NIOSH

HELICOPTER LOGGING SAFETY

Alaska Interagency Working Group for the Prevention of Occupational Injuries

U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

HELICOPTER LOGGING SAFETY

Edited by
Michael L. Klatt, M.S.

Alaska Interagency Working Group for the Prevention of Occupational Injuries

and

Alaska Field Station, Division of Safety Research,
National Institute for Occupational Safety and Health

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

July 1998

DISCLAIMER

Sponsorship of the Helicopter Logging Safety Workshops and this document by the Alaska Interagency Working Group for the Prevention of Occupational Injuries, and the National Institute for Occupational Safety and Health (NIOSH) does not constitute endorsement of the views expressed or recommendations for use of any commercial product, commodity, or service mentioned. The opinions and conclusions expressed in the papers are those of the authors and not necessarily those of the Working Group or NIOSH.

Recommendations are not to be considered as final statements of the Working Group's or NIOSH's policy or of any agency or individual who was involved. They are intended to be used in advancing the knowledge needed for improving worker safety and health.

Copies of this and other NIOSH documents are available from:

Publications Dissemination, EID
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, OH 45226-1998

Fax number: (513) 533-8573
Telephone number: 1-800-35-NIOSH (1-800-356-4674)
E-mail: pubstaft@cdc.gov

To receive other information about occupational safety and health problems, call 1-800-35-NIOSH (1-800-356-4674), or visit the NIOSH Home Page on the World Wide Web at http://www.cdc.gov/niosh

DHHS (NIOSH) PUBLICATION No. 98-147

FOREWORD

During the 18-month period between January 1, 1992, and June 30, 1993, there were six helicopter crashes associated with helicopter logging operations in Alaska, resulting in nine fatalities and ten severe non-fatal injuries. As there were only an estimated 25 helicopters and 50 pilots flying in helicopter logging operations in Alaska at that time, these surveillance data showed that Alaska helicopter logging pilots had an extraordinarily high crash rate of 16% annually, and a catastrophic fatality rate of 5,000/100,000/year for that interval of time. On July 8, 1993, we convened an emergency meeting of the Alaska Interagency Working Group for the Prevention of Occupational Injuries. The Working Group developed consensus safety recommendations and assisted in implementing immediate improvements in the oversight of this industry. This intervention was relatively successful: since then, through year-end 1997, there has been one additional crash, with one fatality, from helicopter logging in Alaska.

The importance and application of the work presented in this document extends beyond Alaska. For the 2,000 pilots in this nation (according to Federal Aviation Administration data) who are certified to conduct external load operations such as "heli-logging," work often means not only flying the helicopter, but also conducting many complex tasks simultaneously for up to ten hours per day for up to ten consecutive days. At times, as has occurred in Alaska, highly repetitive lift/transport/drop cycles have been conducted at or beyond maximum aircraft capacity in remote areas where rugged forest terrain, extremely steep mountain slopes, and adverse weather conditions prevail. As a result, helicopter flying conditions are frequently unfavorable for successful autorotation of single engine helicopters in the event of engine failure or loss of power. Under these conditions, and when combined with poor equipment maintenance, flight components and equipment as well as pilot judgement have been known to fail with tragic regularity.

This is a workforce at potentially very high risk for work-related traumatic injury or death. Protecting these workers from occupational injury and death, and assisting this expanding industry to operate safely, will undoubtedly require a unified effort by all who can effect prevention. Toward that end, the Working Group convened the Helicopter Logging Safety Workshops in 1995, 1996, and 1997, in Ketchikan, Alaska. This volume incorporates proceedings and recommendations from each of the Workshops, as well as useful background materials on safety in this industry. By bringing together workers, industry, and government agencies, the Working Group hopes to continue to make progress in preventing further injury and death in the helicopter logging industry. We are very pleased that the Helicopter Association International is also providing leadership in making this industry safer.

This publication marks a step forward in documenting problems that have received little attention in the past. It adds to what has been written about prevention of injury and death in the helicopter logging industry. We hope this document proves helpful in planning prevention efforts and in the further refinement of helicopter logging practices.

Linda Rosenstock, M.D., M.P.H.
Director

PREFACE

The Alaska Interagency Working Group for the Prevention of Occupational Injuries was convened by the National Institute for Occupational Safety and Health (NIOSH) (in parallel with its establishment of a research field station in Alaska), the Alaska Department of Health and Social Services (AKDHSS), and the Alaska Department of Labor (AKDOL). The Working Group was created to provide a forum for the federal, state, municipal and other public agencies responsible for worker safety to meet and exchange pertinent information in order to improve the working conditions of Alaskan workers.

The Working Group first met in March 1991, during the Alaska Governor's Safety and Health Conference and has met at a minimum of semi-annually since its inception. Member agencies are as follows:

AKDHSS

AKDOL

Alaska Federal Safety and Health Council

Alaska Health Project

Alaska Marine Safety Education Association (AMSEA)

Alaska Safety Advisory Council

Federal Aviation Administration (FAA)

Governor's Safety and Health Conference

Indian Health Service (IHS)

Mine Safety and Health Administration (MSHA)

Municipality of Anchorage (MOA)

National Transportation Safety Board (NTSB)

NIOSH

Occupational Safety and Health Administration (OSHA)

United States Coast Guard (USCG)

United States Forest Service (USFS)

University of Alaska Anchorage (UAA)

In July 1993, NIOSH requested an emergency meeting of the Working Group to address surveillance findings interpretable as representing an epidemic of helicopter logging-related fatalities. Agencies in attendance at this meeting were AKDHSS, AKDOL, FAA, NIOSH, NTSB, OSHA, USCG and USFS. The series of events that led up to this meeting and the Working Group's recommendations can be found in a Morbidity and Mortality Weekly Report article entitled "Risk for Traumatic Injuries from Helicopter Crashes During Logging Operations - Southeastern Alaska, January 1992-June 1993" (Appendix).

The Working Group collaborated with NIOSH and industry leaders in convening the Helicopter Logging Safety Workshops in Ketchikan, Alaska, on March 1-2, 1995, February 28-29, 1996, and March 6, 1997. Furthermore, the helicopter logging industry is fortunate that the Helicopter Association International's Helicopter Logging Committee is now carrying the torch and focusing the combined energy of its members on improving safety in the industry.

Michael L. Klatt, M.S.
Public Health Advisor, Alaska Field Station
Division of Safety Research
National Institute for Occupational Safety and Health

Jan C. Manwaring, B.S.
Occupational Safety and Health Specialist, Alaska Field Station
Division of Safety Research
National Institute for Occupational Safety and Health

George A. Conway, M.D., M.P.H.
Chief, Alaska Field Station
Division of Safety Research
National Institute for Occupational Safety and Health

CHAPTER III
FLIGHT AND GROUND CREW

CHAPTER IV
SAFETY TRAINING

CHAPTER V
HELICOPTER LOGGING FROM MANAGEMENT'S PERSPECTIVE

CHAPTER VI
OVERSIGHT OF HELICOPTER LOGGING

CHAPTER VII
PREVENTING, SURVIVING AND INVESTIGATING CRASHES

CHAPTER VIII
HELICOPTER ASSOCIATION INTERNATIONAL

APPENDIX

ACKNOWLEDGMENTS

Convening the Helicopter Logging Safety Workshops was a team effort as was preparing this document. In addition to the planning committee, the presenters and the session moderator, we wish to thank the following staff and editorial advisors for their diligent work at the Helicopter Logging Safety Workshops, and for their help in the preparation of this document.

Foremost in our appreciation, we thank Mr. Jan Manwaring for his lead role in securing the speakers for the Workshops and developing the agendas. He is also to be commended for the excellent job he did in refining and clarifying the final recommendations.

We also thank Ms. Linda Ashley, who has worked with dedication and superb attention to detail in all phases of the publication of *Helicopter Logging Safety*. She is responsible for the completeness of this document.

Thanks are given to Ms. Jennifer Lincoln for preparing many of the graphics. We are also very grateful to Rick Kelly's expert support with computer hardware and software.

To the contributors, a special thanks is extended for their review of the transcripts of their respective presentations and for their responsiveness to every question.

Thanks to Joyce Spiker, Linda Morton, Paul Keane and Herb Linn, of the Division of Safety Research for all of their efforts in preparing this document for publication.

EXECUTIVE SUMMARY

by Michael Klatt

The Alaska Interagency Working Group for the Prevention of Occupational Injuries convened three Helicopter Logging Safety Workshops in Ketchikan, Alaska, on March 1-2, 1995, February 28-29, 1996, and March 6, 1997. The purpose of the Helicopter Logging Safety Workshops was to increase awareness, build coalitions, share information and experiences, and encourage action to prevent injury in the helicopter logging industry. This executive summary encapsulates *Helicopter Logging Safety.*

INTRODUCTION AND BACKGROUND

Mr. George Warren, Vice-President of Safety, Columbia Helicopters Inc., provided a "History of Helicopter Logging" (3/6/97). His research found that it was in the early 1970s when helicopters developed the capability to carry sufficient payloads to make helicopter logging economically feasible. Many new developments in the late 1960s from power line construction with helicopters were used to make helicopter logging safer. The most critical development was a new hover technique called direct visual operational control (leaning out and looking down at the load) that could be substituted for the conventional technique of using a horizontal reference and taking directions from someone else to maintain the helicopter's position.

Dr. George Conway, Chief, Alaska Field Station, Division of Safety Research, NIOSH, presented "Epidemiology and Prevention of Helicopter Logging Injuries" (3/1/95). Dr. Conway began by briefly discussing the six recent helicopter logging crashes in Alaska that resulted in these workshops being convened. The epidemiological analysis of these events demonstrated the following: an annual crash rate of 16% for Alaska logging helicopters; one death annually for every four logging helicopters that were in service; and an annual fatality rate for logging helicopters pilots of approximately 5,000 per 100,000 per year (or one in 20 of the pilots were killed per year). He went on to state that the investigation revealed that all six crashes involved improper operations and/or maintenance practices. The successful intervention for this problem in 1993 is described, along with the major recommendations made and implemented.

Mr. Jan Manwaring, Occupational Safety and Health Specialist, Alaska Field Station, Division of Safety Research, NIOSH, presented "Epidemiology and Prevention of Helicopter External Load Accidents" (3/1/95). The NTSB data showed the severity of the helicopter crash injuries to be much greater with heli-logging than with all other external load operations. The same data showed heli-logging crashes in Alaska to be evenly divided between maintenance error and pilot error, and that maintenance error is much more a factor in Alaska than the rest of the U.S. He concluded that to minimize the hazards of helicopter logging, pilots need better training; helicopters and equipment need improved design, as well as more frequent and intensive maintenance; and operators must adhere to existing regulations and manufacturer recommendations.

EQUIPMENT AND MAINTENANCE

Mr. Roy Fox, Product Safety Chief, Bell Helicopter Textron, Inc., addressed "Helicopter Logging Safety: Manufacturer's Concerns" (3/1/95). He stated that operators with good safety records tend to own their own aircraft, operate and maintain them properly, use approved parts, and ensure adequate

rest for their employees; conversely, operators with poor safety records tend to exceed operating parameters, use salvage and/or surplus parts, and fly in bad weather. Military surplus helicopters have a poor safety record because once in use as surplus they tend to be cheaply maintained, attract surplus, counterfeit and salvaged parts, and are doing jobs with poor economic prospects. A poorly capitalized operation will tend to use overworked and under-qualified pilots. He further stated that abusive use beyond what the helicopter was designed for causes in-flight part failures. He stressed that to reduce risk, operators should use helicopters and parts designed for the environment; follow the manufacturer's maintenance and operating requirements; allow adequate rest for the flight and maintenance personnel; not use military surplus aircraft or parts; and never exceed the external load limit.

Mr. Steve Daniels, Manager, Commercial Aviation Operations, Kaman Aerospace, discussed "New Helicopter Technology" (2/29/96). He highlighted the design, components, and capabilities that newly-built aircraft should have to meet today's helicopter logging needs for lighter, second-growth timber. He emphasized the following: achieve maximum lift with minimum horsepower; simplify fuselage design; reduce the number of systems; increase visibility; and install, as standard equipment, monitoring systems (engine, transmission and power train), energy-attenuating seats, worker-friendly shoulder harnesses, collapsible cyclics, and crash-resistant fuel systems.

