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External Loads, Powerplant Problems And Obstacles Challenge Pilots During Aerial Fire Fighting Operations

U.S. accident reports from 1974–1998 show that diversion of attention was a major factor in accidents during external-load operations, which accounted for more than half of the accidents. Powerplant malfunctions and powerplant failures were involved in more than a third of the accidents. More than a quarter of the accidents occurred when helicopters struck obstacles, such as trees and wires, during fire fighting missions.

Patrick R. Veillette, Ph.D.

Helicopter operations in support of fire fighting activities in the United States typically are conducted in remote areas where rugged terrain and adverse flight conditions present unique risks for the aviators. Table 1 (page 2) shows that since 1955, there have been 24 fatal helicopter accidents, in which 45 crewmembers were killed, during aerial fire fighting operations.¹

Table 2, page 2 shows the accident rates for helicopters during U.S. aerial fire fighting operations in five-year periods from 1961 to 1995. The aerial fire fighting accident rates are high, compared with

accident rates in other helicopter operations. For example, rotorcraft were involved in 18.60 accidents per 100,000 hours flown in aerial fire fighting in 1981–1985.² U.S. National Transportation Safety Board (NTSB) data show that, in all civilian flight operations during the same period, turbine-powered rotorcraft were involved in 8.01 accidents per 100,000 hours.



This report examines rotary-wing aerial fire fighting operations but recognizes that fixed-wing aircraft also play a major role in aerial fire fighting.³

To identify accident causes and potential methods of improving U.S. helicopter aerial fire fighting safety, the author conducted a study that included the following:

• Analysis of official reports on 97 helicopter accidents that occurred in direct support of U.S. aerial fire fighting operations from January 1974 through December 1998 (see

Appendix, page 9), with follow-up interviews of accident investigators and some witnesses, and inspections of some accident sites;

- Examination of training documents and training courses;
- Examination of operating specifications and manuals;

Table 1 Aircraft Accidents During U.S. Aerial Fire Fighting Operations, 1955–1997

Aircraft	Accidents	Fatalities
Helicopters	24	45
Airplanes	124	202
Total	148	247

Source: Patrick. R. Veillette, from Bushey, Chuck. "Wildland Fire/Aircraft Firefighter Fatalities in the United States Compared with Ground Based Firefighter Fatalities." In *Proceedings of the First Canada/U.S. Wildland Fire Safety Summit, Rossland, British Columbia, Canada, 29 Sep.–Oct. 1997.* Fairfield, Washington, U.S.: International Association of Wildland Fire, 1997.

- Examination of aircraft; and,
- Inspections of some fire bases.

The study produced the following major findings:

- Forty-two of the 97 accidents occurred while helicopters were being maneuvered for reconnaissance, to release water or chemical retardant on fires, to deliver external loads or to deliver firefighters to the fire area. Human error was involved in 18 of the accidents;
- Sixteen accidents occurred during the en route phase of flight. Human error was involved in nine of the accidents;
- Sixteen accidents occurred during landing approaches. Human error was involved in 12 of the accidents; and,
- Human error was the leading accident cause. Factors contributing to human error were deficiencies in pilot judgment, loss of situational awareness and noncompliance with standard operating procedures (SOPs).

Formal documentation of SOPs improved with the publication in May 1994 of the *Interagency Helicopter Operations Guide* (IHOG). Published by the National Interagency Fire Center, the IHOG establishes procedures for operating helicopters for the U.S. Department of Agriculture and the U.S. Department of the Interior. The IHOG also sets standards for crewmember experience and training. The second edition of IHOG was published in January 1998.

The aircraft used in aerial fire fighting operations frequently are operated as "public aircraft" (commonly called public-use aircraft), which are exempt from some U.S. Federal Aviation Regulations (FARs).^{4,5} Many regulations governing pilot certification, pilot training, aircraft operations and aircraft maintenance apply to "civil aircraft," which by definition do not include public-use aircraft.

Before April 1995, many accidents and incidents involving public-use aircraft were investigated only by the agencies that operated the aircraft. U.S. regulations adopted in April 1995 require that NTSB be notified of, and investigate, all publicuse aircraft accidents and incidents.

Reports on some accidents investigated only by the respective operating agencies were not available for analysis; thus, the exact number of helicopter aerial fire fighting accidents in 1974–1998 is unknown.

Analysis of the 97 reports available for this period shows that eight accidents involved fatalities and that 25 accidents involved serious injuries. Eleven people were killed, 56 people were seriously injured, and 31 people received minor injuries.

Figure 1 shows that 41 nonfatal accidents and one fatal accident occurred as helicopters were being maneuvered for reconnaissance, to drop water or chemical retardant on fires or to deliver cargo and/or firefighters to fire areas. Figure 2 shows that 17 of the maneuvering accidents were caused by

Years	Hours Flown	Total Accidents	Fatal Accidents	Total Accident Rate*	Fatal Accident Rate*
1961–1965	71,000	29	NA	40.84	NA
1966–1970	102,000	46	NA	45.10	NA
1971–1975	126,000	33	NA	26.19	NA
1976–1980	103,000	32	1	31.07	0.97
1981–1985	86,000	16	2	18.60	2.33
1986–1990	108,854	18	1	16.54	0.92
1991–1995	135,262	14	3	10.35	2.22

Table 2U.S. Aerial Fire Fighting Helicopter Accidents, 1961–1995

* per 100,000 hours flown

NA = Not available

Source: Patrick R. Veillette, from U.S. Department of Agriculture, Aviation Accident and Incident Trend Study, Letter to the Director, Fire and Aviation Management. A special report prepared at the request of the U.S. Forest Service. March 1996.



human error, 23 accidents were caused by mechanical failure, and two accidents were caused by adverse weather conditions.

Maneuvering typically is conducted for extended periods at low altitudes in steep, mountainous terrain where maneuvering room is limited. Helicopters often are flown in smoke, gusty winds and in close proximity to other aircraft. High density altitude often reduces hovering capability. Maneuvering at low altitudes and slow airspeeds reduces the probability of a successful autorotative landing if a powerplant fails.

Fourteen nonfatal accidents and two fatal accidents occurred during the en route phase of flight — that is, while helicopters were being flown to a fire area or returning to a helibase. Nine en route phase accidents were caused by human error, and seven accidents were caused by mechanical failure.

Thirteen nonfatal accidents and three fatal accidents occurred during the approach phase of flight. Ten approach-phase accidents involved human error, three accidents were caused by mechanical failure, and three accidents were caused by adverse weather conditions (downdrafts in each case).

Nine nonfatal accidents and one fatal accident occurred during takeoff. Eight takeoff accidents involved human error, one accident involved mechanical failure, and one accident involved adverse weather conditions. Most accidents occurred when helicopters struck obstacles while taking off in confined areas. Misrouted external-load cables were factors in four takeoff accidents.

Six nonfatal accidents occurred during the climb phase of flight. Two climb accidents involved human error, and four accidents involved mechanical failure (engine failures).

Four nonfatal accidents and one fatal accident occurred during landing. Two landing accidents involved human error, two accidents involved mechanical failure, and one accident was caused by adverse weather conditions.

External loads were involved in 55 accidents. Pilot workload is high during external-load operations. Twenty-four externalload accidents involved diversion of the pilots' attention from aircraft control. Sixteen external-load accidents were caused by powerplant failures; nine of these accidents occurred when helicopters were being flown at low altitudes or low airspeeds (or both).

All external loads are attached to helicopters with cargo hooks, which must be approved by the U.S. Federal Aviation Administration (FAA). The cargo hooks must be designed to enable the pilot to jettison the external load, either manually or electrically. External loads had important safety implications because of the high density altitude and limited maneuvering room that are common in aerial fire fighting operations. Helicopters carry water buckets with maximum-load ratings that range from approximately 1,000 pounds to 18,000 pounds (454 kilograms to 8,165 kilograms).

Pilots attempted to jettison external loads in 18 of the 55 external-load accidents. Malfunctions of the external-load line, water bucket or snorkel (a tube-like device used to fill water tanks inside or attached to helicopters) occurred in seven accidents.

Nineteen external-load accidents occurred when helicopters or helicopter external loads struck obstacles (typically, trees and wires) while the helicopters were being maneuvered. When maneuvering a helicopter to drop water on a fire, the pilot concentrates attention on the external load, the engine instruments, aircraft stability and the departure path; the pilot's ability to scan all around the helicopter for obstacles sometimes is diminished.

Eight external-load accidents occurred when helicopters settled under power.⁶

Four external-load accidents were caused by misrouted cables. All the accident aircraft became uncontrollable when their centers of gravity moved beyond limits.

Thirty-four accidents were caused by powerplant failures. Thirty-one accident aircraft were not within range of a suitable area for a safe autorotative landing; 25 of these accidents involved low main-rotor speed and high sink rates. Rugged terrain was a factor in 32 powerplant-failure accidents.

Twenty-seven accidents occurred when helicopters struck obstacles during normal operations (i.e., not during emergency landings). Nineteen helicopters struck trees; eight of these accidents involved collisions with trees that were behind the aircraft. Eight tree strikes occurred when the pilots were performing vertical-reference work, which typically involves leaning outside the cockpit and looking down. Six helicopters struck unmarked wires.

The pilots' attention was diverted in 25 obstacle-strike accidents. Crews misjudged obstacle clearance in 10 of the accidents. Twenty-one helicopters were being operated in confined areas when they struck obstacles.

