it will forcefully move any loose articles around the cabin and flight deck. Remain in your brace position until the violent motion stops; in other words, stay braced until after the impact and the aircraft has filled with water.

Once the violent motion stops, the Egress Phase begins. There are two primary hazards during this phase. The first hazard is disorientation. Most people rely on their eyes to orient themselves in space. Under water, people lose most of their visual acuity; in addition, confined space, murky water, or nighttime conditions further decrease your ability to see.

Remain buckled in your seat. As long as you are in your seat, you can extrapolate the location of other known objects inside the airframe including reference points and exit jettison mechanisms. In order to navigate throughout the aircraft you will need to use physical reference points to replace the visual cues you ordinarily use. By keeping your feet on the floor, with a low center of gravity and maintaining those reference points, you can move around the airframe fluidly, efficiently, and effectively. Under these circumstances, you cannot rely on your ability to see.

The second hazard is disorderly evacuation. The best way to prevent this is to utilize an effective and practiced egress plan and react appropriately to any further problems that arise. Once you locate your emergency exit, open it, pull yourself out and make your way to the surface. When using an EBD (Emergency Breathing Device) as an aid to egress, it is very important you remember to exhale on the way up in order to prevent any further injuries. Once at the top, inflate your PFD and locate other survivors.

The final phase of ditching is the Surface Water Survival Phase. You do not want to go through all the effort to survive the crash, make a successful egress just to not know what to do at the surface. Cold water is dangerous. You need to know how to protect yourself from hypothermia (cooling of the body core temperature below normal functioning levels) and aspirating water. Not knowing could make an already bad situation turn worse, quickly.

A Personal Flotation Device (PFD) is a very important piece of equipment to have with you. Otherwise, you will have to improvise a flotation device or tread water until rescue comes. When you don a PFD, adjust it so the vest is tight. A properly fitted PFD should hold your head and airway above water even if you lose consciousness.

When immersed in cold water (below 60°F, 15.5°C or colder) a person will normally exhibit a gasping response followed by uncontrolled breathing for a few minutes. Your PFD will help protect your airway until your breathing is back under control. It is important for you to know how your PFD inflates both manually and orally. With only your head above water, you cannot look down for the inflation handles or the oral inflation tubes. You must locate them by touch.

Anything that requires you to make finite movements of your fingers such as tying knots or inflating your PFD, perform that task as soon as you can. In cold water, your sense of

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The Commercial Aviation Safety Team (CAST) began with a similar goal in 1996 and their 76% reduction in fatal accidents was arguably successful. The CAST methodology was then "borrowed" and IHST was born. As one might expect, the concept was fairly simple on paper, but much harder to implement in practice. "Data is data," which sounds like rhetoric, however, data holds no emotion and when analyzed produces actionable information. It is hard to argue with fact.

How the Process Works

There are two sub-groups of IHST: the Joint Helicopter Safety Analysis Team (JHSAT) and the Joint Helicopter Safety Implementation Team (JHSIT). The JHSAT takes a year's worth of accident reports and reviews them. The JHSAT report is an accident data breakdown by operational category and causes. The JHSIT then takes the JHSAT report to form programs that implement the JHSAT recommendations. The JHSAT will "close the loop" to document the results (accident/incident data) and whether the accident rate is declining

To be fair, the question should be: Will it work? Let me use more history which made me believe this approach will work. In an earlier career I was part of the CAST effort. The Mineta National Civil Aviation Review Commission Report (http://www.faa.gov/NCARC/reports/pepele.htm) recommended that industry and the FAA work together and meet the 80% fatal accident reduction goal. CAST's first 18-24 months were acrimonious. Participant's behavior was at times barely civil in these meetings. Slowly, trust was established and there was recognition that respect was the center piece of success. In 2006 after 10 years – the data showed a 76% reduction. This is a huge success for the CAST.

Let's look at a different operation as documented in a 2004 U.S. Army Aviation article. The 160th Special Operations Aviation Regiment (SOAR) conducts helicopter flight operations with light single-engine, medium twin-engine and large twin-engine assets. If we limit the discussion to non-combat operations – the 160th SOAR have an enviable safety record.

Many will, and have argued that they have exceptional aviators and equipment. The issue is not really better crews and equipment – it is and to quote from the *Army Aviation** article, **[they] Just do the basics right**. What they do have, is strict adherence to Standard Operating Procedures (SOPs), risk management, training standards and leadership. This article was written in 2004. It was in reality a Safety Management System although SMS was not a well understood concept in 2004.

Safety Management Systems are a deliberate approach to the identification, evaluation and mitigation of risk. The IHST has provided an ICAO compliant SMS Tool Kit located at the IHST web site (http://www.IHST.org). Attributes of an SMS are:

1. SMS Management Plan
2. Safety Promotion
3. Document and Data Information Management
4. Hazard Identification and Risk Management
5. Occurrence and Hazard Reporting
6. Occurrence Investigation and Analysis
7. Safety Assurance Oversight Programs
8. Safety Management Training Requirements
9. Management of Changes
10. Emergency Preparedness and Response
11. Performance Measurement and Continuous Improvement

A key point about an SMS is that it's scaleable. By example, item #11 Performance Measurement. The SMS documentation can be, for a small organization, an Excel spreadsheet and for a large organization, a complete department. The attribute is for the organization to look at the information and then make the appropriate changes. The goal is compliance, NOT complexity.