Mr. Randy Erwin, Chief Pilot, Erickson Aircrane, presented "Helicopter Adaptations for External Load Operations" (3/1/95). It is his opinion that long-line logging may be the most unique application for the helicopter and that external load and vertical reference skills are the most demanding in the helicopter industry. Bubble windows, outside instruments, load cells that tell the pilot how much weight is on the hook, left hand seats, remote hooks that allow the pilot to control what's going on at the end of the hook, and logging shocks are examples of adaptations to helicopters that have made helicopter logging safer. He asserted, "You can't do this business without being safe and efficient, because it's just too expensive."

Mr. Bruce Conn, Manager, Out-of-Production Aircraft Program, Sikorsky Aircraft, discussed "Health and Usage Monitoring Systems" (2/29/96). Health and usage monitoring systems (HUMs) installed in logging helicopters could provide a wealth of useful data for operators and manufacturers alike. Analysis of HUMs data during overhaul would help to more accurately determine what safe-life should be for components when operated at different stress levels. Therefore, HUMs are cost-effective because they contribute positively to the "safety equals productivity equals dollars" equation.

Mr. Dale Hoke, Owner, Aerial Crane Systems, Inc., presented "Alternative Aerologging Techniques" (3/1/95). He described an aerial crane system consisting of an aerostat tethered to four light weight lines, each controlled by a winch. The prototype proved to be extremely easy to operate with great proficiency. He also found that the prototype couldn't be over-torqued, over-extended or tipped over and that the long-line hook assembly was very stable. It could be operated at night, in fog and at about a quarter of the cost of an equivalent-sized helicopter. For these reasons, and the fact that it can be operated from the ground, this aerial crane system may prove to be much safer and less expensive than helicopter logging in certain yarding operations.

Mr. Ron Smith, Maintenance Foreman, Erickson Aircrane, addressed "Helicopter Maintenance in Helicopter Logging Operations"(3/1/95). He pointed out that finding qualified mechanics for helicopter maintenance is extremely difficult; therefore, most training is conducted on-site. Because helicopter logging is such an arduous task, stress from the constant vibration shows up on just about everything

on the aircraft, necessitating frequent and thorough inspections. Logging with helicopters tends to identify the weak areas in an aircraft's design; therefore, Erickson Aircrane mitigated or eliminated many of the design flaws resulting in dependable logging helicopters that can fly for prolonged periods reliably. These modifications are shared with other operators. Although a lack of trained inspectors is a weak link in the industry, when maintenance is a company-wide priority, everybody contributes to overall safety.

Mr. Phil Kemp, Director, Maintenance, Silver Bay Logging, shared his perspectives on "Helicopter Maintenance Management" (2/29/96). They key to maintenance in helicopter logging is proactive maintenance — fixing problems before they occur. Proactive maintenance is dependent upon highly qualified, dedicated and self-motivated mechanics. Also very important in helicopter logging is customized maintenance that focuses on the "problem areas" of the aircraft. Eliminating or lessening the effects of "problem areas" through customized maintenance will go a long way to help in achieving the operating goals of increasing the safety, the availability and the profitability of the helicopter.

FLIGHT AND GROUND CREW

Mr. Mark Lindamood, Chief Pilot, Carson Helicopters, shared his views on "Helicopter Logging from a Pilot's Perspective" (3/1/95). He described the crashes and injuries he has experienced and listed the names of several pilots killed in single-engine helicopter crashes. He noted that, on the other hand, the large, twin-engine helicopters with two engines, two inputs, two servo systems, two electrical systems, two fuel systems and two pilots were designed to carry heavy external loads safely. If one power plant fails in a twin-engine helicopter, a safe landing can be achieved with the remaining one. Having two pilots increases safety dramatically by reducing pilot fatigue and by allowing one pilot to fly and the other to perform all the other required tasks. It was the presenter's opinion that, "Single-engine helicopters must be prohibited from performing external load work."

Mr. Jim Neal, Safety Manager, Aerial Forest Management Foundation, presented "Helicopter Logging from a Ground Crewman's Perspective"(3/1/95). It is his opinion that from a ground crewman's perspective, helicopter logging is the safest form of logging in the woods. He stated that everybody out there has visual and radio contact with the yarding engineer or pilot at all times and nothing moves until the pilot permits it. He further stated that if the helicopter logging industry doesn't want government to impose new rules and regulations upon it, then it must police itself, and that the people with the answers to this industry's problems are attending this workshop.

Dr. Robert Bertoldo, Flight Surgeon, United States Air Force, spoke on the "Operational and Aircrew Factors in Helicopter Application"(3/1/95). He stated emphatically that helicopters are inherently deadly. According to NTSB data, helicopters have a crash rate 15 times that of all other aircraft. However, the United States Air Force is of the opinion that by applying existing technology, 95% of the current helicopter crashes could be survivable. He went on to state that wind is the number one weather-related cause of helicopter crashes and that fog, low ceiling and rain are the primary causes of fatal crashes. There are three determinants of pilot performance: ability, personality, and attitude. Basically, there is no substitute for pilot experience, but even with experience, there's a need to keep coming back to the basic airmanship skills.

Mr. George Warren, Vice-President of Safety, Columbia Helicopters, Inc., discussed "Human Factors" (2/29/96). The workload in a logging helicopter can be intense. "If you're working a pumpkin patch

that's a quarter mile away form the landing, and you're cranking out 25 to 30 turns an hour, it's pretty hard to divide your attention between what's going on in the unit, en route, on the landing, and in the cockpit." Comparing a logging helicopter pilot with an airplane pilot, the workload on the helicopter pilot is much higher, because, for example, a logging helicopter pilot makes as many takeoffs and approaches in one day as an airplane pilot does in one month.

SAFETY TRAINING

Mr. Larry Benner, Ground Crew Trainer, International Heli-Logging Training Institute, explained his company's "Safety Training Programs" (3/6/97). Historically, the helicopter logging industry has conducted its training on the job, and, unfortunately, safety has taken a back seat to production. To remedy this problem, a first-of-its-kind safety training program has been developed that provides classroom and on-site training prior to an employee working in the woods under a helicopter. He also emphasized the need for ongoing training for existing personnel.

Mr. Roger Lansden, Safety Training Coordinator, Columbia Helicopters, Inc., described his company's "Ground Crew Safety Training" (2/28/96). This helicopter logging company has trainers that conduct one-on-one training with new employees who are evaluated at 2, 4, 6 and 8 weeks. Seasoned employees are also provided training when given new job assignments and when new substances, processes, procedures or equipment are introduced to the workplace and pose potential new hazards.

Mr. Paul Mavrinak, Chief Pilot, Erickson Aircrane, described his company's "Flight Crew Safety Training" (2/28/96). This helicopter logging company is convinced that the most effective method to instill proper flight safety standards and practices is through its mentoring program. Senior training captains fly with the other pilots and assess them monthly on safety, attitude, airmanship, aircraft systems knowledge, aircraft power management, hook work, long-line ability, and pilot performance.

HELICOPTER LOGGING FROM MANAGEMENT'S PERSPECTIVE

Mr. George Warren, Vice-President of Safety, Columbia Helicopters, Inc., presented his views on "The Business of Helicopter Logging" (3/1/95). He pointed out that one of the essential aspects of efficient helicopter logging is safety. The cost of operating large helicopters is enormous, and can come as quite a shock to operators of small and intermediate-sized aircraft, who try to extrapolate their costs and operating experience with smaller machines up to logging-size helicopters. The reality is that helicopter logging is a marginal endeavor, with profit margins averaging a few percent. The crucial ingredients to the success of their industry have been the willingness of an innovative management to commit resources on a long-term basis to make heli-logging safe and effective.

Mr. Tim Harper, Risk Manager, Erickson Aircrane, shared his thoughts on "Risk Management" (2/28/96). A personal injury has direct costs (i.e., medical and compensatory) and indirect costs (e.g., time lost from work, loss of earning power, economic loss to family, lost time by fellow workers, loss of efficiency due to breakup of crew, and lost time by supervisor), and these costs don't even consider damaged equipment. Therefore, safety in helicopter logging equals productivity which equals profit.

Mr. Jim Neal, Safety Manager, Aerial Forest Management Foundation, shared his expertise on "Setting Up the Job" (2/28/96). When setting up the job with safety as a priority, divide up the helicopter

logging crew into four categories: cutters, woods crew, landing crew and pilots. Then look at safety issues in three ways for each crew category: for each individual's safety, how the individuals in each crew work together safely, and finally how to put the different crews and work phases together to work safely as a whole unit.

Mr. Larry Maloney, Broker, Caledonian Insurance Group, and Mr. Don Milani, Assistant Vice President, Sedgwick Inc., discussed "Insurance Companies' Perspectives" (2/28/96). The only thing insurers have to go on to determine premiums is what's happened in the past; therefore, the insurance underwriters are looking for a proven track record. One solution to high insurance premiums is to educate the insurance industry about helicopters and helicopter logging. As a general statement, the more safely equipment is operated, the lower the cost of insurance. Using good insurance rates to get operators to work safely is far more effective than imposing additional rules and regulations.

Mr. J. P. Johnston, National Helicopter Program Officer, U.S. Forest Service, shared his thoughts on "The Use of Logging Helicopters from a Forest Service Perspective" (2/28/96). About a decade ago the Forest Service began to appreciate the logging helicopter as a viable and economical tool for wildfire protection. The reasons logging helicopters have become such important firefighting tools are as follows: the fleet is strategically placed throughout the national forest system, the crews are experienced mountain flyers, and the pilots possess premier vertical reference skills and extraordinary long-line abilities.

OVERSIGHT OF HELICOPTER LOGGING

The Honorable John Hammerschimdt, Member, National Transportation Safety Board, provided an overview of the "National Transportation Safety Board" (2/28/96) and an "NTSB Update" (3/6/97). The NTSB is an independent federal investigative agency that, in many respects, is considered to be the watchdog of the FAA. Because of the concerns that surfaced from NTSB accident investigations and from operators' comments at the NTSB Aviation Safety in Alaska Forums, the NTSB study of aviation safety in Alaska included a recommendation to the FAA for it to review the maintenance programs of helicopters used in logging and to develop prescribed service life limits and overhaul times on engines, airframe parts, and components as necessary to provide an adequate margin for safety.

Mr. Rick Barnett, Certification Engineer, Federal Aviation Administration, presented "FAA Aircraft Certification" (2/28/96). When talking about safety, it has to be recognized that the helicopter logging environment is harsh. Also, it must be recognized that none of today's helicopters (except for the Kaman 1200) were designed by the manufacturers for use in logging operations. Helicopter overload operations of as little as 10 percent can reduce critical life and wear limits by 50 percent or more.

Mr. Matt Thomas, Aviation Safety Inspector, FAA, gave an account of "FAA Aviation Safety Inspections" (3/6/97). FAA has recently earmarked specific funds to improve the safety of helicopter logging; therefore, Alaska FSDOs will increase the number of notice and no-notice site visits. This is extremely advantageous, because FAA has the ability to address safety issues in an immediate fashion.

Mr. Ron Tsunehara, Compliance Officer, Occupational Safety and Health Administration, presented "Occupational Safety and Health Administration" (2/28/96). In the area of standards, the states must adopt standards that are at least as stringent as federal standards. There are no specific standards for helicopter logging; however, there is one FAA standard that applies to helicopter and one OSHA standard that applies to logging. Both standards are really minimal standards.

Mr. Don Study, Former Director, Labor Standards and Safety, Alaska Department of Labor discussed "Regulations and Standards in External Load Operations" (3/1/95). He stressed that although bad operators may crash themselves out of business, it's the whole industry's insurance rates and reputation that are adversely affected. The Alaska Department of Labor only has jurisdiction over the ground operations, so it cannot enforce FAA regulations that apply to flight operations. It is the industry people attending this workshop who are in the best position to police or, if need be, make recommendations to the appropriate regulatory agencies to improve the safety of the industry. He stated that, after all, most of OSHA's standards and regulations were initiated by industry.

Mr. Cliff Hustead, Safety Consultant, Alaska Department of Labor, presented a talk entitled "Alaska Department of Labor" (2/28/96). Most of today's codes are performance-based; therefore, if an operator has a good safety record, inspectors probably won't scrutinize its training program. But if injuries begin to occur or increase, the inspectors are going to go over the entire operation with a fine tooth comb. In certain circumstances, rather than providing on-the-job training, it may be preferable to require certain skills as a condition of employment.