Sixteen accidents were caused by loss of tail-rotor effectiveness (LTE). Nine LTE accidents were caused by mechanical failures; four of the accidents involved external loads that either became entangled with the tail-rotor system or struck the tail-rotor system. Four LTE accidents were caused by adverse winds. Three LTE accidents occurred at high density altitudes.

Gusty winds and low-level turbulence were factors in 33 maneuvering accidents and 12 approach-and-landing accidents. All of these accidents involved errors in judgment about the effects of gusty winds and turbulence on aircraft performance.

Fifteen accidents were caused by downdrafts. Only three of the accident pilots had received weather forecasts warning of the possibility of downdrafts.

Twenty-four accidents occurred during takeoffs or landings on sloped terrain. Four slope-operation accidents involved dynamic rollovers.⁷

Fifty-eight accidents occurred in density altitudes above 7,000 feet. High density altitude specifically was cited as a contributing factor in 13 accident reports. Helicopters were being hovered out of ground effect in seven of the high-density-altitude accidents.

High density altitude reduces available engine power, often in situations involving a heavy external load or a heavy payload that increases the engine power required for the mission.

Seven accidents involved miscalculated loads and/or incorrect performance calculations. Crewmembers of three accident helicopters computed hover-in-ground-effect performance, but failed to recognize that hover-out-of-ground-effect (HOGE) conditions would exist at the helispot (a temporary landing area) and did not calculate HOGE performance.

Figure 3 shows that 82 accidents occurred in the months of June, July, August and September. This is the period in which

the greatest fire activity occurs in the western United States. The tempo of aerial fire fighting operations increases significantly during this time, thus increasing the risk of fatigue-related accidents and incidents.

Most aerial firefighters are paid a base salary plus compensation for flight time and for overtime (duty time and flight time beyond limits specified in their contracts). Many of these aviators and crewmembers work on a seasonal basis and welcome the opportunity for overtime compensation.

Nevertheless, the U.S. Forest Service (USFS) and some other aerial fire fighting agencies have adopted FARs Part 135 dutytime restrictions and flight-time restrictions. The duty-time limit for aerial firefighters is 14 hours; during that time, they may fly a maximum of eight hours. A two-day rest period is required in any 14-day period. The USFS has guidelines for further restriction of duty time and flight time during periods of heightened fire activity.

A survey of aerial firefighters showed that short-term fatigue, long-term fatigue and heat-related stress sometimes are experienced during periods of intense fire fighting operations.

Eleven accident reports said that crewmember fatigue was a possible factor. The actual incidence of fatigue-related errors is likely much higher. Studies have shown that fatigue typically



is under-reported in accident reports and incident reports. An analysis of U.S. Aviation Safety Reporting System reports, for example, showed that fatigue specifically was cited in only 3.8 percent of the sample reports, although evidence of fatigue appeared in 21.2 percent of the sample reports.⁸

All the fatigue-related accidents occurred during the hours of 1500–1900, that is, during the late afternoon and early evening. The reports did not say how many flights the crews had conducted during the morning or early afternoon on the days the accidents occurred. Because most aerial fire fighting operations are conducted during daylight and involve multiple flights, the possibility exists that the risk of fatigue was increased. (Accident reports did not provide such details.)

No accidents occurred during the first few days after pilots returned from the two-day rest periods required by the USFS and other government agencies. All 11 fatigue-related accidents occurred more than seven days after pilots returned to duty after two-day rest periods.

Fifteen accidents involved postaccident fires. Thirteen postaccident-fire accidents occurred in off-airport locations, where prompt response by aircraft rescue and fire fighting services was not possible.

Eleven postaccident fires began after the aircraft came to rest. Two postaccident fires began more than one minute after the aircraft came to rest. One postaccident fire began during the impact sequence. One postaccident fire was ignited by a wildfire.

Four reports on accidents involving postaccident fires said that the engine was the most likely ignition source. A hot aircraft surface ignited three postaccident fires. The ignition source was not determined in eight postaccident fires. Fuel tanks were ruptured in two accidents, drenching the aircraft occupants with aviation fuel.

Several accident reports said that postaccident fires were made worse by improperly labeled and improperly secured cargo that either ignited, added combustible material to the fire or impeded occupant evacuation from the helicopters.

The IHOG requires personal-protection equipment (PPE) to be worn by firefighters. PPE typically includes fire-resistant Nomex flight suits or fire fighting clothing, Nomex gloves or leather gloves, and ankle-length leather boots. PPE generally was effective in protecting the accident crewmembers.

Flight helmets (commonly the military SPH-4 helmet) are worn by most helicopter pilots and crewmembers (see "Helicopter Crews Conduct Numerous Fire Fighting Activities").⁹ Hard hats are required to be worn by all ground firefighters while working in the fire area and while riding in a helicopter.

Helicopter Crews Conduct Numerous Fire Fighting Activities

Helicopters are used for a variety of aerial fire fighting missions in the United States. Transportation of personnel is a common mission; firefighters can travel to fires in remote and rugged areas more expeditiously in helicopters than in ground vehicles or by foot.

Helicopters transport "hot-shot" teams (elite 20-person fire fighting crews) and helitak (helicopter-attack) crews. Helitak crewmembers are qualified to fight fires, manage helispots (temporary landing areas), marshal flight activities and ground activities at landing sites, and perform other duties.

When transporting firefighters, helicopter pilots often must find a suitable landing site near the fire. Some firefighters, called heli-rappellers, are trained to rappel (descend by rope) from helicopters onto terrain that is not suitable for landing. Two heli-rappellers exit simultaneously from opposite sides of the helicopter; this procedure is designed to ensure that the helicopter's center of gravity remains within limits during the operation.

Helicopters often are used to light backfires ahead of spreading wildfires to starve the wildfires of fuel. Helicopters also are used in controlled-burning operations, in which fires are deliberately set to control the spread of a wildfire. Backfires and controlled burns also are lighted by ground personnel. The ignition devices carried by helicopters include small (1.25-inch [3.2-centimeter]) polystyrene balls containing potassium permanganate. The balls are injected with ethylene glycol before they are dropped from the helicopter by a dispensing unit; the chemical reaction causes the balls to ignite after they are on the ground.

Helicopters also carry helitorches, which dispense and ignite gelled gasoline or gelled diesel fuel. Helitorches are suspended from cargo hooks and can be jettisoned in an emergency.

Helicopters are used for fire patrol and reconnaissance, and are equipped with infrared-detection systems to detect hot spots in wildfires.

Helicopters are used extensively to drop water — or a mixture of foam and water — on wildfires. A number of different tankage systems and delivery systems are used. A bucket suspended on a long line is a common delivery system. Some buckets are adjustable so that they cannot carry a load that will exceed the helicopter's performance capability. The buckets are filled at dip sites, such as lakes and rivers, or from tanks assembled and filled near suitable landing sites. Some helicopters carry water in internal tanks that are refilled through a snorkel (a tube-like device) while the helicopter hovers over a dip site.

Helicopters also are used to deliver external loads of cargo and supplies to ground-based firefighters, and for command and control of fire fighting operations conducted by the crews of other helicopters.

During a command-and-control flight, a helicopter coordinator aboard the aircraft develops overall fire fighting strategy in conjunction with air-tactical-group supervisors, inspects fire zones for hazards, assigns specific tasks to helicopter crews, and coordinates with the crews of other aircraft for the safe operation of both fixed-wing aircraft and rotary-wing aircraft.

Federal agencies that utilize helicopters for aerial fire fighting include the U.S. Department of Agriculture's Forest Service and the following agencies of the U.S. Department of the Interior: Bureau of Indian Affairs; Bureau of Land Management; Fish and Wildlife Service; and National Park Service.

These agencies utilize contractors for most helicopter operations. The contractors generally operate on either an exclusive-use basis or a call-when-needed (CWN) basis.

Exclusive-use helicopters are available only for aerial fire fighting operations. The contractors' helicopters and pilots are inspected by the contracting agency before the fire season begins. The pilots and other helicopter crewmembers typically work with a government helicopter manager during the fire season. Crewmembers are expected to comply with the standard operating procedures set forth in the *Interagency Helicopter Operations Guide*. The crewmembers and the helicopter manager usually have the opportunity early in the fire season, when activity is low, to become acquainted with each other and to discuss crewcoordination issues.

CWN helicopters and pilots are used when increased fire fighting activity requires more resources. CWN crewmembers often begin working with a government helicopter manager when the crewmembers arrive in the fire area.

Nonpilot crewmembers have critical roles in safety. They perform important tasks, such as weighing, manifesting and loading cargo; hooking up external loads; and marshaling ground activities and flight operations at landing sites.

Many state agencies utilize helicopters for aerial fire fighting. Many agencies use contractors, but some agencies operate their own helicopters. During periods of intense fire activity, many states activate their National Guard helicopter units.

Numerous county governments and city governments also operate helicopters for aerial fire fighting.

- Patrick R. Veillette

Damage to helmets and hard hats worn by 15 occupants in nine helicopter accidents showed that the helmets and hard hats absorbed significant impact forces. Five accident pilots said that their flight helmets saved their lives. In five accidents, a total of three flight helmets and nine hard hats were knocked off the victims' heads.

All helicopters are required to have FAA-approved doublestrap shoulder harnesses with automatic-locking inertia reels for each front-seat occupant. Lap belts are required for all aftseat occupants. If shoulder harnesses are installed on aft seats, the occupants are required to wear them.