The IHST is a truly international effort. Members of the ISHT have been to several foreign countries and successfully set up either country or regional efforts. Among these countries/regions are Canada, Europe, Brazil and India.

The IHST model has been largely followed. The exceptions to this model are due to the nature of regional language similarities and differences. The European Helicopter Safety Team (EHST) has a unique challenge. The accident reports are written in language of the country where the accident occurred. It would be impractical for the EHST to have all the reports translated into a common language.

The solution for the analysis effort was to form teams from France, Germany, UK, Italy, Spain, Switzerland, Norway, Sweden, Denmark/Finland and Ireland/Hungary. This allowed teams to analyze the accident and compile the data in an EHEST common format. The EHEST is using a portion of the CAST/ICAO Common Taxonomy Team. Taxonomy is the methodology that categorizes

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Helicopter Professional Pilots Safety Program

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The primary objective of the HELIPROPS program and the HUMAN A.D. is to help reduce human error related accidents. This newsletter stresses professionalism, safety and good aeronautical decision-making.

Letters with constructive comments and suggestions are invited. Correspondents should provide name, address and telephone number to:

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information into ordered groups.

Brazil is another country that is making good progress as well as Canada. There are plans to visit Dubai this November. The CIS and the Far East are also areas to which inroads will be considered.

The one element which will necessitate a different approach is in *Operations Rules* for each of the states the helicopter operates. It would be impossible and impracticable to try and create a "one size fits all" set of solutions. The solutions are for each operator to voluntarily implement.

Prove It

What are the results to date? The USA domestic rate is 6.4 accidents per 100,000 flight hours. This is a decline from the 9.1 averaged between the years 2001-2005. The same trend is evident with the international data. The 2001-2005 averaged rates were 9.4 accidents per 100,000 flight hours. The most recent rate is 8.1 for 2007. This really is good news considering that approximately 800 single engine turbine aircraft are being introduced into the rotorcraft population every year. Robinson Helicopter alone will produce 800 aircraft. If the number of accidents resulting in hull losses hold, the net gain to the industry is approximately 1,400 new aircraft entering the market every year for the foreseeable future. This is no small matter.

Take Action

What can you do? An electrical extension cord carries no power. But it does **connect** electrical power to the tool. Each of you can **connect** the industry to the safety information being made available. Be aware! There will be opportunities to educate your contemporaries and share the information the IHST will produce. This industry has done great things – Hurricane Katrina and the Tsunami efforts come to mind. Safety is everyone's business not just the safety officer and the regulatory bodies. Get involved and visit the IHST website: www.IHST.org

* Army Aviation, Page 18-20, "Just do the Basics Right!" by BG Joseph A. Smith and CPT. Andy Caine.

Survival Training Continued . . .

touch and manual dexterity will deteriorate very rapidly. If you are alone, you want to get into the HELP (Heat Escape Lessening Posture) position. This is an individual hypothermia mitigation technique. If there are any other survivors, get into a group formation. Group formations have several advantages:

- Keeping the group together increases your overall visibility to rescuers.
- Having warm bodies on either side of you is a very effective means of hypothermia mitigation.
- Giving the group 360° of skyward visibility, you can use your signaling devices more effectively.

During this phase, a life raft is the best tool for survival. Water moves heat away from the body twenty-five times faster than it does for air. If you can leave the water environment, your survivability will increase.

Once you board the raft, hypothermia is less of a threat. However, thermal regulation is still important even aboard the raft. In fact, you may face a new challenge of hyperthermia (heat exhaustion and/or heat stroke) when the body core temperature is above normal functioning levels.

A raft makes you much more visible to rescuers. More importantly, a properly outfitted life raft has potable water, signaling devices, a first aid kit, and other equipment that will aid in your survival. Prepare yourself for life aboard the raft and get as comfortable as you can.

A course in underwater egress should address each phase of ditching. It is important to note that if you do not know how to protect yourself during the Impact Phase you may not make it to the Egress Phase. If you get lost inside the aircraft during the Egress Phase, you will not make it to the Surface Water Survival Phase.

It is not enough for you to make it to the surface; you must know what to do to protect yourself from the environmental conditions long enough for rescuers to find you. Underwater egress training should address proper brace positions for your aircraft, seat, and seat belt configuration. It should help you incorporate physical reference points to aid in making a successful escape.

The training should address how best to maintain proper orientation to the airframe, which expedites the egress itself. The faster you find your objectives underwater the faster you will make your escape. Training should address hypothermia mitigation, life raft righting, boarding and equipment. It should emphasize the value of careful preparation and communication. Egress training can include the safe and effective use of emergency breathing devices.

The training should include inverted aircraft scenarios, and exit-specific training. This means you open and egress an exit in training that is like the emergency exits on your aircraft. Exit specific technology adds realism and repetitive behavior that aid your learning and gives you the procedures to react correctly during an actual emergency.