Mr. Patrick Davie, Occupational Safety Officer, Workers' Compensation Board of British Columbia (WCBBC), provided insight into "Setting the Standard, Heli-Logging in the '90s" (3/6/97). In 1996, the WCBBC reviewed heli-logging accidents and initiated further steps to address the industry. Along with employer and worker groups, it developed specific draft regulations for helicopter logging. The regulations address the root causes of most injuries that can be generally categorized under three general headings: pre-job planning, site supervision, and training. It is noteworthy that a major appendix for this volume has been supplied by the WCBBC.

PREVENTING, SURVIVING, AND INVESTIGATION CRASHES

Mr. Gary Bledsoe, Manager, Alaska Occupational Injury Prevention Program, presented the "Public Health Approach to Preventing Helicopter Logging Injuries" (3/1/95). He discussed the public health approach as it is traditionally used to control infectious diseases and how this same methodology is used in injury prevention. The injury triad of the host as the worker, the agent as the energy source, and the environment as the workplace, was explained to show the interrelationship of these three factors in preventing injuries. He explained the Time-Phase Matrix, or Haddon's Matrix, that is used to break down an injury event for analytical purposes into the pre-event, event, and post-event phases.

Mr. Phil Kemp, Maintenance Director, Silver Bay Aviation, discussed "Weather and Terrain Hazards in Helicopter Logging" (3/1/95). He stressed that although weather and terrain are separate natural features, they are inextricably combined. Most helicopter logging takes place in steep, rugged terrain, placing ground crew in increased danger and making emergency landings and rescue attempts extremely difficult. Water on rotor blades can cause erosion, and water in the fuel system can cause flame-out and power loss. Icing affects engines and rotors, degrading the performance of both. Wind affects helicopter logging both positively and negatively.

Mr. Doug Herlihy, Partner, Herlihy & Leonard, described the importance of "Developing a Pre-Accident Plan: Damage Control, NTSB, FAA, Lawyers and the Press" (2/29/96). The key points in a *written* pre-accident plan are as follows: insure medical/rescue help is en route, spread the duties among key people, organize teams before the fact, deal with the media through a single spokesperson,

guard against speculative communication, obtain "party status," protect proprietary information, plan for family support, and address damage to private property.

Mr. Roy Fox, Chief, Product Safety, Bell Helicopter Textron Inc., shared his expertise on "Crash Survival" (2/29/96). The four basic requirements to survive a crash are as follows: maintaining a livable volume throughout the crash sequence, restraining the occupant, keeping the occupant crash load within human non-injurious tolerance, and providing a means and time to escape.

Mr. Doug Herlihy, Partner, Herlihy & Leonard, presented "Investigation Findings of Helicopter Logging Crashes"(3/1/95). He described in great detail one of the logging helicopter crashes that resulted in the Helicopter Logging Safety Workshops being convened. He stated that no aircraft crash is caused by just one event; it's a causal string of events, like dominoes. NTSB crash investigators look beyond the violation of FAA regulations for the causes of aircraft crashes. From his experience he has found only three scenarios that will kill the occupants of helicopters that crash: 1) the cockpit/ cabin is penetrated or crushed; 2) the occupants are burned or asphyxiated; or 3) the occupants are exposed to g forces beyond human tolerance limits.

Mr. Doug Herlihy, Partner, Herlihy & Leonard, presented "Applying Lessons from Industry Accidents, Helicopter Logging Support: An Investigator's Perspective" (3/6/97). He recommended that all operators prepare a checklist in the event of an NTSB accident investigation that should include the following: cooperate and stay involved in all phases, keep control of all your records, obtain "party status," ensure employees have representation during interviews, follow the NTSB "flow and dissemination of the accident investigation," and submit to the NTSB your own accident investigation report.

HELICOPTER ASSOCIATION INTERNATIONAL

Mr. Glen Rizner, Vice President of Operations, Helicopter Association International (HAI), gave an overview of the organization he works for, the "Helicopter Association International (HAI)" (3/6/97). HAI began in 1948 and currently has 1,400 member organizations, of which 650 are helicopter operators that fly 4,000 helicopters about two million hours each year. Also of the 1,400, HAI has 750 associate members that include manufacturers, repair facilities, brokers, insurers, lessors, and other supporters of the industry. Currently, HAI has 21 committees of which the Helicopter Logging Committee is the newest.

Mr. Phil Kemp, Maintenance Director, Silver Bay Logging, talked about the formation and goals of the "HAI Helicopter Logging Committee" (3/6/97). It became apparent while assisting NIOSH with the second Helicopter Logging Safety Workshop that most of the participants were also members of HAI. Therefore, it made sense to organize a helicopter logging committee under an existing association rather than form some new entity. The main goal of the HAI Helicopter Logging Committee is to promote the safe operation of helicopters within the helicopter logging industry.

Mr. Michael Weaver, Caledonian Insurance Group, talked about and shared copies of the "Draft HAI Helicopter Logging Safety Manual" (3/6/97). The manual will be a generic document so operators can modify it to meet their own specific situations. The HAI Helicopter Logging Safety Manual is the industry's opportunity to set its own voluntary guidelines, to demonstrate the ability/willingness within the industry to address the safety issues, and to possibly avoid additional unwarranted regulations.

CHAPTER I
INTRODUCTION AND BACKGROUND

HISTORY OF HELICOPTER LOGGING

By George Warren, Vice President of Safety, Columbia Helicopters, Inc.

There wasn't much going on anywhere in the way of helicopter logging until about 25 years or so ago. There just weren't any available aircraft capable of a payload which could make logging viable. There had been some experimental attempts at helicopter logging. I think Okanagan Helicopters and one or two others in the late 50s or early 60s, used aircraft like the Sikorsky S-58 to haul logs and had come to the conclusion that it just wasn't economically feasible.

But in the mid to late 60s, the military and a few civilian operators began operating big helicopters capable of a more substantial payload. Though the military was using them to haul external loads, the civilian community at first used them solely to haul passengers in intra-city operations. It wasn't until around 1967 that a Sikorsky S-61 was used for external load by a U.S. operator. It was initially used in power line construction. There was quite a flurry of power line construction going on in the United States about that time. Old lines were being replaced and new ones were built. And, attempting to use the aircraft as effectively as possible, it became apparent quickly that the conventional operating techniques for using helicopters in external lift needed to be modified. The reason for that is that up until that time, the universal technique for maintaining a hover was for the pilot to monitor his position by reference to the sight picture out in front of him. He might also get supplemental information from either an outside signalman, radio man or a person in the back of the helicopter looking down at the load and telling the pilot what to do. In other words, he was sitting there looking straight ahead taking directions from somebody else on how to maintain his position. Up until then, this technique was fairly effective for the jobs then required of a helicopter. It was used a great deal in rescue, and it worked fine for hoisting people into the aircraft.

But, in power line construction, it became apparent early on that a higher level of safety, was needed. A lot of experimenting was done using closed circuit television and a lot of other methods that didn't work out too well. Operators eventually began using an entirely different hover technique which required the pilot to lean out and look down directly at the load. This radical departure from past helicopter hover procedures proved to be very effective. As a result, when the possibility of logging again presented itself, the availability the large helicopters, and the technique of leaning out and looking down at your load, helicopter logging suddenly became practical where it hadn't been in the past. The most critical of these two developments can arguably be the development of Direct Visual Operational Control (DVOC).

Picture in our own mind what it might have been like to take a large helicopter with a 200-foot line hanging under it into a logging area, with the pilot sitting upright looking out at the horizon. Imagine having to lower this line into standing trees to a hooker below prepared to hook the pilot to a turn of logs which must then be lifted clear of the trees and flown to a log landing. The advantages of the DVOC method can readily be seen. At first, the rest of the helicopter industry was extremely skeptical of DVOC, primarily, I think, because of its radical departure from conventional technique. Many

operators outside the logging industry refused to use DVOC and suggested that its use was heterodoxy and not the sort of thing a proper helicopter pilot should be doing.

As helicopter logging became more widespread and more visible to the world in general, both the operation and DVOC gained legitimacy in the eyes of the helicopter community. Indeed, helicopter logging has become an indispensable element of good forest management in sensitive areas where soil, wildlife habitat, visual resources, etc. are vulnerable to serious disturbance by conventional logging methods. No heli-logging is done without DVOC.

NIOSH is deserving of our thanks for calling attention to the need for a formal organization within the heli-logging community. Although there have been other heli-logging organizations in the past, their membership and influence has been limited. It is our hope that this committee will serve as a proper spokesperson for the industry and a source of information to the public.

Since the unfortunate accidents of a few years back, the heli-logging accident rate in Alaska has reverted to the norm. The industry continues to feel that helicopter logging, if done properly, is safe. The data for the entire industry show that.

One of the committee's primary objectives will be to promote safety. There are a number of reasons for this. Most of the major participants in helicopter logging have learned that a safe operation makes a lot of sense from a number of aspects, including economics. Any economically viable operation is inherently a safe operation. Also, it can be shown conclusively that an abiding concern for safety in the work place is an effective booster of employee morale.

Our other objective, is making the public and the industry more aware of what a good helicopter logging operation should be. You don't have to be a genius to know how critically important the public's perceptions can be. By providing a standard of good practice, this committee can encourage an attitude that will enhance stability and future growth of the helicopter logging industry.

EPIDEMIOLOGY AND PREVENTION OF HELICOPTER LOGGING INJURIES

By George A. Conway, M.D., M.P.H., Jan C. Manwaring, U.S. Public Health Service, Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research, Alaska Field Station

INTRODUCTION

To many logging companies, the helicopter represents a viable option for yarding and transporting timber recently felled in areas that are otherwise inaccessible and/or unfeasible for conventional logging (because of rugged terrain, steep mountain slopes, increasing environmental restrictions, and rising costs).[1,2,3] Because of their unique capabilities, the use of helicopters in hauling logs and recently felled trees ("helicopter logging," "helicopter long-line logging," or "heli-logging") has steadily increased in the logging industry. Unfortunately, helicopter logging in some areas, such as southeast Alaska, has been an extremely high risk operation, resulting in helicopter crashes with severe traumatic injury and death to pilots and loggers. A series of serious crashes in Alaska during 1992 and 1993 brought these operations to our attention. We believe that much can be learned from the Alaskan experience with this new technology. We present the recent experience with these operations in Alaska, followed by a summary of the larger (U.S.) experience with this rapidly expanding industry, and recommendations for prevention of injuries.

Alaska Investigative Findings

The National Transportation Safety Board (NTSB) investigated six helicopter crashes related to transport of logs by cable (long-line) that occurred in southeastern Alaska during January 1992-June 1993, and which resulted in nine worker fatalities (five loggers and four pilots) and 10 worker injuries (five loggers and five pilots) (Table 1). The following summarizes case investigations of these incidents:

Incident 1. On February 23, 1992, a helicopter crashed while transporting nine loggers. The copilot and five loggers were fatally injured; the pilot and four loggers were seriously injured. The NTSB investigation revealed that a long-line attached to the belly of the helicopter became entangled in the tail rotor during a landing approach, causing an in-flight separation of the tail section with subsequent crash.[4,5] Passenger flights with long-line and external attachments are illegal and violate industry safety standards.[6]

Incident 2. On March 6, 1992, a helicopter crashed while preparing to pick up a load of logs with a long-line while in a 200-foot hover. The pilot and copilot were seriously injured. According to the pilot and copilot, the engine failed, and the pilot immediately released the external log load and attempted autorotation.[4] NTSB investigation revealed a hole in the side of the rear section of the engine case, which had occurred when the engine failed.[4,7] Further NTSB investigation revealed fatigue failure of the compressor assembly impeller, and inadequate quality control by the manufacturer. Inadequate routine maintenance by the operator was also cited in this incident.

Incident 3. On November 10, 1992, a helicopter crashed while attempting to land at a logging site, sustaining substantial damage. The solo pilot was not injured. NTSB investigation revealed that the

helicopter's long-line had snagged on a tree stump during the landing. Further investigation revealed that the company had no documented training program.[4,8] Thorough training in long-long lift-load techniques might have averted this occurrence.