Crewmembers who conduct special activities — such as rappelling, aerial ignition and infrared sensing — are required to wear approved harnesses. The harnesses must have a quick-release system and should be attached to a helicopter hardpoint (a structure designed to accommodate the external load).

Emergency medical response is most effective when treatment is administered to trauma patients within "the golden hour" — that is, within the first hour of injury. The remote and rugged areas in which most aerial fire fighting operations are conducted, however, impedes quick response. Twenty-six accidents required search-and-rescue (SAR) efforts. Nineteen searches were conducted in aircraft, five searches were conducted in ground vehicles or by foot (or both), and two searches were conducted in boats.

Sixteen accidents requiring SAR immediately were reported to dispatch centers and coordination centers; most of the accidents occurred near significant fire activity and were observed by other firefighters. Seven accidents were reported within 15 minutes by dispatchers who did not receive position reports from the pilots (the IHOG requires that helicopter pilots make position reports every 15 minutes during mission flights). Three accident helicopters were reported missing more than one hour after the accidents occurred.

Eight accident helicopters were located immediately by firefighters. Seven helicopters were found between one minute and 15 minutes after the accidents occurred. Six helicopters were found between 15 minutes and 30 minutes after the accidents occurred. Five helicopters were found more than one hour after the accidents occurred.

In 20 accidents, debris from helicopters caused minor injuries to ground personnel. Helicopters have several components

that rotate at high speeds and can travel significant distances if they separate from the aircraft. Crewmembers who work near operating helicopters are required to wear protective equipment, such as goggles, hearing protection, helmets, longsleeve shirts, trousers and boots.

Eleven accident aircraft descended into water in lakes or rivers. All the water-accident reports said that crewmembers had difficulty escaping from the helicopters. Some crewmembers were hindered during egress because of injuries, disorientation, in-rushing water, confusion or rotor wash from other helicopters flying overhead.

The IHOG requires that personal flotation devices (PFDs) be worn by crewmembers during all operations beyond autorotation distance from shore. Nevertheless, helicopter crewmembers rarely wear PFDs.

Few aerial fire fighting crewmembers receive training in water egress from downed aircraft. In eight water accidents, occupants had to escape from submerged helicopters. Research has shown that the average person, when immersed in cold water, can hold his or her breath for 17.2 seconds, plus or minus 3.7 seconds.¹⁰ Studies of water accidents involving military helicopters and civilian helicopters, however, show that successful underwater escape requires 40 seconds to 60 seconds.¹¹

None of the water-accident helicopters was equipped with a helicopter emergency flotation system (HEFS), which is designed to keep the helicopter level and the cabin above the water line. Despite the advantages of a HEFS in a water accident, when deployed the system has obstructed cockpit hatches.¹²

U.S. helicopter aerial fire fighting safety might be improved by better human-error management, crew training and experience, management of risk in low-altitude operations, aircraft maintenance and ergonomic design for external-load operations.♦

References and Notes

- 1. Bushey, Chuck. "Wildland Fire/Aircraft Firefighter Fatalities in the United States Compared with Ground Based Firefighter Fatalities." In *Proceedings of the First Canada/U.S. Wildland Fire Safety Summit, Rossland, British Columbia, Canada, 29 Sep.–2 Oct. 1997.* Fairfield, Washington, U.S.: International Association of Wildland Fire, 1997.
- 2. U.S. Department of Agriculture. Aviation Accident and Incident Trend Study. Letter to the Director, Fire and Aviation Management. A special report prepared at the request of the U.S. Forest Service. March 1996.

- For more information on fixed-wing aerial fire fighting operations, see: Veillette, Patrick R. "Crew Error Cited as Major Cause of U.S. Aerial Fire Fighting Accidents." *Flight Safety Digest* Volume 18 (April 1999): 1–18.
- 4. U.S. Federal Aviation Administration (FAA). Advisory Circular (AC) 00–1.1, *Government Aircraft Operations*, April 19, 1995.
- 5. FAA. AC 20–132, Public Aircraft, Dec. 21, 1988.
- 6. FAA AC 61-13B, *Basic Helicopter Handbook*, describes settling with power as follows: "This condition of flight is sometimes described as settling in your own [main-rotor] downwash. It involves high vertical rates of descent, and the addition of more power produces an even greater rate of descent."
- 7. FAA AC 90-87, *Helicopter Dynamic Rollover*, describes dynamic rollover as follows: "During normal or slope takeoffs and [slope] landings with some degree of bank angle or side drift with one skid/wheel on the ground, the bank angle or side drift can place the helicopter in contact with the ground. ... If a roll rate is permitted to develop, a critical bank angle (the angle between the helicopter and the horizon) may be reached where roll cannot be corrected, even with full lateral cyclic, and the helicopter will roll over onto its side."
- Lyman, E.G.; Orlady, H.W. Fatigue and Associated Performance Decrements in Air Transport Operations. U.S. National Aeronautics and Space Administration (NASA) Contract Report NAS-210060. A special report prepared at the request of NASA. 1980.
- For more information on helmets, see: Rash, C.E. et al. "Helmets with Visors Protect Helicopter Crews, Reduce Injuries." *Helicopter Safety* Volume 24 (November– December 1998): 1–6.
- 10. Tipton, M.J. "The Initial Responses to Cold Water Immersion." *Clinical Science* Volume 77: 581–588.
- 11. Tipton, M.J. et al. "A Simple Emergency Underwater Breathing Aid for Helicopter Escape." *Aviation Space and Environmental Medicine* Volume 66: 206–211.
- 12. Vrynwy-Jones, P.; Turner, J.M. A Review of Royal Navy Helicopter Accidents, 1972–1984. Report no. 648. A special report prepared at the request of the U.K. Royal Air Force. 1988.

About the Author

Patrick R. Veillette, a professional pilot with more than 11,000 flight hours, flies de Havilland DHC-6 Twin Otter and Shorts

SD-3 Sherpa airplanes in aerial fire fighting operations. Veillette earned a bachelor's degree in aeronautical engineering at the U.S. Air Force Academy and a doctorate in civil engineering at the University of Utah. He has conducted several research projects on cockpit automation and human error in high-risk environments. Veillette has an air transport pilot certificate and is a former U.S. Federal Aviation Administration designated pilot examiner.

Further Reading From FSF Publications

FSF Editorial Staff. "Helicopter Loses Power After Exhausting Fuel Supply During External-load Operation." *Helicopter Safety* Volume 23 (May–June 1998): 1–3.

Mohler, Stanley R. "Pilot Fatigue Manageable, But Remains Insidious Threat." *Human Factors & Aviation Medicine* Volume 45 (January–February 1998): 1–6. FSF Editorial Staff. "Pilot Asphyxiated by Headset Cable After Surviving Failures of Seat and Harness." *Helicopter Safety* Volume 23 (July–August 1997): 1–8.

FSF Fatigue Countermeasures Task Force. "Principles and Guidelines for Duty and Rest Scheduling in Corporate and Business Aviation." *Flight Safety Digest* Volume 16 (February 1997): 1–11.

Harris, Joel S. "Helicopter Impacts River After Smoke Disorients Pilot During Fire-fighting Operations." *Helicopter Safety* Volume 22 (November–December 1996): 1–4.

Harris, Joel S. "For Helicopter Pilots, Managing Stress Is Part of Flying Safely." *Helicopter Safety* Volume 21 (January– February 1995): 1–6.

Engelsman, Keith. "Enter At Own Risk (The Height/Velocity Diagram)." *Helicopter Safety* Volume 16 (September–October 1990): 1–4.

Appendix

Helicopter Accidents During U.S. Aerial Fire Fighting Operations, 1974–1998

Date	Location	Helicopter Type	Helicopter Damage	Injuries
July 10, 1974	Wasatch National Forest, Utah	Sikorsky S-55T	substantial	5 serious
The tail-rotor dri helicopter rotate	ve shaft was severed during cruise flight in gust d 2.5 turns to the left, descended through a 46,	ty wind conditions, at a high g 000-volt power line and lande	pross weight and at a ed hard.	high density altitude. The
Aug. 8, 1975	Challis National Forest, Idaho	Bell 206B	substantial	none
The helicopter resoon enough to	olled onto its right side during takeoff. The repor prevent the dynamic rollover (caused by a roll ra	t said that the pilot failed to re ate that developed while one	ecognize the severity skid was still in cont	y of the takeoff bank angle act with the ground).
July 18, 1976	Modoc National Forest, California	Bell 205A	substantial	3 serious; 4 minor
Rotor speed deo struck trees duri	creased for unknown reasons while the helicoptoing the autorotative landing.	er was being flown approxima	ately 100 feet above	a ridge line. The helicopter
Aug. 17, 1976	Snoqualmie National Forest, Washington	Hughes 500C	substantial	none
The helicopter w was drawn into t	vas on the ground, with the rotors turning, when the main-rotor system. A rotor blade was damag	a passenger attempted to the ged and had to be replaced.	row an object to a fe	llow employee. The object
Aug. 22, 1976	Willamette National Forest, Oregon	Bell 206B	destroyed	2 serious
When the pilot r deflection of the	educed airspeed to about 26 knots (48 kilomete anti-torque pedals had no effect. The helicopter	ers per hour) on final approacl r completed about 20 full rota	h, the helicopter beg tions before striking	an rotating right. Full the ground.
July 24, 1977	Angeles National Forest, California	Bell 205; Bell 212	destroyed	1 fatal; 1 serious; 2 minor
The helicopters frequencies wer maneuvered to l	were approaching a helibase after dropping wat e saturated, and the pilots had difficulty commu land.	ter on a fire at night. Both pilo nicating with the helibase ma	ots were using night- nager. The helicopte	vision goggles. Radio rs collided while being
Aug. 27, 1977	Black Hills National Forest, South Dakota	Hughes 500C	substantial	3 serious
The crew was so autorotative land	earching for a reported fire when the engine lost ding.	t power because of a hot-sec	tion failure. The helic	opter struck trees during the
Oct. 14, 1977	Gifford, Washington	Aerospatiale SA-316	substantial	none
The engine faile struck a floating	d because of fuel contamination. The pilot atten log boom and sank in five feet (1.5 meters) of v	npted an autorotative landing vater.	on the shore of a rea	servoir, but the helicopter