Aircraft ditching: The things you experience during ditching, the inrush of water, the inversion, flooded sinuses and disorientation can overwhelm an untrained individual. You may know people who have experienced egress training in the military or for a job. They will tell you that the mental image you have of the inversion and the reality of it are very different. You cannot appreciate how different they are until you experience it for yourself.

No one can afford to have that experience for the first time in the local lake, river or the open ocean because of an actual aircraft emergency. By knowing what to expect when that water rushes in means you can put your plan into action when the violent motion stops.

Remember, problem solving underwater is a learned skill and for most people it is not easy. The best place for you to learn those skills is in a safe training environment.

In this issue, part three of four on "The History of Helicopter Safety" is featured. The original version in its entirety was presented by Roy G. Fox at the International Helicopter Safety Symposium in Montréal, Québec, Canada on September 26-29, 2005. A complete download of the full article is available on the www.heliprops.com website.

Special Series

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The History of Helicopter Safety Part Three

MEASURING SAFETY

Safety is the management of risk. To make significant safety improvements, you must be able to measure safety. There is no absolute safety (black/white) – there are only different levels of gray (e.g., low to high levels of risk). Fig. 9 shows that variability. The key to safety is to first measure risk, then make a change, and then measure the new risk. If the later risk is lower than the original risk, safety has improved. The typical safety metric (since early days of the first airplanes) is the accident rate expressed as accidents per 100,000 flight hours. Obviously, a serious or fatal injury will be categorized as an accident. But basically, an accident rate is really measuring the risk of the helicopter being damaged within the definition of an accident. Less than 10% of occupants in helicopter accidents receive a fatal injury. There are two elements of safety, which are (1) being involved in a sudden deceleration event (e.g., an accident), and (2) the possibility of being injured.

Webster's Dictionary defines "safety" as "the condition of freedom from harm, loss or injury." The ultimate risk results in death. The proper way to measure risk is number of events of concern for a certain amount of exposure. The risk to the aircraft is the number of accidents per flight hour. This is NOT the risk to the occupant. The key is to remember that safety is primarily an outcome related to the occupant, whereas an accident is an event primarily related to reporting aircraft damage.

The human occupant is the reason for safety. We try to reduce the injury potential for that occupant. If we can prevent the bad event (e.g., an accident) in the first place, we do. But we cannot stop all accidents despite all of the aviation community efforts, so we must protect the occupants. Thus the most important measure of safety is the occupant's Risk of Fatal Injury (RFI). RFI is defined as:

$$\text{RFI} = \frac{\text{No. of accidents}}{\text{Flight hours flown}} \text{ X } \frac{\text{No. of people with fatal injuries}}{\text{No. of people onboard all accidents}}$$

The first fraction is the likelihood of being in an accident (e.g., the accident rate). The second fraction is the likelihood of being killed, given that an accident occurs. The product of these two factors is the individual's risk of a fatal injury per 100,000 occupant hours of exposure. The risk of injury varies on the gray scale just like the risk of damage to an aircraft. We must measure

Table 2 –Statistical Significance of HELIPROPS Changes

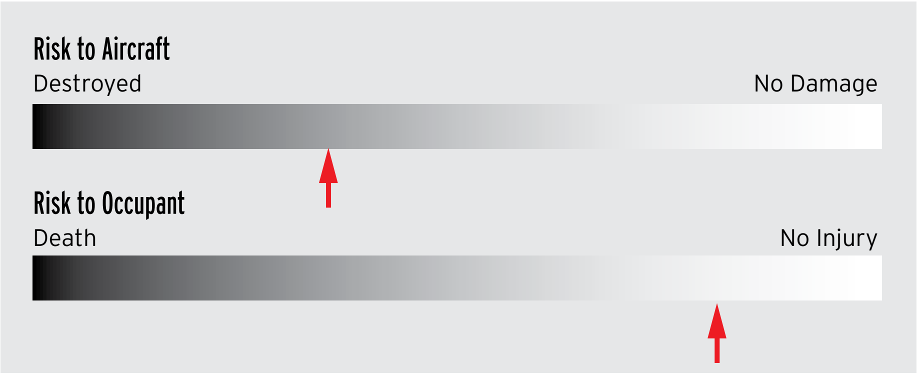
	Average for 1980 to 1986	Average for 1987 to 1993	Difference is Statistical Significance to 0.05 level (95%)
Number of Accidents/Year	53.29	33.43	Yes*
Fatalities/100,000 Hour	2.33	1.60	Yes*
Accidents/100,000 Hour	5.20	3.76	Yes*