Incident 4. On February 19, 1993, a helicopter crashed from a 200-foot hover after transporting two logs to a log drop area (see Doug Herlihy presentation, page 217, figure 4). The pilot and copilot were fatally injured. NTSB investigation revealed an in-flight metal fatigue failure of a flight-control piston rod. Evidence indicated that log loads routinely carried by the helicopter exceeded the aircraft's weight and balance limitations. Laboratory examination of the flight-control hydraulic system revealed a degree of binding and wearing not consistent with normal wear.[4,9]

Incident 5. On May 2, 1993, a helicopter crashed during an attempted emergency landing after using a long-line to lift a log to an altitude of 1,200 feet above ground level followed by rapid descent to a 75-foot hover (see Doug Herlihy presentation, page 220, figure 11). The solo pilot was killed, and a logger on the ground was injured. NTSB investigation revealed an in-flight separation of the tail rotor and tail rotor gear box from the helicopter. Investigative evidence indicated that log loads routinely carried by the aircraft exceeded its weight and balance limitations. Additionally, according to NTSB, on the day of the crash the company "...was reportedly using a procedure that would have heavily loaded the helicopter drive train, e.g., autorotating with a heavy external load from a point near the logging site to a drop point at a lower altitude where a full power recovery to a hover was executed before dropping the external load".[4] Further, records associated with the helicopter gear box showed that it had been purchased (by the company) as surplus from the U.S. Army, which had removed it from service in 1986 because of "excessive wear".[4,10]

Incident 6. On May 8, 1993, a helicopter crashed after attempting to lift a log from a logging site with a long-line (see Doug Herlihy presentation, page 220, figure 10). The pilot and copilot sustained minor injuries, and the aircraft was substantially damaged. NTSB investigation revealed that company maintenance personnel had recently installed the engine and that the engine failed because machine nuts had come loose from the engine or its housing and became caught in the engine. The helicopter crashed as the pilot attempted autorotation. Investigative evidence indicated that log load weights for flights over the preceding 2 weeks had substantially exceeded the maximum authorized gross weight of the helicopter.[4,11]

Epidemiologic Analysis

Statewide occupational injury surveillance in Alaska through a federal-state collaboration was established in mid-1991, with 1992 being the first full year of comprehensive population-based occupational fatality surveillance for Alaska.

During the time these incidents occurred, an estimated 25 helicopters in Alaska were capable of conducting long-line logging operations; approximately 20 were single-engine models from one manufacturer (Federal Aviation Administration [FAA], unpublished data, 1993). Approximately 50 helicopter pilots were employed in heli-logging operations in southeastern Alaska (FAA and Alaska Department of Labor, unpublished data, 1993). Using these denominators, the events reported here were equivalent to an annual crash rate of 16% (6 crashes/25 helicopters/18 months), 0.24 deaths per long-line helicopter in service per year (9 deaths/25 helicopters/18 months), and an annual fatality rate for long-line logging helicopter pilots of approximately 5,000 deaths per 100,000 pilots, or 5% (4 pilot

deaths/50 pilots/18 months).[12] In comparison, during 1980-1989, the U.S. fatality rate for all industries was 7.0 per 100,000 workers per year; Alaska had the highest overall occupational fatality rate of any state (34.8 per 100,000 per year) for the same period.[4]

According to NTSB investigations, all six crashes involved "...improper operational and/or maintenance practices that reflected a lack of FAA surveillance of logging operations (routine regulatory inspections of long-line helicopter logging) at remote sites in southeast Alaska".[4] NTSB further stated that, "The inadequate surveillance allowed unsafe operations and maintenance practices to continue until fatal accidents caused those practices to be detected".[4] In one-half of these incidents (numbers 4, 5, and 6 above) investigative evidence also indicated that log loads routinely exceeded weight and balance limits for the aircraft.

All of these severe incidents occurred among helicopters operated by two companies using single-engine aircraft (Table 1). To enable a more thoughtful approach to this analysis, proven and putative risk factors for these events have been arranged in a time-phase or Haddon's matrix (Table 2). These events are often the result of the interaction of many different factors.

Table 1. *Helicopter Logging Incidents, Alaska, 1992-1993.*

Date	# Killed	# Injured	Type of Helicopter	Logging Company
2/23/92	6 (co-pilot and 5 loggers)	5 (pilot and 4 loggers)	Manufacturer A, type A Single-engine	Company A
3/6/92	0	2 (pilot and co-pilot)	Manufacturer A, type A Single-engine	Company A
11/10/92	0	0	Manufacturer A, type B Single-engine	Company A
2/19/93	2 (pilot and co-pilot)	0	Manufacturer A, type A Single-engine	Company B
5/2/93	1 (solo pilot)	1 (ground crew logger)	Manufacturer A, type C Single-engine	Company B
5/8/93	0	2 (pilot and co-pilot)	Manufacturer A, type A Single engine	Company B

Table 2. *Features of Alaska Helicopter Logging Injury Events (After Haddon).*

	Host/Human	Agent/Vehicle	Environment
Pre-event/ Pre-injury	Pilot Training Experience Fatigue Stress Rx Illegal drugs Alcohol Ground crew Training Experience	Helicopter design Lift & durability Maintenance & repairs Engines & controls Ergonomics Unstable work platform; Surplus/improvised equipment	Terrain Weather Landing zones Oversight FAA (CFR pt 133) Industry
Event/Injury	Pilot Reaction to emergency situation (i.e., autorotation) Task overload Ground crew Reacting & avoiding	Helicopter Autorotation performance Deformation on impact Fires & explosions	Terrain Weather
Post-event	Types of injury Severity		Little assistance available EMS not available

Overview of Hazards of Helicopters and Sling-load Logging Operations

Helicopters are very complex machines with an inherent requirement for constant vigilance and input from the pilot during flight, and extraordinary maintenance requirements between flights. In contrast to conventional fixed-wing aircraft, helicopters can take off and land vertically, but are not self-trimming (i.e., able to maintain stable or level flight when control surfaces are in a neutral position), and cannot successfully move or hover without constant input to the controls by the pilot. The aerodynamics of these machines are fundamentally unforgiving, as they do not glide, and when the engine stops, free fall commences immediately, and can only be arrested by successfully restarting the engine or by autorotation maneuvers. Autorotation allows a helicopter to make an unpowered descent by maximizing on the windmilling effect and orientation of the main rotor. Forward airspeed and altitude can be converted to rotor energy to reduce the rate of descent. However, successful autorotation depends on helicopter airspeed and altitude when the maneuver is attempted (see Figure 1, Height-Velocity Curve (often referred to as the "Dead Man's Curve") for Autorotation).[13] Most helicopter logging operations are conducted at an altitude of less than 500 feet while at a hover or very slow airspeed, which is dangerously within the height-velocity curve for single-engine helicopters, as illustrated. This chart also displays the location of the six previously mentioned crashes, all dangerously inside this curve.

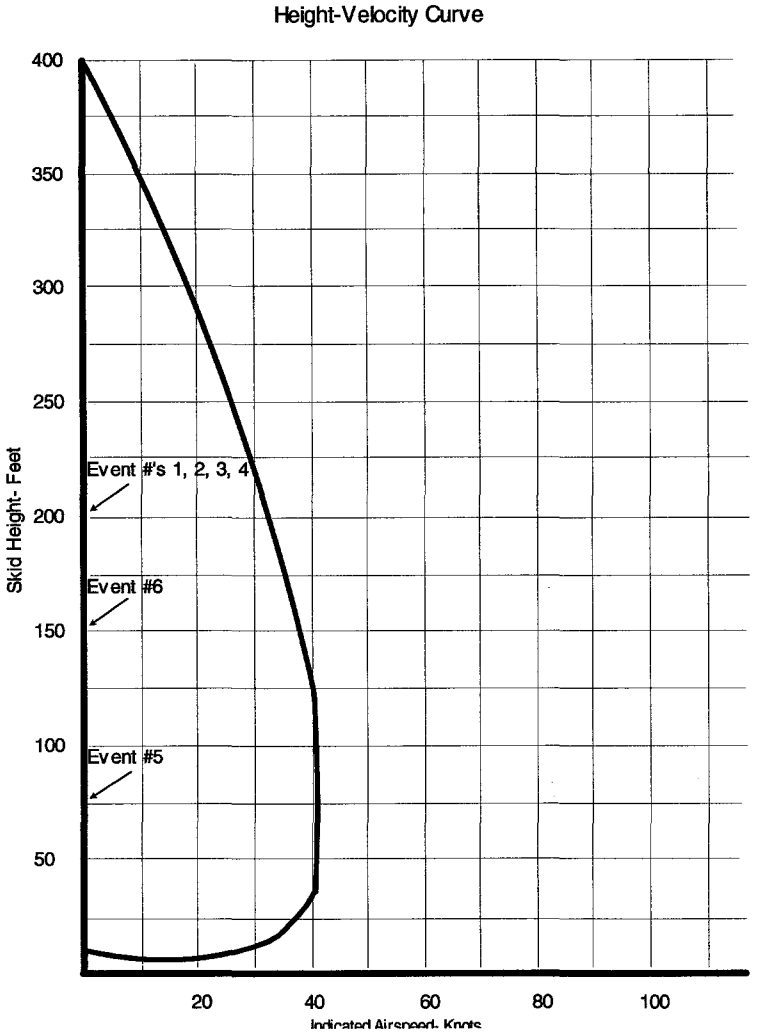


Figure 1. *Fundamentals of Fixed and Rotary Wing Aerodynamics*
Adapted from curve illustrated in Part I Fundamentals of Fixed and Rotary Wing Aerodynamics by H.E. Roland, Jr. and J. F. Detweiler, University of Southern California, November 1967

Even if successful autorotation were possible, suitable emergency landing sites in logging areas are rare. In short, such complex operations under these extreme and demanding circumstances, combined with frequent overloading of equipment (whether inadvertent or intentional), greatly increase the likelihood of both human error and machine failure.[14]

Helicopter flight is also comparatively dangerous: according to NTSB 1990 data, the rate of fatal crashes for unscheduled flights in helicopters is 14.5 per million hours flown, 18-fold that for fixed-wing aircraft, 0.82 per million miles flown.[15] Helicopter pilots have been well-documented to be an especially high-risk group for fatal occupational injuries.[16]

Helicopter logging operations place heavy demands on helicopter machinery and associated equipment. A typical logging helicopter carries an approximately 200-foot cable or long-line, which is attached by a hook to the belly of the helicopter (photo 1). A second hook is attached to the free end of the long-line, where a choker cable (a cable apparatus designed to cinch or "choke" around suspended logs) is connected to haul from one to four logs per load (a load may weigh from 6,000 to

10,000 pounds); the hook is opened and closed electronically by a hand control located in the helicopter cockpit.

A helicopter used in logging operations may complete up to 250 to 320 load/lift cycles, or "turns," each day; each turn takes one to three minutes to complete. These highly repetitive lift/transport/drop "turns" are frequently conducted at or beyond maximum aircraft capacity in remote areas where rugged forest terrain, and extremely steep mountain slopes (as great as 70 degrees), and adverse weather conditions prevail. Under these conditions, and when combined with poor equipment maintenance, helicopter flight components and equipment have been known to fail with tragic regularity.[12, 17]

The majority of experienced pilots we have interviewed reported having much greater confidence in multi-engine helicopters. One pilot with 20 years experience (and over 18,000 flight hours) in helicopter logging stated his concerns about heli-logging with single-engine helicopters and the need for redundant systems: "Imagine accelerating your automobile engine from idle, to full throttle 320 times a day, six days a week, 52 weeks a year. Engines do quit, clutches fail, inputs fail, fuel pumps stop pumping, accessory drive shafts break, power plants do stop running, and most always at times when the pilot least expects it to happen. However, if he is flying a helicopter with two engines, things are a whole lot easier to handle....These helicopters have: (in addition to 2 engines), 2 servo systems, 2 electrical systems, 2 fuel systems, and 2 pilots!".[18]

Another human factors concern is the tremendous potential for task overload in solo pilots. The experienced heli-logging pilot quoted above also stated, "The small engine aircraft usually have only one pilot who flies all day long. He must divide his attention between the engine temps, pressures, power gauges, warning lights, fuel quantity, and weight cell, as well as watching his load to keep it clear of obstacles and ground personnel and his rotor blades out of the trees. While concentrating on all this, he very often lifts off too much weight and over grosses the aircraft before he realizes it."[12, 18] Under such complex operations, it is not uncommon for a helicopter long-line to suddenly snag on a tree, log, stump, or forest debris with occasional disastrous outcome.