Date Helicopter Type Helicopter Danage Injuries June 22, 1978 Toyabe National Forest, Navada Bel 2089 substantial none The pict began = precautionary landing because of excessive turbine-outlet temperature. The engine flamed out at about 150 feet. The min-noto bladkes severed the fail boom during the hard landing. June 2, 1979 Plumes National Forest, California Acrospatiale SA-315B substantial none The value table on the temperature. The engine flamed out at about 150 feet. The inhibitor on the ground. None The temperature. The temperature. The engine flamed out at about 150 feet. The minimum constrained to profit on the one when the helicopter are the at the temperature on set. The piot and as attemp tight turn downhill, to oxid a ridge abaed. and the helicopter settled. The rotors struck tall trees, but the helicopter was fluebale and took of with the grounding cable still attached. The cable was drawn into the main-rotor system and struck the main rotor, tall rotor and horizonial stabilizer. Serious The bictopter sub temp (Down 150 feet (46 meter); above trees when the engine failed because of a locee nut on the high pressure fuel line. The helicopter sub temp (Down 150 feet (46 meter); above trees when the engine failed because of a locee nut on the high pressure fuel line. The helicopter struck trees, rolled and struck the ground on its right side. Serious Series 1.3 1980 San Bernardino National Forest, California Bel 2068-3 substantial none The helicopte	Helicopter	Accidents During U.S. Aerial	Fire Fighting Opera	tions, 1974	1–1998 (continued)
Unite 22, 1978 Toyabo National Forest, Nevada Bell 206B substantial none The pilot began a precoutionary landing because of excessive turbine-outlet temperature. The engine flamed out at about 150 feet. The min-rotor blades servered the tabout food feet. The min-rotor blades servered the tabout food feet. The min-rotor blades servered the tabout food feet. The min-rotor blades struck a treetop, and the helicopter spun to the ground. June 2, 1979 Plumeas National Forest, California Aerospatiale SA-315B substantial none The value-facit Action food feet on group the helicopter arrived at the drop site. The pilot made a steep right turn downhill, to avoid a ridge ahead, and the helicopter system and struck the man rotor. Table add the drop settine protocol filot operform an adequate prelipt timpection after the helicopter continued flying. Aug. 7, 1979 Salmon National Forest, Utah Bell 2061 substantial none The helicopter adequate prelipt timpection after the helicopter continued flying. Aug. 7, 1979 Salmon National Forest, Utah Bell 2061. substantial solm one The helicopter struck trees, role and struck the ground on its right side. Sept. 22, 1079 Henna National Forest, California Bell 2065 substantial finor Alog 7, 1979 Henna National Forest, California Bell 2068 substantial finor Sept. 22, 1079 <td< th=""><th>Date</th><th>Location</th><th>Helicopter Type</th><th>Helicopter Damage</th><th>Iniuries</th></td<>	Date	Location	Helicopter Type	Helicopter Damage	Iniuries
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The helicopter was being maneuvered for landing when a gusting left crosswind was encountered at approximately 20 feet. The main rotor was damaged when it struck a tree, but the pilot was able to land the helicopter.July 26, 1983Fort Howes, MontanaHughes 500CsubstantialnoneThe pilot made a precautionary landing on a concrete helipad because of an approaching thunderstorm. The two forward main-rotor blades were tied to the helicopter, but the helicopter was not tied to the helicopter was substantially damaged when it was blown off the helipad by strong winds.July 29, 1983Summerville, South CarolinaHughes 269CsubstantialnoneThe helicopter was being flown 20 feet (six meters) over timberland when the engine lost power. The helicopter rolled over during the forced landing. Postaccident examination of the piston engine revealed lead fouling of all eight spark plugs.noneOct. 20, 1983McAdams, MississippiBell 206BsubstantialnoneThe pilot said that, because of terrain and obstacles, his attention was diverted during an aerial-ignition flight in support of a controlled- burning operation. After completing the burn operation, he saw that about three gallons (11 liters) of fuel remained. The engine flamed out about a quarter mile (a half kilometer) from the landing area, and a hard landing occurred.noneOct. 28, 1983Lolo National Forest, MontanaBell 206BsubstantialnoneA ground signalman was in a poor location to monitor tail-rotor clearance and was not able to give accurate directions to the pilot as he lifted off in a confined area. The tail rotor struck a pine tree. The external load was not jettisoned.2 seriousFeb. 15, 1984Waldo,	June 17, 1983	Gila National Forest, New Mexico	Aerospatiale SA-315B	substantial	none
July 26, 1983Fort Howes, MontanaHughes 500CsubstantialnoneThe pilot made a precautionary landing on a concrete helipad because of an approaching thunderstorm. The two forward main-rotor blades were tied to the helicopter, but the helicopter was not tied to the helipad. The helicopter was substantially damaged when it was blown off the helipad by strong winds.July 29, 1983Summerville, South CarolinaHughes 269CsubstantialnoneThe helicopter was being flown 20 feet (six meters) over timberland when the engine lost power. The helicopter trainantion of the piston engine revealed touling of all eight spark plugs.noneOct. 20, 1983McAdams, MississippiBell 206BsubstantialnoneThe pilot said that, because of terrain and obstacles, his attention was diverted during an aerial-ignition flight in support of a controlled- burning operation. After completing the burn operation, he saw that about three gallons (11 liters) of fuel remained. The engine flamed out about a quarter mile (a half kilometer) from the landing area, and a hard landing occurred.substantialnoneQct. 28, 1983Lolo National Forest, MontanaBell 206BsubstantialnoneA ground signalman was in a poor location to monitor tail-rotor clearance and was not able to give accurate directions to the pilot as he lifted off in a confried area. The tail rotor struck a pine tree. The externate load was not jettisoned.substantial2 seriousFeb. 15, 1984Waldo, FloridaHiller UH-12Esubstantial2 seriousDuring a flight in support of a controlled-burning operation, a fire erupted in a supply of incendiary devices stored in front of the seats. The pilot lost control of t	The helicopter wa was damaged whe	s being maneuvered for landing when a gusting en it struck a tree, but the pilot was able to land	left crosswind was encountered the helicopter.	at approximately	/ 20 feet. The main rotor
The pilot made a precautionary landing on a concrete helipad because of an approaching thunderstorm. The two forward main-rotor blades were tied to the helicopter, but the helicopter was not tied to the helipad. The helicopter was substantially damaged when it was blown off the helipad by strong winds. July 29, 1983 Summerville, South Carolina Hughes 269C substantial none The helicopter was being flown 20 feet (six meters) over timberland when the engine lost power. The helicopter rolled over during the forced landing. Postaccident examination of the piston engine revealed fouling of all eight spark plugs. none Oct. 20, 1983 McAdams, Mississippi Bell 206B substantial none The pilot said that, because of terrain and obstacles, his attention was diverted during an aerial-ignition flight in support of a controlled-burning operation. After completing the burn operation, he saw that about three gallons (11 litters) of fuel remained. The engine flamed out about a quarter mile (a half klometer) from the landing area, and a hard landing occurred. Oct. 28, 1983 Lolo National Forest, Montana Bell 206B substantial none A ground signalman was in a poor location to monitor tail-rotor clearance and was not able to give accurate directions to the pilot as the lifted off in a confined area. The tail rotor struck a pine tree. The extremal load was not jettisoned. substantial 2 serious Puing a flight in support of a controlled-burning operation, a fire erupted in a supply of incendiary devices stored in front of the seats. The pilot lost contro	July 26, 1983	Fort Howes, Montana	Hughes 500C	substantial	none
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Oct. 20, 1983McAdams, MississippiBell 206BsubstantialnoneSubstantialSubstantialNoneSubstantialSubstantialSubstantialSubstantialSubstantialSubstantialSubstantialSubstantialOct. 28, 1983Lolo National Forest, MontanaBell 206BsubstantialA ground signalmar was in a poor location to monitor tail-rotor tail-rotor tail-rotor struck a pine tree. The externational under the externation of the substantialsubstantialFeb. 15, 1984Waldo, FloridaHiller UH-12EsubstantialDuring a flight in support of a controlled-burning operation, a fire erupted in a supply of incendiary devices stored in front of the seats. The pilot lost control was area after delivering supplies to firefighters, the helicopter struck down was area field elivering supplies to firefighters, the helicopter struck down was area of the power lives as the power live struck down was area the power live struck down was area of the power live struck down was area of the power live struck down was area the power live struck down was area of the power live struck down was area the power live struck down was area of the power live struck down was area the power live struck down was area of the power live struck down was area the power live struck down was area of the power live struck down	The helicopter wa landing. Postaccid	s being flown 20 feet (six meters) over timberla lent examination of the piston engine revealed l	nd when the engine lost power. T ead fouling of all eight spark plug	he helicopter roll gs.	led over during the forced
The pilot said that, because of terrain and obstacles, his attention was diverted during an aerial-ignition flight in support of a controlled- burning operation. After completing the burn operation, he saw that about three gallons (11 liters) of fuel remained. The engine flamed out about a quarter mile (a half kilometer) from the landing area, and a hard landing occurred.Oct. 28, 1983Lolo National Forest, MontanaBell 206BsubstantialnoneA ground signalman was in a poor location to monitor tail-rotor clearance and was not able to give accurate directions to the pilot as he lifted off in a confined area. The tail rotor struck a pine tree. The external load was not jettisoned.substantial2 seriousFeb. 15, 1984Waldo, FloridaHiller UH-12Esubstantial2 seriousDuring a flight in support of a controlled-burning operation, a fire erupted in a supply of incendiary devices stored in front of the seats. The pilot lost control of the helicopter during an attempted landing on a road.Bell 206BsubstantialnoneMay 13, 1984Palmer, AlaskaBell 206BsubstantialnoneWhile returning to the staging area after delivering supplies to firefighters, the helicopter struck unmarked power lines 85 feet (26 meters) above a valley. Although the pilot had flown numerous trips to area the group to struck unmarked power lines 85 feet (26 meters)	Oct. 20, 1983	McAdams, Mississippi	Bell 206B	substantial	none
Oct. 28, 1983Lolo National Forest, MontanaBell 206BsubstantialnoneA ground signalmar was in a poor location to monitor tail-rotor clarance and was not able to give accurate directives to the pilot as he lifted off in a confined area. The tail rotor struck a pine tree. The externational was not jettisoned.substantial2 seriousFeb. 15, 1984Waldo, FloridaHiller UH-12Esubstantial2 seriousDuring a flight in support of a controlled-burning operation, a fire area.erupted in a supply of incendiary devices stored in front of the seats. The pilot lost control of the helicopter during an attempted landing or a road.Bell 206BsubstantialnoneMay 13, 1984Palmer, AlaskaBell 206BsubstantialnoneWhile returning to the staging area after delivering supplies to firefighters, the helicopter struck unmarked power lines 85 feet (26 meters) above a valley. Although the pilot had flown numerous trips to are from the staging area the previous day, he was not aware of the power lines.	The pilot said that burning operation about a quarter m	because of terrain and obstacles, his attention After completing the burn operation, he saw the ile (a half kilometer) from the landing area, and	n was diverted during an aerial-ig hat about three gallons (11 liters) a hard landing occurred.	nition flight in su of fuel remained	pport of a controlled- . The engine flamed out
A ground signalman was in a poor location to monitor tail-rotor clearance and was not able to give accurate directions to the pilot as he lifted off in a confined area. The tail rotor struck a pine tree. The external load was not jettisoned. Feb. 15, 1984 Waldo, Florida Hiller UH-12E substantial 2 serious During a flight in support of a controlled-burning operation, a fire erupted in a supply of incendiary devices stored in front of the seats. The pilot lost control of the helicopter during an attempted landing on a road. May 13, 1984 Palmer, Alaska Bell 206B substantial none While returning to the staging area after delivering supplies to firefighters, the helicopter struck unmarked power lines 85 feet (26 meters) above a valley. Although the pilot had flown numerous trips to and from the staging area the previous day, he was not aware of the power lines.	Oct. 28, 1983	Lolo National Forest, Montana	Bell 206B	substantial	none
Feb. 15, 1984Waldo, FloridaHiller UH-12Esubstantial2 seriousDuring a flight in support of a controlled-burning operation, a fire erupted in a supply of incendiarysubstantial2 seriousMay 13, 1984Palmer, AlaskaBell 206BsubstantialnoneWhile returning to the staging area after delivering supplies to firefighters, the helicopter struck unmarked power liness5 feet (26 meters)above a valley. Alth-ugh the pilot had flown numerous trips to and from the staging area the previous day, he was not aware of the power	A ground signalma	an was in a poor location to monitor tail-rotor cl rea. The tail rotor struck a pine tree. The extern	earance and was not able to give al load was not jettisoned.	accurate direction	ons to the pilot as he lifted
During a flight in support of a controlled-burning operation, a fire erupted in a supply of incendiary devices stored in front of the seats. The pilot lost control of the helicopter during an attempted landing on a road. May 13, 1984 Palmer, Alaska Bell 206B substantial none While returning to the staging area after delivering supplies to firefighters, the helicopter struck unmarked power lines 85 feet (26 meters) above a valley. Although the pilot had flown numerous trips to and from the staging area the previous day, he was not aware of the power lines.	Feb. 15, 1984	Waldo, Florida	Hiller UH-12E	substantial	2 serious
May 13, 1984Palmer, AlaskaBell 206BsubstantialnoneWhile returning to the staging area after delivering supplies to firefighters, the helicopter struck unmarked power lines 85 feet (26 meters) above a valley. Although the pilot had flown numerous trips to and from the staging area the previous day, he was not aware of the power lines.	During a flight in s pilot lost control of	support of a controlled-burning operation, a fire f the helicopter during an attempted landing on	erupted in a supply of incendiary a road.	devices stored i	n front of the seats. The
While returning to the staging area after delivering supplies to firefighters, the helicopter struck unmarked power lines 85 feet (26 meters) above a valley. Although the pilot had flown numerous trips to and from the staging area the previous day, he was not aware of the power lines.	May 13, 1984	Palmer, Alaska	Bell 206B	substantial	none
	While returning to above a valley. Alt lines.	the staging area after delivering supplies to fire hough the pilot had flown numerous trips to and	efighters, the helicopter struck un d from the staging area the previo	marked power lir ous day, he was r	nes 85 feet (26 meters) not aware of the power