*Actually still different to 99.5%

REFERENCES

1. MIL-STD-882D, "Standard Practice for System Safety," U.S. Department of Defense, February 2000.
2. Fox, R. G., "Relative Risk, True Measure of Safety," 28th Corporate Aviation Safety Seminar, Flight Safety Foundation, April 1983.
3. MIL-T-42722B, "Tank, Fuel, Crash-Resistant, Aircraft," U.S. Department of Defense, 1971.
4. Gabella, B. "No More Crash Burn Fatalities," Flight Operations Magazine, June 1976.
5. Knapp, S. C., et al, " Human Response to Fire," U.S. Army Aeromedical Research Laboratories, NATOAGARD, May 1982.
6. Coltman, J. W., et al., Aircraft Crash Survival Design Guide, USAAVSCOM TR 89-D-22, 5 Volumes, (U.S. Army Aviation Research & Technology Activity), 1989.
7. MIL-STD-1290A, "Light Fixed and Rotary-Wing Aircraft Crash Resistance," U.S. Department of Defense, September 1988.
8. Fox, R. G. "Helicopter Crashworthiness," 34th Corporate Aviation Safety Seminar, Flight Safety Foundation, April 1989.
9. Fox, R. G. "Realistic Civil Helicopter Crash Safety," National Specialist's Meeting on Crashworthy Design of Rotorcraft, Georgia Tech and American Helicopter Society, April 1986.
10. Coltman, J. W., et al. "Analysis of Rotorcraft Crash Dynamics for Development of Improved Crashworthiness Design Criteria," DOT/FAA/CT-80/11, U.S. Federal Aviation Administration, 1985.
11. Rotor Roster 2005, Air Track.
12. Fox, R. G., "Helicopter Accident Trends," American Helicopter Society, September 1987.
13. Fox, R. G., Measuring Risk in Single- and Twin-Engine Helicopters, AHS 2nd Asian Vertiflite Seminar, Singapore, February 24, 1992.
14. Fox R. G., "The Path to the Next Helicopter Safety Plateau," American Helicopter Society 61st Forum, June 2005.
15. Vice President A. Gore, et al., "Final Report to President Clinton by White House Commission on Aviation Safety and Security," February 12, 1997.
16. Fox, R. G., "Measuring Safety Investment Effectiveness Relative to Risks," AHS 54th Forum, May 1998.
17. Fox, R. G., "Civil Rotorcraft Risks," 2002 China International Helicopter Forum, Chengdu, People's Republic of China, August 2002.

Figure 9 –Safety Is Not Absolute, Only Shades Of Gray



that initial risk of fatal injury and then find ways to further reduce that risk. A periodic measurement of risk determines if safety is improving or not. Using NTSB data and FAA flight hour estimates, Fig. 10 shows the U.S. helicopter industry accident rate and occupant's RFI. Moreover, the accident rate history of U.S. helicopter industry as a whole is not improving and appears to be increasing. Data are from Helicopter Association International (who collects NTSB accident information and FAA flight hour estimates) and from the NTSB website data bank. The trend for RFI for a U.S. registered helicopter occupant is holding constant and not improving. We must try some other approaches to make that leap to the next safety plateau (Ref. 14).

SAFETY GOAL POTENTIAL: 80% REDUCTION IN 10 YEARS

Once it is possible to measure safety, analyses can be performed to identify accident causes within Safety Investment Areas (SIA) and their respective frequency. Since there are always limits to the amount of money available to fix safety problems or make improvements, the most severe and most frequent safety problems should be corrected first, before correcting those problems that are extremely rare or that do not cause serious injuries.

There was a National Safety Goal established by the White House Commission on Aviation Safety study (Ref. 15). Specifically, Recommendation 1.1 stated "Government and industry should establish a national goal to reduce the aviation fatal accident rate by a factor of five within ten years and conduct safety research to support that goal."

A study (Ref. 16) was conducted to determine (1) if an 80% reduction (e.g., a factor of five) was possible for the U.S. civil helicopter fleet and (2) if so, to identify Safety Investment Areas (SIA) needed to achieve such a reduction. The basic ground rules used were as follows:

- SIA had to be applicable/retrofitable to the existing fleet, as 90+% of the future fleet in 10 years are aircraft flying today. Introduction of new technology aircraft will have little effect of the fleet-wide rates due to the small numbers introduced each year.
- SIA must be cost effective and affordable. Cost of a helicopter in the helicopter fleet ranges from $50,000 to more than $10 million each.
- Priority for SIA selection was most effective (e.g., cover large number of accident causes), most cost efficient (must be affordable), and available soon: Basically, the "biggest bang for the buck with a short time to fleet introduction."

The civil U.S. helicopter fleet was analyzed for the latest 5-year period of 1990–1994, using NTSB accident data and FAA flight hours estimates for three groups as shown in Table 3.

The accident causes were determined with their respective accident rate frequencies. These accidents were then grouped into SIA areas that could have prevented or mitigated that type of accident cause. For example, all of the wire strikes, post strikes, fence strikes, and tree strikes could have been prevented if there was an active obstacle strike detection system onboard that could detect nearby threats and alert the pilot. There are several SIAs that could have prevented the same accidents so each SIA was initially listed. The SIA areas and their frequency of occurrences were determined as accident rate, fatal accident rate, and RFI in Table 4 for the combined fleet. More detailed group breakdown information is in Ref. 16. There are multiple SIAs for the same accident, so the total of the frequencies does not equate to the