From a human factors standpoint there are other concerns. Helicopter logging, as well as other external load helicopter operations (which are regulated under the Code of Federal Regulations [CFR], Part 133) include (non-regulated) flight crew duty periods which can exceed 10 hours per day for 10 consecutive days, and flying much of the time under conditions which are unfavorable for successful autorotation of single engine helicopters in the event of engine failure or loss of power. This practice may lead to fatigue of sufficient magnitude to be hazardous. Recent analyses of NTSB data for fixed-wing aircraft show that pilots involved in repeat crash incidents ("accident-prone" pilots) were twice as likely to have crashed in Alaska and have flown for more hours in the previous 3 months.[19] Decrements in aircrew function due to fatigue from overlong and repeat missions were also documented during the Desert Shield Operation.[20]

Ground operations also pose unique hazards in helicopter logging. Fallers and buckers must be especially cautious of downwash (air moved at high velocity by the helicopter's propeller[s], which may also knock limbs and debris onto ground crew). The long-line cable is made of steel, and must be grounded prior to being handled, because of its high static electrical (shock) potential. Loads can be accidentally released in transit, and crush those below. Ground crewmen have also been killed by walking or falling into a moving prop or tail rotor, as has been well documented in military settings.[21] Rigorous attention to communications, procedures, and protective equipment can mitigate these risks.[22]

Also, many loggers and ground crew are transported to their worksites by helicopters, with the attendant risk of such transport (see incident 1, above).

Lastly, major attention in private-sector helicopter design to adequate occupant restraint, crash attenuation, and fire prevention has been relatively recent.[23] Modest modifications in occupant restraint, such as headrests and chest harnesses, as well a g-absorbing or crash-attenuating seats and well-tested fire attenuation systems, when combined, could prevent up to an estimated 95 percent of all helicopter fatalities, and likely a substantial proportion of those associated with heli-logging.[24, 25, 26, 15]

Hazard Reduction and Injury Prevention: The Interagency Response in Alaska

In response to the six Alaska logging helicopter crashes of '92 and '93, we convened a meeting in Anchorage on July 8, 1993, to discuss approaches for reducing the number of such crashes and ameliorating the outcome of crash injuries. The meeting was attended by representatives from the Interagency Working Group for the Prevention of Occupational Injuries (consisting of the Alaska Department of Health and Social Services, Alaska Department of Labor, FAA, NTSB, OSHA, U.S. Coast Guard, the U.S. Forest Service, and NIOSH). The working group noted that there were no formalized training programs or standards of performance required by the FAA for helicopter long-line logging operations. Furthermore, crash investigation teams had previously observed that operating standards did not comply with manufacturers' recommendations.

Based on these and other findings, the following eight recommendations were made by the Working Group. [12, 27, 28]

- All helicopter logging pilots and ground crews should receive specific training in long-line logging operations.
- Companies should follow all manufacturers' recommendations for more frequent helicopter maintenance (because of intensity and use) and for limits on maximum allowable loads.
- Companies should establish and observe appropriate limits on helicopter crew flight time and duty periods.
- Companies should consider the additional safety factor of using multi-engine helicopters for long-line logging.
- Specific industry-wide operating standards and procedures should be developed.
- Companies should provide training in on-site emergency medical care for helicopter logging crews at all work locations.
- State, regional, and local agencies involved in emergency medical services education should make low-cost emergency medical training available to persons likely to work in a helicopter logging environment.

- All flights over water should include appropriate survival equipment for all crew, who should wear personal flotation devices at all times during flights over water.

When these preventive interventions are superimposed on the risk time-phase matrix for these events (Table 3), it becomes clear that the emphasis chosen by the Working Group was on pre-event factors.

Table 3. *Alaska Helicopter Logging Injury Recommended Countermeasures (from Alaska Interagency Working Group for the Prevention of Occupational Injuries, July 1993)*

	Host/Human	Agent/Vehicle	Environment
Pre-event/ Pre-injury	Increased training for pilots and ground crew Improved work/ rest cycles	Maintenance per manufacturer's recommendations Impact (g)- resistant seats NTSB- to prohibit surplus equipment	Improved interagency communication Increased FAA oversight
Event/Injury	Practical training in autorotation		Emergency (backup) landing zones
Post-event			

One other major concern was discussed during the July '93 Working Group meeting: According to CFR, Part 133, regardless of where helicopter logging operations are conducted, the jurisdictional responsibility for inspection currently resides with the FAA office nearest the main or registered corporate office for the helicopter logging company, no matter how distant the FAA office may be from the actual helicopter logging site. In the six Alaska cases in this report, these FAA offices were in Salt Lake City, Utah, and Riverside, California (this necessitates travel of great distances to conduct helicopter logging inspections, and therefore remote operations, such as encountered in Southeastern Alaska may not be inspected for long periods). According to the NTSB, in the six Alaska heli-logging accidents, one operator had not received an onsite FAA inspection for two years, and the other operator had never received an onsite FAA inspection.[4] The NTSB has therefore recommended that operational and maintenance oversight responsibilities for remote heli-logging sites be assigned to the nearest FAA office.[4]

During the summer of 1993, the FAA and the Alaska Department of Labor increased their inspectional oversight of flight and ground operations at helicopter logging sites. Also, during this same period of time, two of the helicopter logging companies with the most operating problems, and who each accounted for three of these serious crashes, closed down their Alaska operations. Fortunately, there are other helicopter logging companies in southeast Alaska with outstanding safety records, that had

already implemented the safety recommendations made by the Interagency Working Group. As a result, since then there has only been one logging helicopter crash in Alaska through 1997, as shown in Figure 2. That crash, involving a military surplus multi-engine aircraft, killed one and seriously injured the other occupant. The NTSB has attributed that crash to a mechanical failure, possibly related to parts supplied or the wear life of military surplus parts.[30]

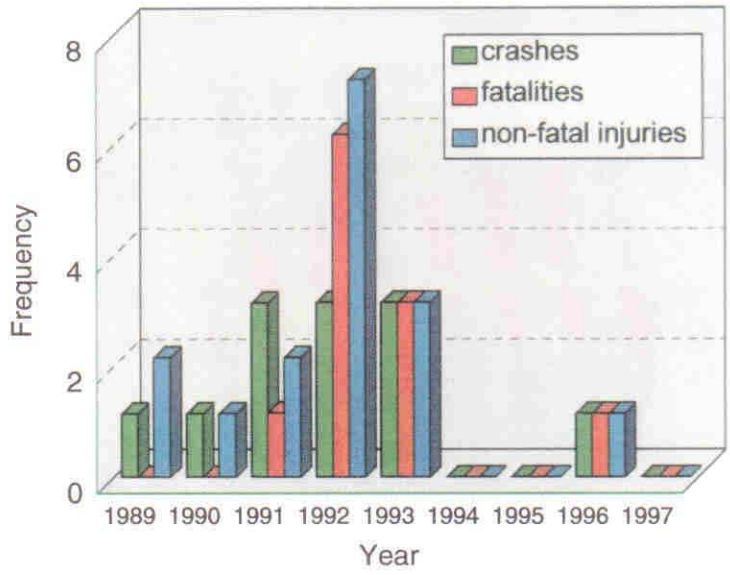


Figure 2. *Crashes, Fatalities, and Non-fatal Injuries in Alaska Helicopter Logging Operations, 1989-1997*

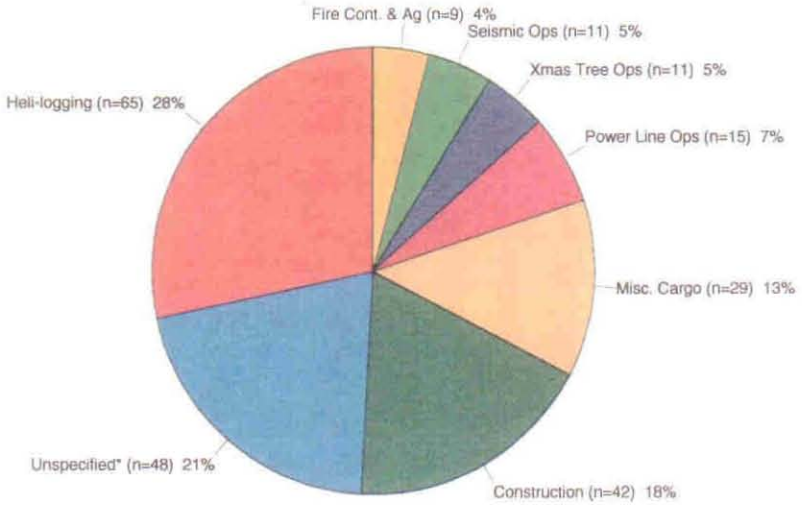
U.S. HELI-LOGGING EXPERIENCE

NTSB data from 1980 through 1995 (compiled from information contained in the NTSB's Accident Briefs of CFR Part 133 helicopter external load operations in the U.S.) was analyzed for common factors for all known heli-logging accidents and crashes investigated by the NTSB. There were 230 such accidents known, of which 224 (or approximately 97%) were considered crashes. (It should be understood that crashes and accidents are not interchangeable words for the purposes of this study. "Crashes" are a subset of accidents that involve impact of the helicopter body or its parts, resulting in serious injury or fatality to humans, and/or damage or destruction of the aircraft.)

Perhaps the most notable findings involving NTSB data are those that reveal the most common probable causes and other common factors contributing to these helicopter crashes, even though denominator data from the helicopter logging industry were not available for determining rates. Each of these NTSB "Accident Briefs" was abstracted for 62 variables and entered them into a computer database (using Paradox software).

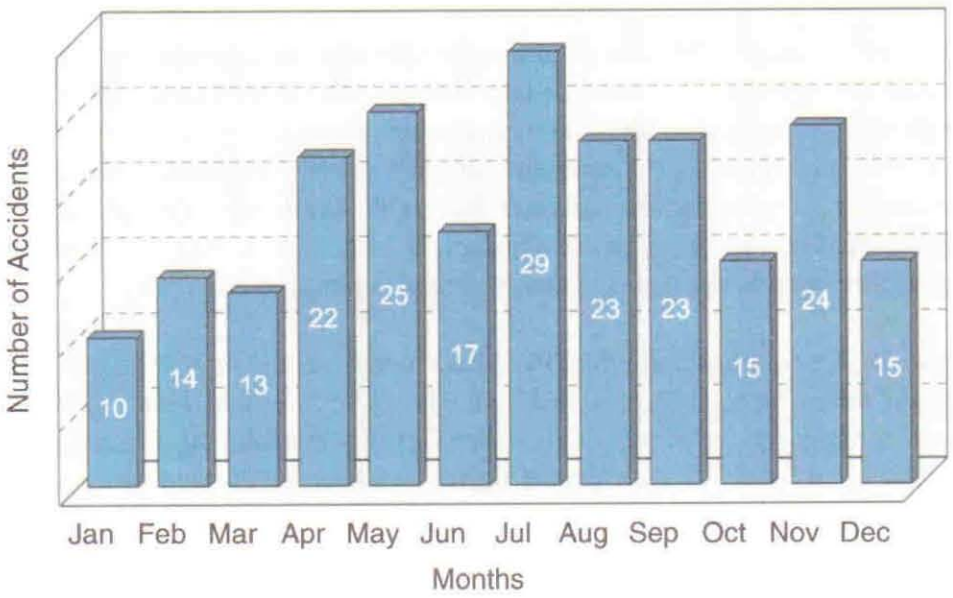
Of the 230 external load accidents, 65 (28%) occurred during helicopter logging operations and represent the largest portion of helicopter external load accidents by type of operation (Figure 3). These 65 accidents resulted in 25 fatalities, of which 18 were pilots, 5 were loggers being transported as passengers in 1 crash event, and 2 were ground crew involved in two separate accidents.

When we examined the distribution of all U.S. heli-logging accidents by month (Figure 4), we saw that the majority of accidents occur during warmer weather, which is when most heli-logging operations are conducted. Although denominator data for both the number of pilots and helicopters involved in heli-logging is lacking, it has been suggested that the main reason for the increased number of accidents during the spring and summer months has been due to the increased amount of heli-logging operations during that time of year, not that these operations are necessarily inherently more hazardous during the spring and summer.



Percentages rounded
* Unspecified - no flight purpose listed
Source: NTSB Accident Briefs 1980-1995

Figure 3. *Helicopter External Load Accidents in U.S., 1980-1995 by Type of Operation (n=230)*



Source: NTSB Accident Briefs 1980-1995

Figure 4. *Helicopter External Load Accidents in U.S., 1980-1995 by Month (n=230)*

Alaska leads the U.S. in the number of heli-logging accidents, followed by Washington, California, and Oregon (Table 4). Of the 65 total U.S. long-line logging helicopter crashes 1980-1995, Alaska had 15 (22%) of the crashes.