Helicopte	r Accidents During U.S. Aeria	I Fire Fighting Opera	ations, 197	4–1998 (continued)
Date	Location	Helicopter Type	Helicopter Damage	Injuries
Aug. 1, 1984	Cleveland National Forest, California	Bell 206B	substantial	none
After the helicopt the helicopter en support ring rem	er completed a water drop, the water bucket be countered a downdraft. The water bucket then s oved from the bucket.	gan to move back and forth. The truck the tail boom. The water bu	pilot reduced air ucket had been a	rspeed; at the same time, ttached with the upper
Aug. 22, 1984	Nez Perce National Forest, Idaho	Bell 206B-3	substantial	1 fatal
A cable was misi communication b when the helicop prevented his es	outed around a helitorch barrel and became fou etween the pilot and a ground crewmember we ter rolled right and yawed right. The ground crew cape. He was struck and killed by the tail rotor.	Iled when the barrel was lifted. Wre inadequate. The ground crewn wmember then attempted to mov	'isual communica nember was atte /e away from the	ation and verbal empting to clear the cable helicopter, but obstacles
July 16, 1985	Payette National Forest, Idaho	Bell 206B-3	substantial	none
After picking up v The wires were o	vater, the helicopter struck unmarked wires and lepicted on hazard maps.	descended into the Salmon Rive	er. The pilot did r	not jettison the water bucket.
Aug. 4, 1985	Los Padres National Forest, California	Aerospatiale SA-316B-1	substantial	1 serious
The pilot failed to tree, and the heli	maintain adequate separation from obstruction copter descended to the ground. The bucket wa	ns during a water drop. The main s not jettisoned.	rotor disintegrat	ed upon contact with an oak
Aug. 9, 1985	Winthrop, Washington	Aerospatiale SA-316B	destroyed	1 fatal
The helicopter wait in the tail-rotor sy	as flown at an excessive airspeed while towing a /stem and the main-rotor system.	a 100-foot (31-meter) cable with	a cargo hook. Th	ne cable became entangled
Aug. 18, 1985	Boise National Forest, Idaho	Bell 206B-3	substantial	none
The pilot and a c	rewmember misjudged clearance at a landing s	ite. The main-rotor blades struck	a tree during the	e landing.
Sept. 3, 1985	Boise National Forest, Idaho	Bell 205	substantial	2 serious
The pilot attempt came to rest inve	ed a downwind landing in a helicopter that was rted.	too heavy to land at the cargo-d	elivery site. The I	helicopter struck trees and
Oct. 10, 1985 The helicopter's with a helitorch s	Mount Hood National Forest, Oregon fuel system was contaminated with water. The e till attached. The main-rotor blades struck the ta	Hiller (Soloy) UH-12E ngine failed on takeoff. The helic il boom and several small trees.	substantial copter struck the	1 minor ground in a level attitude,
Jan. 8, 1986	Brewton, Alabama	Hughes 269A	substantial	1 minor
The helicopter ware exhaustion.	as being flown at a low altitude in support of a c	ontrolled-burning operation whe	n the engine lost	power because of fuel
Feb. 4, 1986	Council, North Carolina	Hughes 269B	substantial	1 serious
During a controll autorotative land	ed-burning operation, the engine failed because ing.	of a connecting-rod fracture. Th	e helicopter stru	ck trees during the
Aug. 4, 1986	Watson, Oklahoma	Bell 206B	substantial	1 serious
The pilot experie apparatus. On ta The helicopter st	nced problems with a fire-dispensing apparatus keoff, a cable from the apparatus caught on the ruck trees and terrain.	slung beneath the helicopter. He right skid. The pilot lost control o	e landed the heli of the helicopter of	copter and released the during a climbing right turn.
Dec. 3, 1986	Glendora, California	Bell 206B	substantial	4 minor
During a controll struck telephone	ed-burning operation, the pilot completed a fire- wires and tumbled down a steep embankment.	lighting pass along the side of a The helitorch was not released u	ridge and began until ground impa	to climb. The helicopter act was imminent.
July 15, 1987	El Dorado National Forest, California	Bell 206L-1	substantial	5 minor
The helicopter was had insufficient a struck a tree.	as 430 pounds (195 kilograms) heavier than the nti-torque control, and the helicopter began to t	hover-out-of-ground-effect weig urn right. The pilot added power	ht limit. During a to go around, bu	shallow approach, the pilot t the main-rotor blades
July 22, 1987	Shasta, California	Bell 206B-3	substantial	none
The pilot was cor main-rotor blades	nducting a hovering approach with a full bucket s. The pilot jettisoned the bucket and landed the	load when the helicopter struck helicopter.	power lines, subs	stantially damaging the
Sept. 8, 1987	Six Rivers National Forest, California	Hughes 500D	substantial	none
The pilot was una the main-rotor bla	able to release water from a bucket because of a des struck trees. The pilot released the bucket	an electrical malfunction. The he and flew the helicopter back to b	licopter then encoase.	countered a downdraft, and