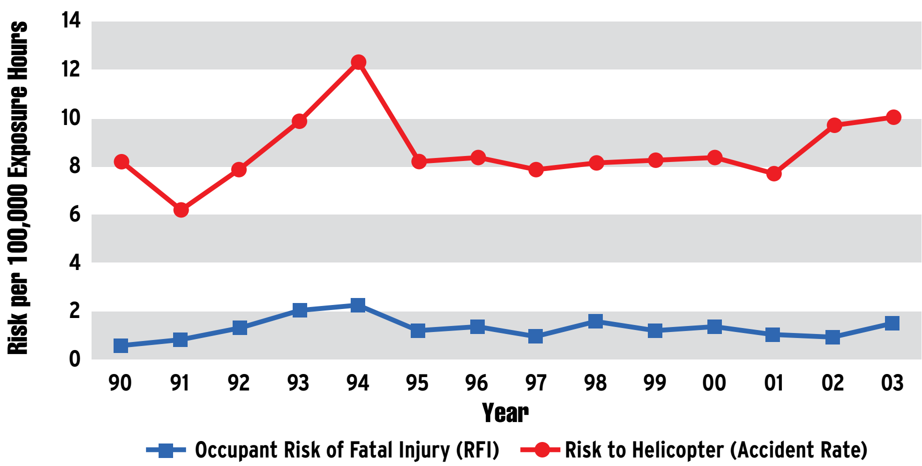


Figure 10 – U.S. Registered Helicopter Accident Rates and Occupant Risks

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The History of Helicopter Safety Continued...

Group	Flight Hours	Accidents	Fatal Accidents
Piston	2,361,526	486	66
Turbine	7,990,747	294	77
Military Surplus UH-1	171,049	24	4
Combined Fleet	10,522,322	804	147

Table 3 –Helicopter Accidents and Exposure

SIA Problems	Accidents/ 100,000 Hour	Fatal Accidents/ 100,000 Hour	Risk of Fatal Injury/ 100,000 Occupant Hour
1. Obstacle Strike	0.89	0.31	0.28
2. Loss of Aircraft Situational Awareness	2.49	0.59	0.57
3. Real Time Aircraft Performance Exceeded	1.56	0.13	0.08
4. Loss of Situational Awareness Internal to Aircraft	1.43	0.15	0.11
5. Loss of Visibility	0.47	0.24	0.24
6. Inability to Respond in Short Duration Emergency	0.38	0.04	0.02
7. Aircraft Component Failure	1.95	0.30	0.25
8. Maintenance Error	0.76	0.10	0.07
9. Cockpit Actions Unknown	5.85	1.11	1.04

Table 4 –Combined Fleet Risk Related to SIAs

SIA Number	SIA Solutions	Accidents/ 100,000 Hr.	Fatal Accidents/ 100,000 Hr.	Risk of Fatal Injury/ 100,000 Occupant Hr.
	Present risk rates. Implemented SIAs below will	0.89	0.31	0.28
1, 2	Add Proximity Detection Systems	5.07	0.76	0.65
1, 2, 3, 4, 7	Add HUMS, Aircraft Health, Real Time Performance, and Pilot Aids	2.14	0.39	0.37
1, 2, 3, 4, 7, 9	Add cockpit Image & Audio Monitoring	0.36	0.06	0.10
	Residual Risk After Combined Potential of All SIAs	0.36	0.06	0.10
	10-Year Future Goal/Target (80% of Present)	1.53	0.28	0.25

Table 5 –SIA Solutions to Achieve 80% Reduction

total accident rate.

By applying the ground rules on priority of assigning a SIA, the accidents assigned to the most effective SIA were removed from the helicopter fleet accidents. The next best SIA then could only affect the remaining accidents, and those affected accidents were then removed from the fleet. This priority sequencing was used until nearly all of the accidents were mitigated by an SIA. This provided a priority list of SIAs, and how much accident reduction was possible for each. SIAs were added until achievement of the 80% reduction goal was reached. The resulting SIAs in order of priority and their respective rate reduction potential are shown in Table 5.

As a result, it is possible to reduce the accident rates and RFI rates by 80% using the SIAs and priorities shown. These are not the only SIAs that could help, but they are the simplest and easiest from which to measure effectiveness and progress toward the goal. The potential exists to drive the helicopter fleet accident rate down to 0.36/100,000 hr. For a perspective, the accident rate in 2003 for all U.S. registered Part 121 Scheduled Air Carriers was 0.30/100,000 hr. For the last five years (2000–2004), the Part 121 Scheduled Air Carriers had a rate of 0.23/100,000 hr. The helicopter industry has the potential to have comparable accident rates.

A key SIA is the CAVR (Cockpit Audio Visual Recorder), also described in more detail in Ref. 14 as a Cockpit Information Recorder (CIR). We must document what happened in the cockpit, and ONLY THEN can we correct procedures and know what type of training is needed to correct specific accident causes. Further, we can then evaluate the effectiveness of different trainings.

Look for Part 4 of this story in Vol. 20, No 4. For download of complete article go to www.heliprops.com.

The Human Factor

By John Williams • HELIPROPS Manager

Statistical evidence* suggests that airframe and engine malfunctions are relatively a minor cause of helicopter accidents. That doesn't mean the helicopter manufacturers are off the hook and can breathe easy. They must continuously improve the reliability and safety of their products.