Table 4. *Known Long-line Logging Helicopter Crashes by State (All U.S., 1980-1995, n=65**)*

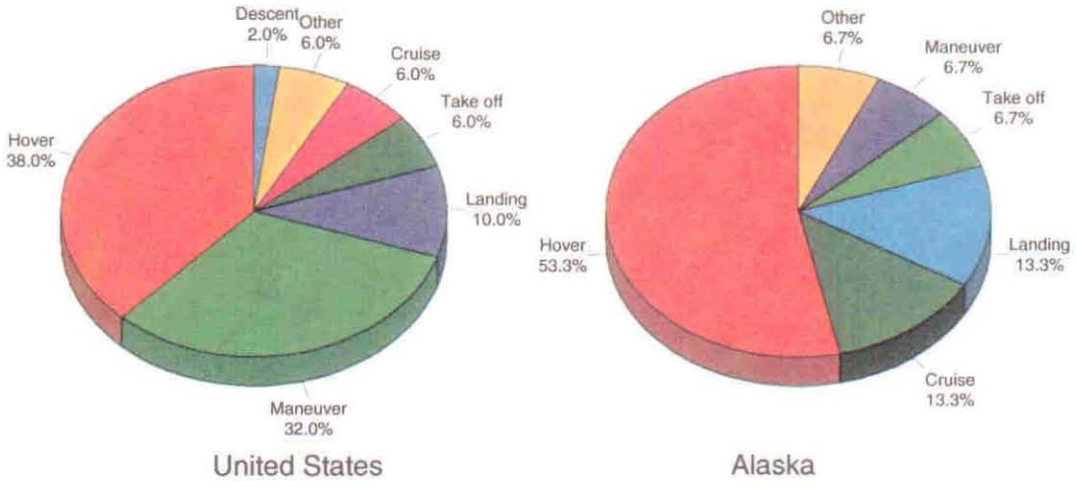
State	Number	Percent*
Alaska	14	22
Washington	11	17
California	10	15
Oregon	8	12
Idaho	7	11
Alabama	4	6
South Carolina	4	6
Georgia	2	3
Florida	2	3
Montana	2	3
Louisiana	1	2

*Percentages rounded off
** Two events were non-crash accidents

There are differences in external load helicopter accidents by operational phases in which the accidents occurred (Figure 5). When non logging-related helicopter accidents take place, they most often occur during the hover phase (33%), with the maneuvering phase second (19%). When we look only at long-line logging helicopters and further sort for geographic variations between Alaska and the rest of the U. S., the differences become even more striking. Helicopter accidents in the rest of the United States are evenly divided between maneuvering, hovering and landing phases, with descent and other phases coming in smaller portions behind these categories. In Alaska, however, over half occur in the hovering phase. These differences between Alaska's operational phase statistics and those for the rest of the country raise many as-yet unresolved questions: Do these data suggest anything about the lack of suitable emergency landing sites? Could this be due to the rough, and often steep terrain of a logging environment, as compared to all other external load operations, and heli-logging in states other than Alaska where suitable emergency landing sites may be perhaps more plentiful and accessible? If so, then what can be done in the Alaska heli-logging environment to improve the accessibility and suitability of emergency landing sites?

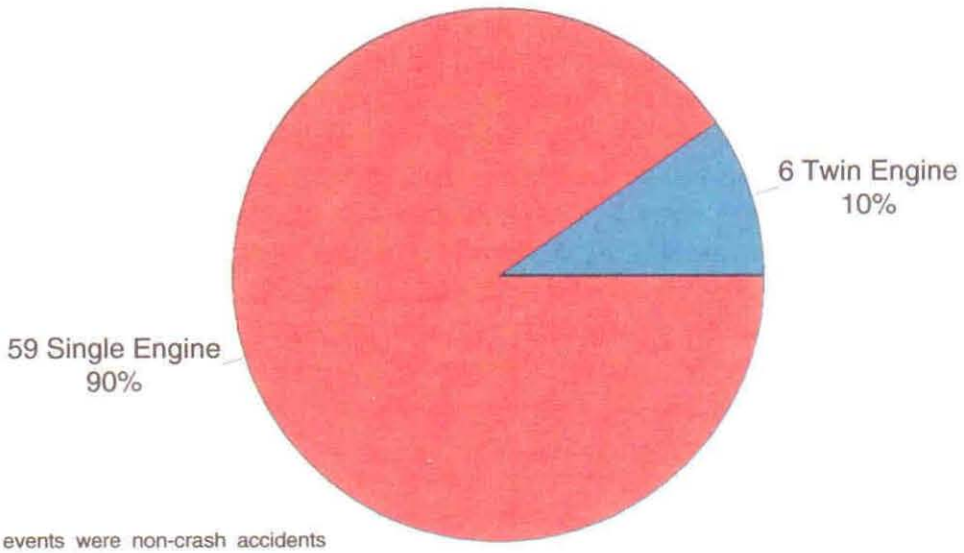
Approximately 91% (59) of the heli-logging accidents were in single-engine helicopters, and 9% (6) in twin-engine helicopters (Figure 6). Unfortunately, there are not adequate data available for number of helicopters of single or dual engine design currently in use in helicopter logging operations, nor are there available tabulations by number of engines.

Logging helicopter crashes within the lower 49 states (minus Alaska) were caused primarily by part failures (41%), with flight crew error a distant second (27%) (Figure 7). In Alaska, however, the data are strikingly different: maintenance error and flight crew error contribute 40% each, with parts failures contributing the remaining 20%. What does this suggest regarding helicopter maintenance operations in Alaska heli-logging? Several NTSB investigations of logging helicopter crashes in Alaska indicated inadequate maintenance facilities contributing to the probable causes of those accidents. Our office is still in the initial phases of data analysis of Part 133 helicopter long-line-related crashes. Continued research will provide a better idea of what safety issues are involved in this form of logging transportation. For the near future, research efforts will be focusing on obtaining denominator data for a better assessment of helicopter logging risks.



* Two events were non-crash accidents

Figure 5. *Logging Helicopter Crashes by Operation Phase, United States (n=50*), and Alaska (n=15), 1980-1995 (NTSB 1997)*



* Two events were non-crash accidents

Figure 6. *Long-line Logging Helicopter Accidents (n=65*) by Number of Engines, All U.S., 1980-1995 (NTSB 1997)*

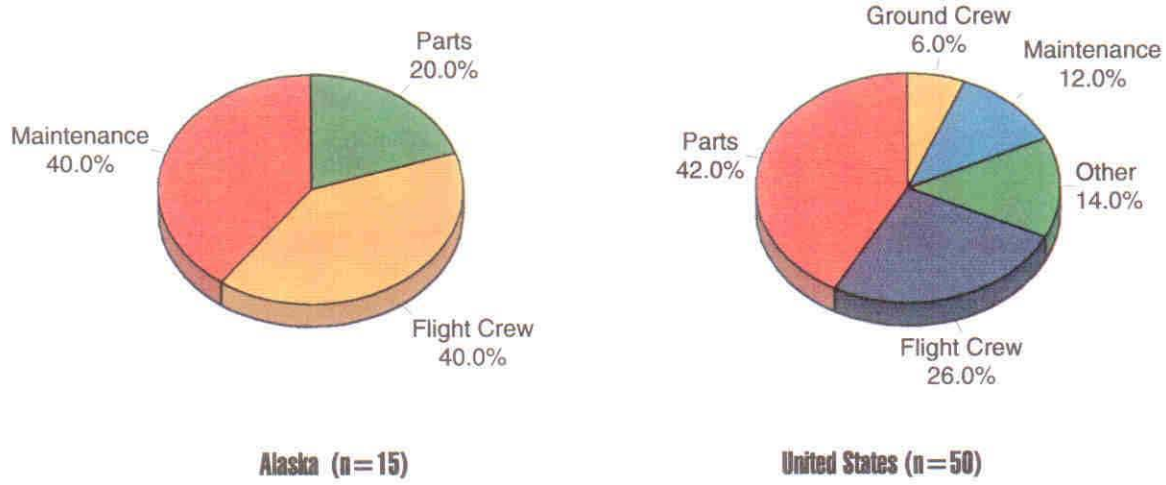


Figure 7. *Logging Helicopter Crashes by Primary Probable Cause (NTSB 1995)*

Because of the previous Alaskan experience, a rising concern for heli-logging safety nationwide, and a projected increase in heli-logging due to environmental restrictions and economic factors, the Alaska Interagency Working Group for the Prevention of Occupational Injuries and NIOSH sponsored the first Helicopter Logging Safety Workshop in Ketchikan, Alaska, on March 1-2, 1995. The objectives of the Workshop were to: describe and analyze the risks of helicopter logging; share new aerologging technology; foster safety research in aerologging operations and technology; review current regulations governing helicopter logging; consider helicopter logging safety training opportunities and options; and draft consensus safety recommendations for helicopter logging.

The 65 workshop participants, representing twelve helicopter logging companies, four helicopter manufacturers, four industry associations, five federal agencies, two state agencies, six logging companies, one university, and a representative from the Helicopter Association of Canada, used a consensus-building group process to determine possible root causes, countermeasures, and action plans. Workshop participants drafted the following safety recommendations for injury prevention in heli-logging:[29]

EQUIPMENT

The use of multi-engine helicopters is recommended for aerologging.

The design, weight & balance, and operating limitations established by the manufacturer must not be exceeded.

Aerologging equipment and components should be certified by the FAA, and overhauled in accordance with the manufacturers documentation or manuals.

MAINTENANCE

The aerologging industry should establish standards for sound maintenance procedures.

Adequate facilities should be available for the level of maintenance to be accomplished.

An FAA-approved maintenance program should be established.

Only FAA-approved parts should be used.

All flight critical components should have accurate historical records.

All maintenance work should be inspected prior to sign-off by certificated authority.

HUMAN FACTORS

The use of a qualified second pilot is recommended for aerologging.

Companies should develop and publish standards for maximum flight and duty time.

Companies should establish and enforce standards and methods to monitor unsafe attitudes and unsafe types of competition.

The use of drugs and alcohol in aerologging should be prohibited, and aerologging camps should be dry.

There should be random drug and alcohol testing, and mandatory testing in the event of a mishap.

The FAA should not be permitted to sanction by way of irrevocable certificate action, those individuals entering voluntary drug & alcohol rehabilitation programs.

It was also recommended that NIOSH conduct or sponsor a study of cockpit environment design for improvement of comfort & safety, and chronic injury reduction.

TRAINING

Helicopter model-specific and flight-specific training should be provided for aerologging operations.

Flight and ground crew coordination training should be provided for all aerologging crews.

Companies should provide maintenance training in specific helicopter models, special inspections, and documentation of maintenance operations.

Companies should provide recurrent documented training for flight crews and mechanics.

MANAGEMENT

An aerologging association should be established to serve as a forum and spokesman for the aerologging industry.

Companies should be encouraged to develop a strong safety culture within upper level management.

Mid-level managers should be trained on the concepts and responsibilities of developing a strong safety management culture.

Employees should be encouraged to report safety violations without fear of punishment.

Companies should specifically designate a safety manager, with a specific job description.

The safety manager should receive formal training on a continuous basis.

Companies should establish an employee/management safety committee.

All employees should participate in the management of safety.

Company officials and employees should be made aware of the cost benefits of an accident free operation.

Companies should establish job/task termination safety rules.

OVERSIGHT

The group strongly recommended that FAA promptly enforce all known rule violations.

Staff of all local FAA, Flight Standards District Offices (FSDO'S) should be trained in all pertinent aspects of aerologging operations.

Companies should be required to give prior notification to the local FAA, FSDO'S concerning any proposed helicopter logging operations in their service area.

INTERAGENCY/COMPANY COOPERATION

Establish a helicopter logging association and encourage membership.

Companies should establish communication between each other when conducting aerologging operations in close proximity.

Companies conducting aerologging in the same areas should establish joint EMS and emergency action plans.

Companies and agencies should develop and disseminate a contractors safety check list.

Companies and agencies should assist each other in writing and disseminating incident and accident reports.

Companies and agencies should develop and disseminate Standard Operations Procedures manuals.

ENVIRONMENT

Companies should provide improved and continual training concerning environmental hazards for all helicopter logging crews.