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Date	Location	Helicopter Type	Helicopter Damage	Iniuries
Sept. 23, 1987	Shasta. California	Bell 212	substantial	none
The main-rotor blancreased. The pil	ades struck trees during a water-drop operation ot then conducted a precautionary landing. Ins	The pilot continued flying the pection revealed delamination of	helicopter until a of the main-rotor b	vibration began and plades.
Oct. 6, 1987	Nez Perce National Forest, Idaho	Bell 206B-3	substantial	none
The helicopter wa	is on short-final approach to Selway Lodge Airs	strip when the main-rotor blades	s struck a thin, un	marked wire.
March 3, 1988	Olympic National Forest, Washington	Bell 206B-3	substantial	none
The pilot was flyir mmediately jettis	ng lower than normal during a controlled-burnin oned the helitorch.	g operation when the helitorch	struck a tree at at	bout 20 feet. The pilot
July 22, 1988	Bridger, Wyoming	Bell 206B-3	none	1 serious
A crewmember w was obstructed by crewmember jum	as trying to unload shovels jammed in the carg y a rain-spotted windshield, believed that he ha ped to the ground as the pilot executed a right	o compartment when the helicc d received a takeoff signal, but turn.	opter began to lift the marshaller ha	off. The pilot, whose vision d signaled him to hold. Th
Aug. 8, 1988	Deschutes National Forest, Oregon	Bell 212	substantial	1 serious
The pilot lost tail- during the autorot	rotor control when an empty bucket slung unde tative landing. The external load was not jettison	r the helicopter struck the tail-ronned.	otor drive shaft. Th	ne helicopter struck trees
Aug. 17, 1988	Bridger, Wyoming	Bell 212	none	none
The pilot heard a lluminated. The p	loud rushing noise before rotor speed decrease ilot shut down the engine and landed the helico	ed and the engine-failure light a opter at an airport.	and the engine-fire	e light for the no. 2 engine
Aug. 25, 1988 The pilot conduct	Helena National Forest, Montana ed an autorotative landing after the engine com	Bell 205A pressor failed in flight.	substantial	none
Sent 9 1988	Entiat Washington	Bell 204B	destroyed	2 fatal
The helicopter str and the helicopter copilot, who was	uck terrain for unknown reasons while flying a r broke up while being flown in strong gusty wir making his first flight in type and his first flight f	water bucket to a fire. There wa nd conditions and mountain-way or the company, was the pilot fl	is evidence that the vertice conditions. Evid ying.	e main-rotor mast fracture dence indicated that the
Sept. 14, 1988	Challis National Forest, Idaho	Bell 212	minor	none
he pilot conduct	ed an autorotative landing after the transmissio	n failed during a water-bucket o	operation.	
Sept. 20, 1988	Shoshone National Forest, Colorado	Bell 206B	substantial	none
Contrary to the m bucket was attach nelicopter to roll le	anufacturer's instructions, the water bucket was ned 180 degrees out of phase with the actuator. eft on takeoff and come to rest inverted in 10 fe	s installed with the data-plate in Strands of wire draped over th et (three meters) of water.	nstructions facing the heel of the left s	the wrong direction. The skid and caused the
lune 25, 1989	Ellensburg, Washington	Bell UH-1B	substantial	1 minor
The pilot was setti otated out of cont	ng an empty water bucket on the ground when th rol. The pilot jettisoned the bucket while attemptir	e engine lost power for undetern ng to regain control. The helicopt	mined reasons. The er struck the bucke	e helicopter descended and et and rolled onto its left sid
uly 8, 1989	Susanville, California	Sikorsky S-58T	substantial	1 minor
he helicopter en ettisoned the buc	tered an uncommanded left yaw in swirling win ket and began a descent. The pilot was unable	ds during an approach to a wat to arrest the descent during the	ter drop. The pilot e flare, and the he	dumped the water, elicopter landed hard.
ug. 3, 1989	Payette National Forest, Idaho	Bell 206B-3	substantial	none
he pilot's vision bservation flight	was obstructed by smoke and by the setting su The helicopter began to spin and then hit trees	n as he maneuvered the helico s.	pter within confine	ed spaces during an
ug. 9, 1989	Boise National Forest, Idaho	MDD MD-500D	substantial	none
Ouring an infrared elicopter struck	d-reconnaissance mission, the engine failed be a treetop during the autorotative landing.	cause of a corrosion-induced fa	ailure of the pneur	natic-control tube. The
Aug. 14, 1989	Payette National Forest, Idaho	Bell 205A-1	substantial	none
he pilot pulled th occurred. The eng	ne water bucket from a lake and was transitionir gine then flamed out. The skids were damaged	ng from a hover to forward flight during the autorotative landing.	t when several en	gine-compressor stalls

Date	Location	Helicopter Type	Helicopter Damage	Injuries
Oct. 22, 1989	Ogilvie, Minnesota	Hughes 369HS	substantial	none
The pilot was dro anding in a swar	pping a sling load when the engine failed for npy area.	or undetermined reasons. The h	nelicopter rolled over d	luring an autorotative
June 21, 1990	Klamath National Forest, California	Bell 206L-3	substantial	4 serious
The engine failed anding site. The	l for undetermined reasons during initial clin skids and airframe were damaged during a	nb. Rotor speed decreased wh hard autorotative landing.	en the pilot turned the	helicopter toward a suitable
June 28, 1990	Los Padres National Forest, California	Sikorsky S-62A	substantial	1 minor
The helicopter wa	as being flown in dense smoke during a wat	er-drop operation when the en	gine lost power for une	determined reasons.
July 1, 1990	Coronado National Forest, New Mexico	Sikorsky S-58ET	substantial	none
The pilot aborted he ground. The h anding at the he	a landing when the helicopter encountered nelicopter was within the hover-in-ground-ef lispot (temporary landing area).	I a gust at about five feet. The t fect weight limits but was not w	ail rotor struck a tree, /ithin the hover-out-of-	and the helicopter spun to ground-effect limits for
Aug. 13, 1990	Bieber, California	Bell UH-1B	substantial	1 serious
The pilot was slo able to release th	wing the helicopter for a water drop on risin the water before the helicopter struck the gro	g terrain when the helicopter ya und.	awed right and began	to settle. The pilot was not
Sept. 14, 1990	White River National Forest, Colorado	Aerospatiale SA-315B	substantial	none
During an approa when they struck	ach to an unimproved landing area, the pilot a tree.	was distracted by a passenge	r's question. The main	-rotor blades were damage
Sept. 17, 1990	Stanislaus National Forest, California	Bell 204B	substantial	none
he helicopter be y trees. The pilo	egan to spin to the right when the pilot cond t released the bucket and conducted an aut	ucted a vertical climb after fillir corotative landing. The tail boor	ng the water bucket fro n was damaged when	m a small pond surrounded it struck a fence post.
uly 13, 1991	Payette National Forest, Idaho	Bell 206L-3	substantial	none
The helicopter er blades struck the	ncountered a strong downdraft on short-fina tail boom.	I approach to pick up firefighte	rs. The helicopter land	ed hard, and the main-roto
luly 24, 1991	Provencal, Louisiana	Bell 47D-1	substantial	none
The pilot was ma Irained from the	neuvering the helicopter for a controlled-bu fuel-cell-sump-drain valve because of failur	rning operation when the engir e or premature deterioration of	ne failed because of fu the valve.	el exhaustion. Fuel had
luly 26, 1991	Stanislaus National Forest, California	Bell 206L-1	destroyed	1 fatal
Ouring a landing otor lift. The heli	approach out of ground effect, the helicopte copter descended, struck trees and impacte	er descended into the vortices ad nose down.	created by its main-rot	or blades and lost main-
Sept. 4, 1991	Sierra National Forest, Colorado	Bell 212	substantial	1 minor
he helicopter er out the helicopter	ncountered a strong downdraft while droppir r descended and struck the ground.	ng water on a fire. The pilot app	blied full power and jet	tisoned the external load,
Oct. 18, 1991	Panhandle National Forest, Idaho	Bell AH-1G	substantial	2 serious
The pilot was fillinaid that he relea	ng the water bucket from a lake when a mai used the water but was not certain whether t	n-transmission-component fail the bucket was released before	ure caused loss of taile the helicopter descer	rotor effectiveness. The pile nded into the lake.
April 9, 1992	Manteo, California	Kaman HH-43F	substantial	none
Strong gusts cau relicopter. During	sed the pilot to reject four landings on an al the fifth landing attempt, a main-rotor blad	uminum mat on sloping terrain e struck one of the helicopter's	with a water bucket su vertical stabilizers.	uspended from the
uly 29, 1992	Wallowa, Oregon	Bell 206L-3	substantial	1 serious
The pilot was how oss of power. Th	vering the helicopter over a pond to refill the e external load was not jettisoned. The μ hel	water bucket when a cracked icopter descended into the por	engine-pneumatic-cor nd, and the pilot swam	trol line caused a partial to shore.
Aug. 3, 1992	Challis National Forest, Idaho	Bell 205A-1	substantial	7 serious
Fatigue cracking approach. Rotor	that originated from a manufacturing defect speed decreased, and the helicopter desce	in the second-stage power tur nded rapidly to the ground.	bine caused the engin	e to lose power during an
Aug. 12, 1992	Los Padres National Forest, California	Bell 204B	substantial	1 minor
When the engine sitting in the left s	lost power because of cracks in the power seat of the helicopter to observe the long-lin	turbine section, the pilot was une operation; the remote extern	nable to release the e al-load release switch	xternal load because he wa cannot be reached from th