Human error is the predominant cause of helicopter accidents and account for approximately 74% of them. The following situations illustrate poor decisions with a potential for disaster. It's time to put on your "safety hat" and take a critical look at some of the following anecdotes.

A Failure in Common Sense

Let's begin with a question: Is it acceptable to leave a helicopter running without a pilot at the controls? If so, what is a safe procedure to follow?

Whether it is "acceptable" or not isn't the only question. There are mechanical issues and regulations to consider. By design, the friction device on the helicopter assists the pilot by allowing the ability to adjust control sensitivity for flight.

Then on helicopter shut down, the pilot uses the cyclic and collective friction to fix the flight controls in preparation for the engine shut down procedure. This frees the pilot's hands to perform other shut down tasks. From a safety and mechanical failure standpoint, use of the friction device as a **flight control lock** for the purpose of leaving an operating helicopter was never a good practice.

In Section One, Limitations, of your civilian Rotorcraft Flight Manual and under the heading Flight Crew it reads, "Minimum flight crew consists of one pilot who shall operate helicopter from right** crew seat." The key word is "operate" the helicopter. How can a pilot properly operate the helicopter when he is not in the pilot seat?

Because the statement comes from this section, there can be no deviation by the pilot and it is not open for debate. This section of the flight manual even begins with the following statement: "Compliance with the Limitations Section is required by appropriate operating rules." Think of it as **LAW**.

The only possible exception from which seat the pilot flies is when a pilot sits at the opposite pilot station in order to conduct sling load or hoist operations. Even then, the capability to perform from that seat is addressed in the Limitations Section of the applicable Flight Supplement. Bottom line: there is a pilot in the cockpit "operating" the helicopter.

I listened to an account told by an FAA Inspector who witnessed a pilot leave his helicopter running on an active taxi way. This pilot proceeded to walk away, and venture off into two different buildings. As he conducted his business (helicopter out of sight) airplanes taxied all around and next to it.

By walking away, the pilot was considered careless and reckless by the FAA Inspector. According to him it was a clear violation of FAR Part 91.13, which is titled "Careless or reckless operation."

The pilot may have added friction to the flight controls before he exited the helicopter, but flight control frictions were not intended to be used as "locks." What would have happened had there been a collective or cyclic hard over; much less a collision with a taxiing airplane?

Mechanically Speaking

Use of the friction device as a "control lock," over time will strip the friction device threads and ruin the mechanism entirely. Maintenance personnel deal with this routinely. Over-tightening the control friction until it cannot move can freeze it to a point where it is almost impossible to loosen. Have you ever tried to un-tighten a collective friction knob on a helicopter (that would not budge) because some unknown, "over zealous" pilot could not gage when to stop cranking it?

Any solution? Sure, use a trained loader to assist with passengers entering and exiting the helicopter should your operation require the aircraft be running. The **very best** solution is to shut down the helicopter and wait until the rotors come to a complete stop before allowing any movement of passengers, especially in the absence of a passenger loader.

How much revenue time is lost when you shut down the helicopter? There is the two minute engine cool down time; then the time it takes to bring the rotor to a stop, usually with a rotor brake. That's another 30 seconds or so. Do you still believe you have lost an excessive amount of fuel/revenue by shutting the aircraft down before passengers are loaded or unloaded?

I am now speaking to the pilot that turns the hydraulic switch OFF as a substitute for flight control friction.

Is it okay to turn off the hydraulic switch and use it like you would a control friction? Better think this one through. Although it is rare, some hydraulic malfunctions only occur when the hydraulic switch is turned off, with rotors turning. A stuck pilot valve comes to mind. When a hydraulic boost cylinder pilot valve sticks, it can cause the flow of hydraulic fluid to travel in only one direction, forcing the cylinder to fully extend or retract. In other words, a hydraulic hard-over.

Imagine your collective moving full up or the cyclic driving full aft or forward along its axis of motion. No one is at the flight controls to prevent severe damage. Get the message? Under **NO** circumstances should a pilot turn the hydraulics off as a substitute for flight control friction. Use of this "technique" has caused disastrous results.

Sometimes, We Are Our Own Worst Enemy

The following is a lesson in poor judgment. One pilot witnessed a helicopter pilot exit the cockpit and then load passengers as his assistant hot refueled the running helicopter. Is there any better formula for disaster? Are you shaking your head in disbelief yet? Enough said.

CONTINUED ON PAGE 11

Tail Rotor Tales

By Lloyd D. Knight

EDITOR'S NOTE

Lloyd Knight wrote in the last issue Vol 20 Number 2, an article titled "The Whisky Flask." It relates his experience with a "jammed collective." After he broke the collective free, it was later later learned that a whisky flask filled with water had lodged itself beneath the collective flight control.

He is a prolific writer and will contribute another article for the next HELIPROPS issue. More about Lloyd then.

Most people would be aware that helicopter tail rotors are extremely dangerous things to be near. They pose the same sort of hazard as a propeller on an aeroplane. They just happen to be on the other end. This was a significant factor in these two anecdotes about tail rotors.