Companies should establish improved communication and educate U.S. Forest Service, state agencies, and environmental group personnel concerning the necessity of more adequate helicopter emergency landing zones, and concerning the potentially hazardous combination of danger trees and rotor downwash.

These recommendations are also summarized in matrical format (Table 5).

Table 5. *Alaska Helicopter Logging Injury Countermeasures - Proposed at March 1995 Workshop in Ketchikan, Alaska.*

	Host/Human	Agent/Vehicle	Environment
Pre-event/ Pre-injury	Qualified second pilot, Flight/duty time limits, Drug/alcohol/ testing, Availability of alcohol/drug rehabilitation	Multi-engine only, Dual drive train, Improved controls, Improved crash worthiness, Limit to certified parts with valid FAA history	Industry SOP for maintenance, safety culture & management, Heli-logging association, Educate FAA FSDO, Improve communications
Event/Injury	Qualified second pilot	Crash-resistant fuel tanks, Controlled deformation	
Post-event		EPIRBs	Improve EMS availability, CPR/first aid training for crews

SUMMARY

Helicopter logging is an expanding industry in the U.S. and abroad. Helicopter pilots and ground crews involved in long-line logging operations face an extremely high risk for severe traumatic injuries resulting from helicopter crashes. Inadequate equipment, improper operational and/or maintenance practices, and the lack of adequate inspectional surveillance of helicopter long-line logging operations in Alaska have been frequently cited as the factors most strongly associated with the risk of crashes. The risks for fatal and serious injuries in this industry should and can be reduced by scrupulous attention to the needs of pilots, crew, and equipment. To minimize these extreme hazards, pilots and crew need more rest and better training; helicopters and equipment need more frequent and intensive maintenance; and operators must adhere not only to existing regulations, but also to manufacturer recommendations for load, lift cycle, and other appropriate applications. The Alaska experience has shown that helicopter logging can be extremely hazardous. However, careful attention to identifying and minimizing the risks and hazards can make it safer.

REFERENCES

1. Proctor, P.: "Ecological Benefits Boost Heli-logging", Aviation Week and Space Technology, 140:65, May 9, 1994.

2. Stehle TC [1990]. Helicopter logging of valuable furniture from natural rain forest in the Southern Cape. South African Forestry Journal *155*:51-53.

3. Georgia Forestry Commission. Harvest by helicopter— a new way of logging. Georgia Forestry. September, 1986.

4. National Transportation Safety Board. NTSB Safety Recommendation A-93-78 through -80. National Transportation Safety Board. Washington, DC, June 17, 1993.

5. National Transportation Safety Board, Final Report, Aviation, NTSB Accident/Incident Number: ANC92FA040, 1992-93, Washington, DC.

6. Office of the Federal Register. Code of Federal Regulations, Vol. 14, part 133. Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, January, 1992.

7. National Transportation Safety Board, Final Report, Aviation, NTSB Accident/Incident Number: ANC92LA044, 1992-93, Washington, DC.

8. National Transportation Safety Board, Final Report, Aviation, NTSB Accident/Incident Number: ANC93LA015, 1992-93, Washington, DC.

9. National Transportation Safety Board, Final Report, Aviation, NTSB Accident/Incident Number: ANC93FA033, 1992-93, Washington, DC.

10. National Transportation Safety Board, Final Report, Aviation, NTSB Accident/Incident Number: ANC93FA056, U.S. Government Printing Office, 1992-93, Washington DC.

11. National Transportation Safety Board, Final Report, Aviation, NTSB Accident/Incident Number: ANC93FA061, 1992-93, Washington DC.

12. CDC (Centers for Disease Control and Prevention) [1994]. Risk for traumatic injuries from helicopter crashes during logging operations — Southeastern Alaska, January 1992-June 1993. MMWR *43*(26):472-475.

13. Roland HE Jr., Detweiler JF [1967]. Fundamentals of fixed and rotary wing aerodynamics, part i. Los Angeles: University of Southern California.

14. University of Southern California, Institute of Safety and Systems Management [1992]. Aircraft accident investigation manual. Los Angeles, CA.

15. Bertoldo R [1996]. Operational and aircrew factors in helicopter applications. In: Klatt M, Hudson D, Conway GA, eds. Proceedings of the Helicopter Logging Safety Workshop, March 1-2, 1995, Ketchikan, AK. Alaska Interagency Working Group for the Prevention of Occupational Injuries, Anchorage, AK, pp. 76-81.

16. Conroy C, Russell JC, Crouse WE, Bender TR, Holl JA [1992]. Fatal occupational injury related to helicopters, U.S. 1980-1985. Aviat Space Environ Med *63*:67-71.

17. Transportation Safety Board of Canada (TSB) [1991]. Aviation occurrence report: Hydra Management Ltd. Aerospatiale 332c Super Puma (Helicopter) C-GQRL, Quantam River, British Columbia, 03 October 1987 TSB.

18. Lindamood M [1996]. Helicopter logging from a pilot's perspective. In: Klatt M, Hudson D, Conway GA, eds. Proceedings of the Helicopter Logging Safety Workshop, March 1-2, 1995, Ketchikan, AK. Alaska Interagency Working Group for the Prevention of Occupational Injuries, Anchorage, AK, pp. 76-81.

19. Baker SP, Li G, Lamb MW, Warner M [1995]. Pilots involved in multiple crashes: 'accident proneness' revisited. Aviat Space Environ Med *66*:6-10.

20. Bisson RU, Lyons TJ, Hatsel C [1993]. Aircrew fatigue during Desert Shield C-5 transport operations. Aviat Space Environ Med *64*:848-853.

21. Crowley JS, Geyer SL [1993]. Helicopter rotor blade injury: a persistent safety hazard in the U.S. Army. Aviat Space Environ Med *64*:854-858.

22. Workers Compensation Board of British Columbia [1990]. Helicopter operations in the forest industry: a manual of standard practices. Richmond, British Columbia.

23. Vyrnwy-Jones P [1985]. A review of Army Air Corps helicopter accidents 1971-1982. Aviat Space Environ Med *56*:403-409.

24. Krebs MB, Li G, Baker SP [1995]. Factors related to pilot survival in helicopter commuter and air taxi crashes. Aviat Space Environ Med *66*:99-103.

25. Glatz JD. Energy attenuation for crashworthy seating systems: past, present, and possible future development. Naval Air Development Center, Warminster, PA.

26. Springate CS, McMeekin RR, Ruehle CJ [1989]. Fire deaths in aircraft without the crashworthy fuel system. Aviat Space Environ Med *60*(10)(Suppl):B35-38.

27. Alaska Department of Health and Social Services, Division of Public Health, Section of Epidemiology. Helicopter logging: Alaska's most dangerous operation? State of Alaska Epidemiology Bulletin #32. August 16, 1993.

28. Alaska Department of Health and Social Services [1993]. Alaska EMS goals document. Juneau, AK.

29. Klatt M, Hudson D, Conway GA, eds. [1996]. Proceedings of the Helicopter Logging Safety Workshop, March 1-2, 1995, Ketchikan, AK. Alaska Interagency Working Group for the Prevention of Occupational Injuries, Anchorage, AK.

30. NTSB # ANC96FA098 available at http://www.ntsb.gov/aviation/Anc/Inarr-96A098.htm.

EPIDEMIOLOGY AND PREVENTION OF HELICOPTER EXTERNAL LOAD ACCIDENTS

By Jan C. Manwaring, B.S.; George A. Conway, M.D., M.P.H.; Larry C. Garrett, BSN, M.P.H., U.S. Public Health Service, Centers for Disease Control and Prevention (CDC), National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research, Alaska Field Station

ABSTRACT

From 1980 through 1995, there were 230 helicopter external load accidents resulting in 57 fatalities and 74 serious non-fatal injuries in the U.S. investigated by the National Transportation Safety Board (NTSB). Helicopter external load operations, such as helicopter logging, places unique demands on the aircraft helicopters and the pilots who fly them. A descriptive analysis of NTSB "accident briefs" indicate that mechanical failure, pilot error, and maintenance errors were cited as the most common probable causes of the accidents. Recent experience in Alaska has shown that by adhering to existing regulations, manufacturer recommendations, improved training, and frequent maintenance, helicopter external load operations are safer with fewer accidents, crashes and injuries.

INTRODUCTION

For several reasons, the helicopter represents a commercially viable option for helicopter logging operations and for lifting and transporting other heavy objects. Many heavy lift sites are located in rugged terrain or on steep slopes that make them inaccessible, economically impractical, or environmentally restricted for conventional crane, cable rigging, and surface transportation. This has resulted in an increased use of helicopter external load operations (Georgia Forestry Commission, 1986; Proctor, 1994; Stehle, 1990).[7, 16, 19]

Helicopter external load operations, lift load and long-line, have gained wide acceptance for use in logging, construction, seismic, firefighting, and for other lift and transport purposes. However, numerous accidents resulting in serious injury and death are associated with these operations. According to accident investigation data from the National Transportation Safety Board (NTSB), there were 230 helicopter external load accidents reported to and investigated by the NTSB during the 16-year period from 1980 through 1995. These incidents resulted in 57 fatalities and 74 serious non-fatal injuries (NTSB, 1997).[14] The NTSB accident data reported the most common probable causes and other contributing factors. Accident rates for each probable cause could not be determined because exposure (denominator) data were not available.

Compared to fixed wing aircraft (airplanes), rotary wing aircraft (helicopters), have a higher accident rate and helicopter pilots are in a high risk group for fatal injuries. Helicopters are at an increased risk for crashing when compared to fixed wing aircraft, and helicopter pilots have been cited as a high risk group for fatal occupational injuries (Conroy, 1992).[4] According to NTSB data for 1990-94, the accident rate for all helicopters was 10.4 accidents per 100,000 flight hours, while the accident rate for all fixed wing aircraft was 8.2 accidents per 100,000 flight hours (Bradley, 1997).[2] There are many reasons for these higher accident rates. This analysis focused on helicopter logging external load accidents in Alaska. The findings, action taken, and decreased external load accident rate is applicable wherever these operations occur.

BACKGROUND

Helicopter Flight Regimes

Most phases of helicopter external load operations are conducted while in a hover or at very low airspeeds. This places the aircraft and the pilot in a high risk flight regime for long periods of time. Rotary wing aerodynamics are fundamentally different from fixed wing aircraft. Fixed wing, as the name implies, rely on the airflow over the fixed wing surface for lift. They glide and have fewer movable control surfaces and dynamic components that must be coordinated and adjusted to maintain flight. Rotary wing aircraft rely on a movable, rotating wing for lift. High dynamic loading is placed on the components to maintain flight. The rotor begins to fly in the traditional sense after forward flight produces translational lift, and rotary wing flight occurs.

Power Failure in a Hover

In the event of a power failure or other type of emergency in a hover, the aircraft does not glide. The ability to successfully recover by "autorotation" involves unloading the rotor, thereby reducing the angle of attack on the blade. This permits the rotor speed to increase. The pilot then increases the angle of attack on the rotor in order to land successfully. The ability to land safely is a function of pilot reaction time, hover height and rotor response time. The area beneath the aircraft ("landing zone") may or may not permit a safe landing despite a successful recovery (see Figure 1, "Height-Velocity Curve for Single-Engine Helicopter" Prouty, 1985)[17].