Helicopter	Accidents During U.S. Aerial	Fire Fighting Opera	tions, 1974	4–1998 (continued)
Data	Location	Helicopter Type	Helicopter	Injurios
			Damage	Injunes
Aug. 27, 1992 The engine-combi collapsed, and the performed in com	North Platte, Nebraska ining-gearbox drive shaft failed during liftoff, cau a main-rotor blades struck the ground. The gear pliance with an airworthiness directive.	Sikorsky S-581 Jsing loss of power and loss of di box drive shaft had been marked	substantial rectional control incorrectly, and	none The right-main gear maintenance had not been
June 30, 1993	Agoura Hills, California	Bell 206L-3	destroyed	1 minor
The helicopter wa improperly wired a	s on the ground with the rotors turning at flight i aerial-ignition device. The helicopter was destro	idle when incendiary devices inac yed by fire.	dvertently were o	lispensed from an
July 27, 1993	Tonto National Forest, Arizona	Bell 206B-3	substantial	1 serious
The pilot was fillin	g a bucket with water when the tail-rotor blades	struck the lake surface and the t	ail boom separa	ted.
June 10, 1994	Lincoln National Forest, New Mexico	Bell 204B	substantial	none
The pilot was fillin installed improper	g a bucket with water from a portable tank when ly. The tail boom struck the tank.	n the engine lost power because	a fuel-control-ac	tuator rod had been
July 1, 1994	Coronado National Forest, New Mexico	Bell 206B-3	destroyed	1 serious
The pilot was how and descend. The and burned.	ering the helicopter to position a sling load on a sling load, suspended from a 50-foot (15-meter	ridgetop when a strong gust was r) line, jammed in a rock outcropp	encountered. T bing. The helicop	he helicopter began to turn ter then struck the slope
July 8, 1994	Lincoln National Forest, New Mexico	Sikorsky S-64	substantial	none
A snorkel (a tube- helicopter to begin	like device) was being used to fill the helicopter a vertical bouncing motion that increased in in	's tank with water from a pond. M itensity. The tail rotor was damag	lud ingested by t ed when it struck	he snorkel caused the the water.
July 12, 1994	Gila National Forest, New Mexico	Bell 206L-3	destroyed	3 fatal; 1 serious
The pilot made a to hover out of gro	downwind approach to offload firefighters on a p ound effect. The helicopter struck trees and rolle	pinnacle at 9,520 feet. He then lo d down a steep slope.	st control of the	helicopter while attempting
July 29, 1994	Superior, Montana	Bell 212	substantial	none
The pilot was mar helicopter to an ai	neuvering to fill a bucket with water from a river rport, released the external load and hovered w	when the helicopter struck wires /hile mechanics inspected the he	at about 100 fee licopter for dama	t. The pilot flew the age.
Aug. 1, 1994	Leander, Louisiana	Hughes 269A	substantial	none
The helicopter wa rod bolts in the no	s being flown at 100 feet during a controlled-bu . 1 cylinder. The helicopter touched down hard o	rning flight when the engine lost during the autorotative landing.	power because o	of failure of the connecting-
Aug. 17, 1994	Klamath National Forest, California	Bell 206B-3	substantial	1 minor
The helicopter wa rotor. Loss of anti-	s on approach to a helispot when a piece of the torque control and severe vibration necessitate	e cabin headliner, held in place by d an immediate landing.	/ Velcro strips, de	etached and struck the tail
Aug 21, 1994	Nez Perce National Forest, Idaho	Bell 212	minor	none
The pilot was mar external load and	neuvering the helicopter for a water drop when a landed the helicopter.	one engine failed because of inte	rnal damage. Th	e pilot released the
Sept. 1, 1994	Libby, Montana	Sikorsky S-64F	substantial	2 minor
The water-tank-qu through a snorkel was slow, and the	antity indicator was malfunctioning, and the cre The crew stopped the water transfer and began crew was not able to dump water or jettison the	ew was not certain whether lake wan flying away from the lake. Contr e tank. Rotor speed decreased, a	vater was being ol response was nd the helicopte	loaded into the tank s sluggish and rate of climb r descended into the lake.
Sept. 1, 1994	Kootenai National Forest, Montana	Bell 206L-3	substantial	none
During short-final normal preflight in	approach, the tail-rotor drive shaft was severed spection. The pilot conducted emergency proce	by a disconnected antenna-lead edures and landed the helicopter.	coupling that co	ould not be seen during a
Sept. 6, 1994	Clearwater National Forest, Idaho	Bell 206B-3	substantial	none
The pilot lost posi returned to the he	tional awareness while concentrating on a wate lispot without further incident.	r drop, and the rotor blades struc	k trees. The pilot	t dumped the water and
Sept. 23, 1994	Payette National Forest, Idaho	Boeing Vertol CH-47D	destroyed	1 fatal; 4 serious
The helicopter wa and the helicopter	s touching down when the tail rose slightly in th flipped over onto its back. A front-rotor blade s	e air with the front landing gear of truck the fuselage and killed the f	on the ground. Th light engineer.	ne tail then rose rapidly,