I was shut down at a New Zealand Fire Support Base (FSB), somewhere in the Phuoc Tuy Province, Vietnam, waiting for my passengers to complete their business before transporting them back to base. While we waited I was enjoying a mug of tea, supplied by a young Australian lieutenant who was attached to the battery. I think he was a liaison/operations officer. The tea was, like the coffee consumed by the troops, black and sugarless. I still drink those beverages the same way after thirty-nine years. Saves a lot of hassles.

While I was talking to the lieutenant, a flight of four or five USAF, C123 transports roared directly overhead spraying their 'Agent Orange' defoliant. The lieutenant went 'ape'. He raced into his HQ tent and got on the line to Saigon to register a strong complaint. When he came out he had calmed down a little.

'That's the third time this week,' he almost yelled. 'They are going to make us all sick if they keep that up.'

We all now know how right he was.

Well may you say, 'What's that got to do with tail rotors?'

'Well, absolutely nothing.' I would reply.

I just threw that one in for the record.

While we were discussing the poor coordination applied to such spraying operations, another Huey arrived to pick up a different party of senior officers. It landed about a hundred metres away and the officers, about six in number, started out from the tree line to cover the fifty metres from their waiting area to the chopper. Perhaps chopper is an apt slang term in this instance.

As has always been very much my habit *since* that event, I observed their boarding procedure, as an added safety precaution.

This was just as well, because, as the first five headed for the right hand door, number six, who was in fact a non-combatant major, broke off from the group and ran, head down, straight for the tail rotor. The crewman was fixing the seat belts or something, and the pilot wasn't looking towards them.

I took off at full pace after him, yelling my head off. I couldn't be heard above the engine and rotor noise.

I screamed, 'Stop! Stop! Hey! Stop!' It was to no avail. The major kept doggedly on his course to certain destruction. I ran even faster, the adrenaline really pumping now, and continued to yell at the top of my voice. Over my shoulder I saw the lieutenant running even faster than I, and also yelling. None of the party could hear us and the helicopter crew just weren't looking our way.

We had almost caught up to him when suddenly, not more than three metres from the whirling disc, he looked up and stopped dead in his tracks.

The crewman, who was now organizing the boarding of the rest of the group, saw what was occurring and came running back towards the major. We all got to him at the same time. He turned his bloodless face towards us and mouthed a big 'Thanks.' Then he almost fainted – and so did I. The crewman bundled him aboard and they went on their way.

I could hardly talk for a week after the screaming. I think I was transformed from a tenor, into a Johnny Cash for a further two weeks.

I never heard from the major. However, he did ask the pilot of his ship to convey his heartfelt gratitude. He had heard our cries just in time.

He also told the pilot he had received some induction training in helicopter procedures back home. But he had never boarded a running helo before. He had flown in a few single engine aeroplanes though.

That's where he had received his conditioning to, 'go round the back'.

Lack of experience cannot be cited as a cause for the next event. However, recent aeroplane exposure was probably a factor. I must caution you that the outcome was not as efficacious.

One day I landed at an Aeroplane Landing Area, the name of which I forget. It was in the northeast of our operational area, out past Dat Do. The area was quite attractive, with tall green trees on both sides of the short runway. There was a gentle breeze wafting through the tall grass in front of the trees. The whole atmosphere, away from the usual hustle and bustle of most airfields, was a pleasant change. We had to shut down, with the inevitable wait for our passengers.

Some US Army personnel were in the process of wheeling an OH-6 Cayuse (Hughes 500) helicopter off the edge of the Perforated Steel Plank (PSP) pad. I could see that it had a badly damaged tail rotor. I strolled over to see what had happened.

As I approached the area, I was disturbed to see a large amount of fresh blood, and other little bits, on the steel covered landing zone. The soldiers completed their task of securing the aircraft and I asked them what had happened.

They told me that a Special Forces (US) major had alighted from a passenger seat, grabbed his kit, and walked straight back into the tail rotor. The medics had removed his body, and *they* now had the unpleasant task of cleaning up the rest.

This very experienced soldier had done the inconceivable. Maybe he had been somewhat preconditioned by the fact that he had recently been conducting his observation duties from an O-1 Birddog aeroplane. A moment's lack of awareness had led to a horrible outcome.

I have related these stories to amplify the fact that, when operating near running engines, rotors and propellers, folks have to be extra careful. Of course the same principle applies to jet engine intakes and exhausts.

What's Your Story?

If you have an account that you would like to share with other *HumanAD* readers, please send them to:

Bell Helicopter Textron Inc.
John Williams, HELIPROPS Manager
P.O. Box 482, Fort Worth, TX 76101
Fax: 817-278-3688
www.heliprops.com

Speaking of Safety Continued...

Just When You Thought It Was Safe To Go Back Into The Air . . .

Typical 3 bladed wind turbines. Each blade is 65-130+ feet (20 - 40 meters) in length and are situated atop wind towers that stand anywhere from 200 to 300 feet (61 - 91 meters). They turn at 10 to 22 revolutions per minute.

Typical 3 bladed wind turbines. Each blade is 65-130+ feet (20 - 40 meters) in length and are situated atop wind towers that stand anywhere from 200 to 300 feet (61 - 91 meters). They turn at 10 to 22 revolutions per minute.