July 30, 1995 Wenatchee National Forest, Washington Bel 20EL-3 substantial none The pilot had to fly toward the setting sun to conduct an approach into the wind and over the lowest obstacles. The main-rotro blades struck at tree. Image: Struct Action Action Struct Action Action	Date	Location	Helicopter Type	Helicopter Damage	Injuries
The plot had to fly toward the setting sun to conduct an approach into the wind and over the lowest obstacles. The main-rotor blades struck ree. After landing, the plot inspected the main-rotor blades and decided to resume the mission. During a flat, fast departure, the plot misjudged clearance, and the helicopter struck a tree. If the leading town upslope and downwind — and at near-maximum gross weight for hover out of ground effect — the helicopter began to bettle. The plot unsuccessfully attempted to jettison the water load and reverse course. The helicopter settled line trees in the fire area. Nug, 19, 1996 Umatilia National Forest, Oregon Bell UH-1H substantial none The helicopter was approaching the fire zone when either the light-control system or the hydralic system malfunctioned for undetermined easons and rotor speed decreased. The plot dropped the water but did not jettison the bucket. The helicopter landed hard, collapsing the kitds, and rolled over. Sept. 4, 1996 Sheridan, Wyoming Bell 206L-3 substantial nnone The plot latempted to recover by entering an autorotation, but the helicopter struck trens blore he could regain control. Sept. 13, 1996 St. Regis, Montana Bell 206B-3 substantial none The plot latempted to recover by entering an autorotation, but the helicopter struck wires, and the plot lated grade. So that the owater null functioned, and he was unable to drop the water on a fire. He then attempted to place the bucket on allocad grade. So that the could in the bucket over and empty the water. The main-rotor blades struck wires, and the plot landed the elicopter struck trees, rolled inverted and descended to the ground. Sup 116, 1997 Canderwood, Tannessee Bell 204B destroyed none The helicopter was being flown over a river to fill the bucket when the engine lost power because of a transmission-coupling failure. During he autorotative landing on the rive tank, the helicopter struck trees, rolled inverted and descended to the ground. Sup 1, 51, 1997 Lake Tanke, California Bell 204B destroyed 1	luly 30, 1995	Wenatchee National Forest, Washington	Bell 206L-3	substantial	none
June 18, 1996 Pagosa Springs, Colorado Bell 212 substantial 1 minor While being flown: upslope and downwind — and at nearm canximum gross weight for hover out of ground effect— the helicopter began to settlet. The pilot unscreassfully attempted to jettison the water load and reverse courses. The helicopter settled into trees in the first area. Nag. 19, 1996 Umatilla National Forest. Oregon Bell UH-1H substantial none The helicopter was approaching the firs zone when either the flight-control system or the hydraulic system maltenectioned for undetermined easons and rotry speed decreased. The pilot distribution trees in the bucket. The helicopter load at not effect or subtantial none Bepl 14, 1996 Sheridan, Nyoming Bell 206L-3 substantial none The pilot sets tail-rotor control while maneuvering the helicopter for a water drop in high winds and turbulence. The helicopter began to spin. The pilot satist that the water bucket maluncioned, and he was unable to drop the water on a fire. He than attempted to place the bucket or and analyze the water on a fire. He than attempted to place the bucket or and analyze the unable to drop the water on a fire. The the initiand grade. April 16, 1997 Caldenwood, Tennessee Bell 204B destroyed 1 fatal the helicopter was being flown over a niver to fill the bucket when the engine failed for undetermined reasons. The helicopter was in autorotative flight when i intruck a slope. 1 fatal 1 serious </td <td>The pilot had to fly ree. After landing misjudged clearan</td> <td>v toward the setting sun to conduct an approace the pilot inspected the main-rotor blades and ice, and the helicopter struck a tree.</td> <td>th into the wind and over the lo decided to resume the mission</td> <td>west obstacles. Th n. During a flat, fas</td> <td>e main-rotor blades struck t departure, the pilot</td>	The pilot had to fly ree. After landing misjudged clearan	v toward the setting sun to conduct an approace the pilot inspected the main-rotor blades and ice, and the helicopter struck a tree.	th into the wind and over the lo decided to resume the mission	west obstacles. Th n. During a flat, fas	e main-rotor blades struck t departure, the pilot
While being flown upsiges and downwind — and at near-maximum gross weight for howre out of ground affect — the helicopter began to subter. The helicopter settled into trees in the fire area. Way, 19, 1996 Umatilia National Forest, Oregon Bell UH-11H substantial none The helicopter was approaching the fire zone when either the flight-control system or the hydraulic system malfunctioned for undetermined easons and rotor speed decreased. The plot dropped the water but did not jettison the bucket. The helicopter landed hard, collapsing the kikes, and rolide vor. Sept. 4, 1996 Sheridan, Wyoming Bell 2061-3 substantial nmor The plot last tail-rotor control while maneuvering the helicopter struck terrain before he could regain control. substantial none Struct 13, 1996 St. Regis, Montana Bell 206B-3 substantial none The plot additional the water bucket malfunctioned, and he was unable to drop the water on a fire. He then attempted to place the bucket on allored grade, so that he could in the bucket over and empty the water. The main-rotor blades struck wires, and the plot landed the ellocopter was being flown over a river to fill the bucket when the engine flox power because of a transmission-coupling failure. During he autorotative landing on the river bank, the helicopter struck trees, rolled inverted and descended to the ground. take Uh (5, 1997 San Bernardino National Forest Bell 206L-1 destroyed 1 fatal	lune 18, 1996	Pagosa Springs, Colorado	Bell 212	substantial	1 minor
ugg 19, 1996 Umatilia National Forest, Oregon Bell UH-1H substantial none The helicopter was approaching the fire zone when either the flight-control system or the hydraulic system malfunctioned for undetermined asons and rotors speed decreased. The pilot dropped the waterware build dn ot jettison the bucket. The helicopter land, collapsing the kile zone when either the flight-control system or the hydraulic system malfunctioned for undetermined asons and rotor speed decreased. The pilot bots the bucket. The helicopter struck terrain before he could rot. Sept. 1, 1996 S. heridan, Wyoming Bell 206B-3 substantial 1 minor The pilot tast termined to recover by entering an autorotation, but the helicopter struck terrain before he could ropian control. Sept. 13, 1996 St. Regis, Montana Bell 204B-3 substantial none Fier pilot said that the water bucket ower and empty the water. The main-rotor blades struck wires, and the pilot landed the elicopter on the railroad grade. None April 16, 1997 Calderwood, Tennessee Bell 204B destroyed 1 fatal The pilot sabout to drop water on a fire when the engine failed for undetermined reasons. The helicopter was head water and sance and	While being flown settle. The pilot un	upslope and downwind — and at near-maximusuccessfully attempted to jettison the water lo	um gross weight for hover out o ad and reverse course. The he	of ground effect — licopter settled into	the helicopter began to trees in the fire area.
he helicopter was approaching the fire zone when either the flight-control system or the hydraulic system mailfunctioned for undetermined easons and rotor speed decreased. The pilot dropped the water but did not jettison the bucket. The helicopter landed hard, collapsing the kids, and rolled over. Sept. 4. 1996 Sheridan, Wyoming Bell 206L-3 substantial 1 minor he pilot attempted to recover by entering an autorotation, but the helicopter struck terrain before he could regain control. Sept. 13, 1996 St. Regis, Montan Bell 206B-3 substantial none he pilot attempted to recover by entering an autorotation, but the helicopter struck terrain before he could regain control. Sept. 13, 1996 St. Regis, Montan Bell 206B-3 substantial none he pilot staid that the water bucket mailunctioned, and he was unable to drop the water on a fire. He them attempted to place the bucket on alicopt or as being flown over a niver to fill the bucket when the engine lost power because of a transmission-coupling failure. During he autorotative lending on the niver bank, the helicopter struck tress, rolled inverted and descended to the ground. uly 6, 1997 San Bernardino National Forest Bell 206L-1 destroyed 1 fatal he pilot was about to drop water on a fire when the engine failed for undetermined reasons. The helicopter was heing flown over a niver to fill the the engine failed for undetermined reasons. Uly 24, 1998 Reklaw, Taxas Bell 206L-3 substantial serious he pilot tanticate atops. Uly 24, 1998 Reklaw, Taxas Bell 206L-3 substantial none he pilot was the helicopter struck the water when the helicopter rolled that the water. Evidence indicated that the bucket cable ha ecome draped across the left skid. Uly 24, 1998 Reklaw, Taxas Bell 206L-3 substantial none he pilot was filting a bucket from the water when the helicopter rolled left and struck the water. Evidence indicated that the bucket cable ha ecome draped across the left skid. Uly 24, 1998 Reklaw, Taxas Bell 206L-3 substantial none he pilot was filting a bucket trom the wa	ug. 19, 1996	Umatilla National Forest, Oregon	Bell UH-1H	substantial	none
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The plict lost tail-rotor control while maneuvering the helicopter for a water drop in high winds and turbulence. The helicopter began to spin. The pilot attempted to recover by entering an autorotation, but the helicopter struck terrain before he could regain control. Sept. 13, 1996 St. Regis, Montana Bell 206B-3 substantial none he pilot stail that the water bucket malfunctioned, and he was unable to drop the water on a fire. He then attempted to place the bucket on aliroad grade, so that the could tip the bucket over and empty the water. The main-rotor blades struck wires, and the pilot landed the elicopter on the railroad grade. April 16, 1997 Calderwood, Tennessee Bell 204B destroyed none The helicopter was being flown over a river to fill the bucket when the engine lost power because of a transmission-coupling failure. During he autorotative landing on the river bank, the helicopter struck trees, rolled inverted and descended to the ground. Wild, 1997 San Bernardino National Forest Bell 206L-1 destroyed 1 fatal The pilot was about to drop water on a fire when the engine failed for undetermined reasons. The helicopter was in autorotative flight when it truck a slope. Way, 15, 1997 Lake Tahoe, California Bell UH-11H substantial 1 serious The pilot lifted off the lake, transitioned to forward flight and then realized that the helicopter would not clear trees ahead. He attempted to urn, and the helicopter struck the water and sank. Way 24, 1998 Reklaw, Texas Bell 206L-3 substantial none he pilot usiliting a bucket from the water when the helicopter rolled left and struck the water. Evidence indicated that the bucket cable ha decome draped across the left skid. Way 8, 1998 Juntra, Oregon Bell 212 substantial none 'he pilot was filling a bucket with water from a cattle tank when the helicopter began to settle. The pilot believed that the helicopter was etting in the vortices created by its main-rotor blades, and he initiated a descent. When he attempted to blades struck is a tree branch. Wa	Sept. 4, 1996	Sheridan, Wyoming	Bell 206L-3	substantial	1 minor
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The pilot said that the water bucket malfunctioned, and he was unable to drop the water on a fire. He then attempted to place the bucket on alitrad grade, so that he could tip the bucket over and empty the water. The main-rotor blades struck wires, and the pilot landed the elicopter on the railroad grade. wpril 16, 1997 Calderwood, Tennessee Bell 204B destroyed none The helicopter was being flown over a river to fill the bucket when the engine lost power because of a transmission-coupling failure. During the autorotative landing on the river bank, the helicopter struck trees, rolled inverted and descended to the ground. uly 6, 1997 San Bernardino National Forest Bell 206L-1 destroyed 1 fatal he pilot was about to drop water on a fire when the engine failed for undetermined reasons. The helicopter was in autorotative flight when in truck a slope. 1 serious ung, 15, 1997 Lake Tahoe, California Bell UH-1H substantial 1 serious ne, and the helicopter struck the water and sank. uly 24, 1998 Reklaw, Texas Bell 206L-3 substantial none he pilot was ilifting a bucket from the water from a cattle tank when the helicopter rolled left and struck the water. Evidence indicated that the bucket cable ha ecome draped across the left skid. none he pilot was lifting a bucket from the acatter from a cattle tank when the helicopter pagn to settle. The pilot beliewed that the helicopter was etiling in the vortices created by its main-rotor blades, and he initiated a descent.	sept. 13, 1996	St. Regis, Montana	Bell 206B-3	substantial	none
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