As a helicopter pilot I have a primordial fear of power-line wires of any size or height. I'm not fond of antennas either and now wind generators are on my list. Recently, a helicopter pilot related a story to me how he found himself literally in the middle of a wind generator farm while navigating his way through marginal weather.

A US Sectional Chart depicting a Wind Turbine Farm near Abilene, TX.

Never mind how he got there; he knows it wasn't smart to fly that day. He would be the first to admit it. The point is wind generators have become another danger to deal with in a helicopter pilot's life.

The number of Wind generators is on the increase, not decrease. You can find them wherever the wind blows. So pilots, be route savvy. Keep the most current aeronautical charts with you. Take extra care when planning your route. Be aware of the hazards on either side of your course line in case you must deviate. Where there is one wind generator unit you should expect many more near by.

*Part II, "The History of Helicopter Safety," page 8, Figure 5.
**Helicopter model dependant.

What's New at the HELIPROPS Web Site?

Twenty Years of HELIPROPS Newsletters Now Online

Current and back-issues of the *Human AD* newsletters can now be downloaded from the HELIPROPS web site at: www.heliprops.com. Making the newsletter available online was in response to requests from readers that were interested in research and some people for general interest.

Passenger Briefings

Need a helicopter passenger briefing poster for your operations? One is now available for download from the HELIPROPS web site. The poster is a PDF file with two downloadable sizes: 11 x 17 inches and a smaller version, 8½ x 11 inches sized to fit in a cabin pocket. You can fold and laminate the briefing cards as you need.

The information presented references the United States FAR Parts 91 and 135. The Passenger Briefing document alone does not constitute a sufficient briefing. Remember, a crew member must give an oral briefing to passengers before flight.

BELL HELICOPTER AWARD PROGRAMS

Many Bell pilots and operators have requested information on what type of Bell Helicopter wings and safety awards are available to them. There are two ways to obtain recognition for pilots who fly Bell helicopters. The first recognition is a Pilot Safety Award issued on the basis of safe flying hours in Bells. The second is a wings award based on the pilot's flight hours in Bell helicopters. It is possible for a pilot to obtain both awards.

Bell Flight Time Wings Award

The second recognition is for a pilot's flight time in Bell Helicopters. The Bell Training Academy issues this Certificate of Achievement and a Wings Lapel Pin in the following flight time hours:

1,000 hrs. plain wings pin + certificate
5,000 hrs. 5,000 hr. wings pin + certificate
10,000 hrs. 10,000 hr. wings pin + certificate
15,000 hrs. 15,000 hr. wings + certificate
20,000 hrs. 20,000 hr. wings + certificate

Example: If a person had 6,500 hours in Bells he would receive a 5,000 hour pin, although the certificate would read 6,500 hours. Their next opportunity for a higher hour level pin would be at the 10,000 hour level.

For the hour level recognition to be awarded, the pilot (or company) must provide the following: Name of pilot as they would like it printed on a certificate, a verified flight time in Bells by either the Chief Pilot or a Company Administrative Official. In the case of an individual pilot making the request, a signed copy of the page in the pilot's log book that verifies the hour level for the wings requested. Mail or email the information (including copy of documentation) to Rosalind Larmer at: rlarmer@bellhelicopter.textron.com. Bell Helicopter Textron Inc., P.O. Box 482, Rosalind Larmer, Dept. 9S, Bldg. 61, Fort Worth, TX 76101 USA

Pilot Safety Award

Recognizing an individual pilot for flying safely is far too rare. Most pilots only hear of mistakes made by another pilot in an accident. Bell provides a Pilot Safety Award certificate for hours flown without an accident in a Bell helicopter. This can be achieved in either military or commercial aircraft. The award is given in thousand hour increments to recognize those pilots with a proven commitment and history of safe flying. To apply for this recognition certificate, please send a request letter from the chief pilot, CEO, military commander, or other individual who can confirm how many accident-free flight hours you have flown in Bell helicopters. If you are an individual pilot / owner, you can write the statement yourself. Let us know how you would like the name to appear on the certificate. If you want to include a military rank, you need to indicate that.

The award is maintained through the Bell's Flight Safety Department within Bell Engineering; Lee Roskop (ldroskop@bellhelicopter.textron.com) is the Bell point of contact. His mailing address is: Bell Helicopter Textron Inc., Attn: Lee Roskop, Dept. 81, Group 60, P.O. Box 482, Fort Worth, TX 76101 USA

The pilot's name and safe flight hours are posted on Bell's Flight Safety web page www.heliprops.com. Follow the link to the Heliprops Pilot Safety Award Program.

Significant Achievement

Colonel Uwe Seeburg, Commander of the German Army's Transport Helicopter Regiment 10, recently received two Certificates of Recognition from Bell Helicopter. One certificate was for 2,500 hours of accident free flight hours in Bell Helicopters and the other for 40 years of service in the German Army. The presentations were made at Colonel Seeburg's retirement ceremony on 29 September 2008.

Specialized troops rappel from a UH-1 helicopter under Colonel Seeburg's command.

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