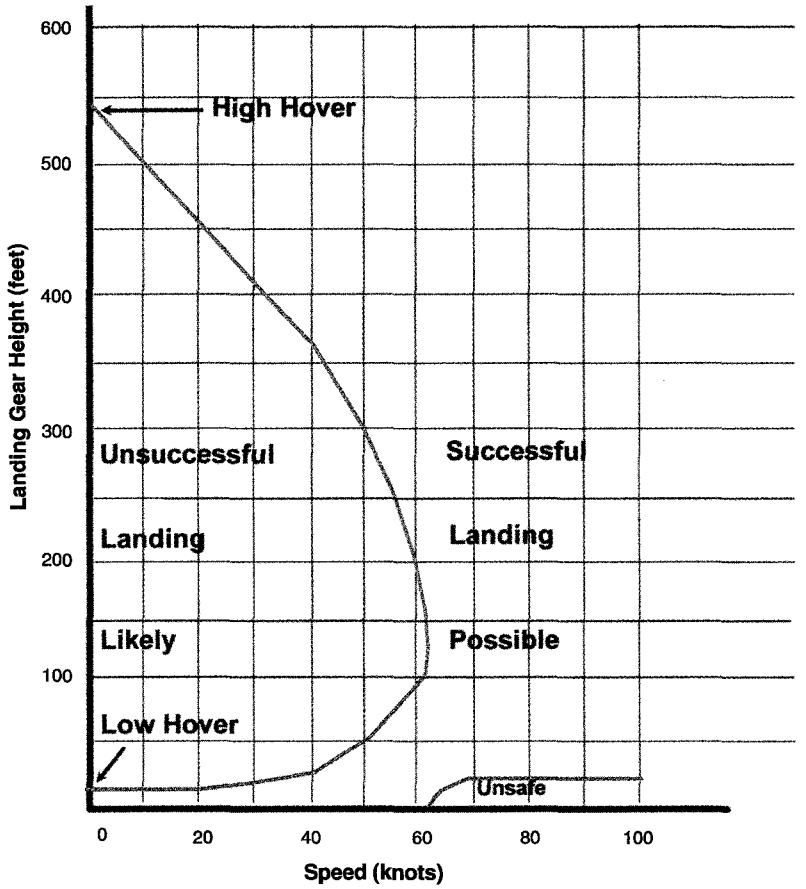


Figure 1. *Height-Velocity Curve for Single-Engine Helicopter Autorotation Regions*
Adapted from Helicopter Aerodynamics by R.W. Prouty, 1985, pg. 80

Power Failure in Flight

The ability to successfully recover during rotary wing flight depends on the pilots reaction time, rotor recovery time, altitude, airspeed, and aircraft weight. During flight, the helicopter has a very limited gliding distance due to airspeed, which provides some additional time in order to execute autorotation procedures, reduce aircraft weight, select a safe landing site and prepare for landing (see Figure 1).

Maintenance Hours per Flight Hour

The greater number of moving parts necessary to keep the helicopter flying, the stress on the dynamic components, and the hydraulic systems requires more maintenance per flight hour than fixed wing aircraft. A small airplane requires only an engine, propeller and wires to move the control surfaces to maintain flight.

Helicopter Operating Environment

Because of their capability to operate in remote and unusual terrain, helicopter operations are often conducted under extreme and demanding circumstances which place high demands on the aircraft, pilots, maintenance, and other personnel that support those operations. Helicopters rely exclusively on the pilots' skill to continually mentally recalculate all the factors during each phase of a flight operation. The high volume of these operations, and absence of environmental aids such as air conditioning, hour after hour place excessive demands on man and machine, greatly increasing the likelihood for human error and machine failure (USC, 1992).[21]

Helicopter Logging Operating Conditions

Perhaps no other external load operation better illustrates these inherently complex and demanding circumstances than helicopter logging, or "heli-logging": A typical logging helicopter carries an approximately 200-foot-long cable or long-line, which is attached by a hook to the belly of the helicopter. A second hook is attached to the free end of the long-line, where a choker cable (a cable apparatus designed to cinch or "choke" around suspended logs) is connected to haul one or several logs per load (a typical load may weigh from 6,000 to 10,000 pounds). The load is released by the pilot with an electronic control which opens the second hook. A helicopter used in logging operations may complete 250 to 320 load/lift cycles, or "turns," each day; each turn takes one to three minutes to complete. These highly repetitive lift/transport/drop "turns" are frequently conducted at or beyond maximum aircraft capacity in remote areas where rugged forest terrain, extremely steep mountain slopes, and adverse weather conditions prevail.

Single Engines and Single Systems

Under these conditions, and when combined with inadequate equipment maintenance, helicopter flight components and equipment have been known to fail with tragic regularity (CDC, 1994; TSB, 1991).[3,20] One pilot with 20 years experience (and over 18,000 flight hours) in helicopter logging stated his concerns about heli-logging with single-engine helicopters and the need for redundant systems: "Imagine accelerating your automobile engine from idle, to full throttle 320 times a day, six days a week, 52 weeks a year. Engines do quit, clutches fail, inputs fail, fuel pumps stop pumping,

accessory drive shafts break, power plants do stop running, and most always at times when the pilot least expects it to happen. However, if he is flying a helicopter with two engines, things are a whole lot easier to handle....These helicopters have: (in addition to 2 engines), 2 servo systems, 2 electrical systems, 2 fuel systems, and 2 pilots!" (Lindamood, 1996).[13]

Decision-Making and Pilot Task Saturation

Pilot in-flight decision-making and task saturation are critical to the safety of helicopter external load operations. The experienced heli-logging pilot quoted above also stated, "The small engine aircraft [helicopters] usually have only one pilot who flies all day long. He must divide his attention between the engine temps, pressures, power gauges, warning lights, fuel quantity, and weight cell, as well as watching his load to keep it clear of obstacles and ground personnel and his rotor blades out of the trees. While concentrating on all this, he very often lifts off too much weight and over-grosses the aircraft before he realizes it." (Lindamood, 1996)[13] Under such complex operations, it is not uncommon for a helicopter long-line to suddenly snag on a tree, log, stump, or forest debris, which can lead to disastrous outcome (NTSB, 1997).[14] Helicopter pilots have also been known to conduct external load operations with insufficient fuel on board, either unintentionally or intentionally (NTSB, 1997).[15] The main reasons are as follows: Task saturation can result in pilot inattention to a low fuel gauge. Exacerbating the problem is the fact that pilots often lift increasingly heavier loads as fuel is consumed. Doing so increases mental processing, resulting in a greater potential for inattention to an already low fuel gauge (Skjenna, 1986).[18] NTSB data and an NTSB recommendation to the FAA indicate "fuel starvation" as the most common type of probable cause related to crew error in helicopter external load accidents (NTSB, 1997).[15]

Pilot Fatigue

Heli-logging, as well as other helicopter external load operations (which are regulated under the Code of Federal Regulations, Part 133 [FAA, 1997]) include non-regulated flight crew duty periods. At times they exceed 10 hours per day for 10 consecutive days, and fly much of the time under conditions which are unfavorable for successful autorotation of single engine helicopters in the event of engine failure or loss of power. This practice may lead to pilot fatigue of sufficient magnitude to be hazardous. Decreases in aircrew function due to fatigue from overlong and repeat missions were well described during the Desert Shield Operation (Bisson, 1993).[1]

Ground Support Hazards

Ground crews supporting helicopter external load operations are frequently exposed to a number of potential hazards. For example, objects have fallen from external loads, striking and killing workers below (NTSB, 1997).[14] Others have been killed by walking or falling into a moving tail rotor (Crowley, 1993).[5] Loggers and construction workers must be especially cautious of rotor downwash (the downward movement of air at high velocity caused by the helicopter's rotors), which may knock down tree limbs and send construction debris flying in all directions. Another hazard, unique to external loads, is the high static electric shock potential of the steel long-line and hook, which must be allowed to touch the ground to discharge the static electric energy before being handled.

METHODS

NTSB Accident Briefs of CFR Part 133 helicopter external load operations in the U.S., 1980-1995) were reviewed and 65 data elements were entered into a computer database, and analyzed for descriptive information about the accidents. Denominator data (such as the total number of external load flight hours or the total number of lift cycles) was not available to determine the rate information necessary for a more in-depth analysis.

The NTSB and FAA define an aircraft "accident" as an event resulting in personal injury or substantial aircraft damage. There were 230 reported accidents. A "crash" is an accident subset which involves the impact of the helicopter body or its parts, resulting in personal injury or substantial aircraft damage. The terms are not interchangeable. Of the 230 reported accidents, 97% (222) were classified as crashes. The other eight (8) events involved the external load. For example, in one accident, a cedar block fell from an external load, fatally injuring a ground crewman (NTSB, 1997).[14]

For purposes of this study, NTSB accident data from 1980 through 1995 provided a sufficient data base and is available on the Internet and in diskette and paper format. NTSB data is collected on private and commercial accidents. Publicly owned and military helicopter external load accident data are not included in the report.

RESULTS

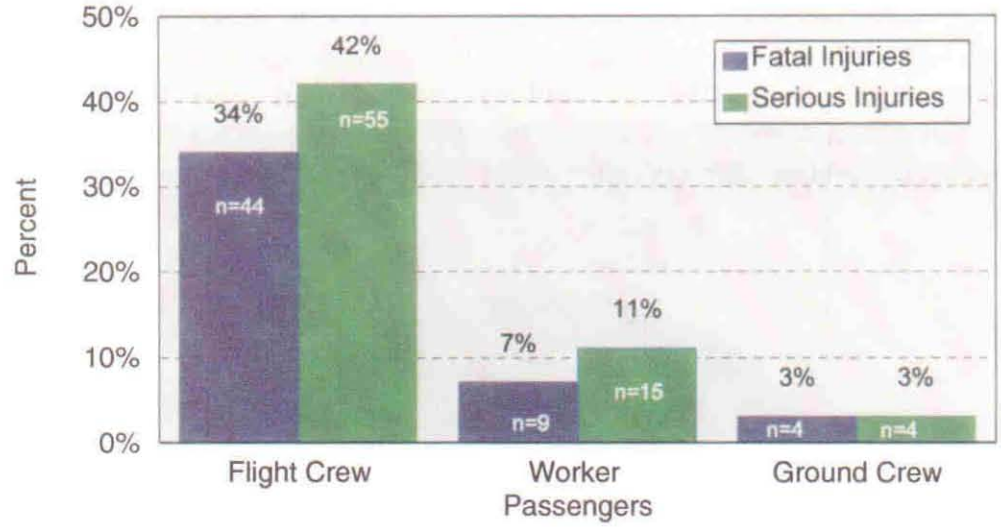
Work Crew Fatalities, Serious Injuries, and Pilot Age

There were 230 external load accidents, resulting in a total of 57 work crew fatalities (25% accident fatality rate), 44 flight crew fatalities (19% accident fatality rate), 74 serious non-fatal injuries to work crew (32% accident injury rate), and 55 serious non-fatal injuries to flight crew (24% accident injury rate) during the study period (Table 1 and Figure 2). The work crew distribution of fatal and serious non-fatal injuries combined were flight crew with 99 (76%), worker passengers with 24 (18%), and ground crew with 8 (6%) (Figure 3). Of the 230 accidents, there were 44 (19%) resulting in one or more fatalities, 51 (22%) resulting in one or more serious injuries, and 135 (59%) resulting in one or

Table 1. *Helicopter External Load Fatalities and Serious Non-Fatal Injuries in U.S.,1980-1995 by Work Crew (n=131)*

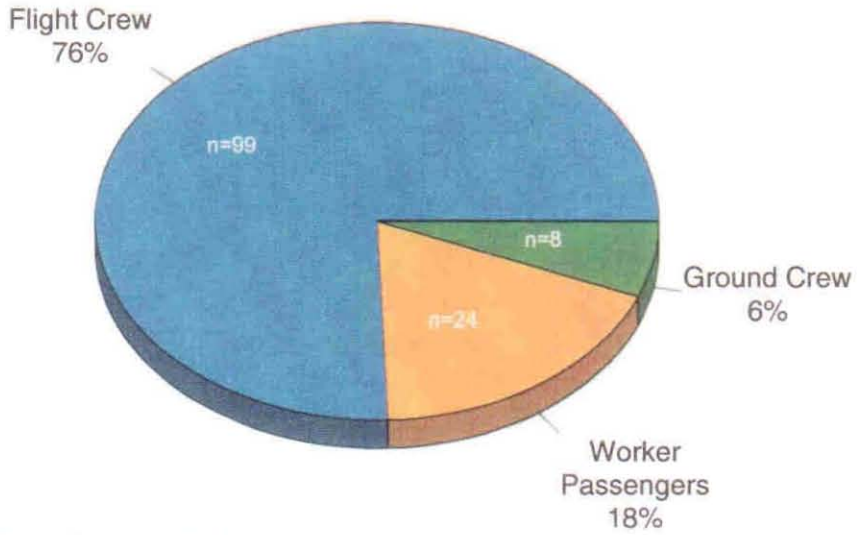
57 Total Fatalities = 230 Accidents	25% Fatality rate for work crew (flight crew, worker passengers, and ground crew)
44 Flight Crew Fatalities = 230 Accidents	19% Fatality rate for flight crew
74 Total Serious Non-Fatal Injuries = 230 Accidents	32% Serious injury rate for work crew
55 Flight Crew Serious Non-Fatal Injuries = 230 Accidents	24% Serious injury rate for flight crew

Source: NTSB Accident Briefs 1980-1995



Source: NTSB Accident Briefs 1980-1995

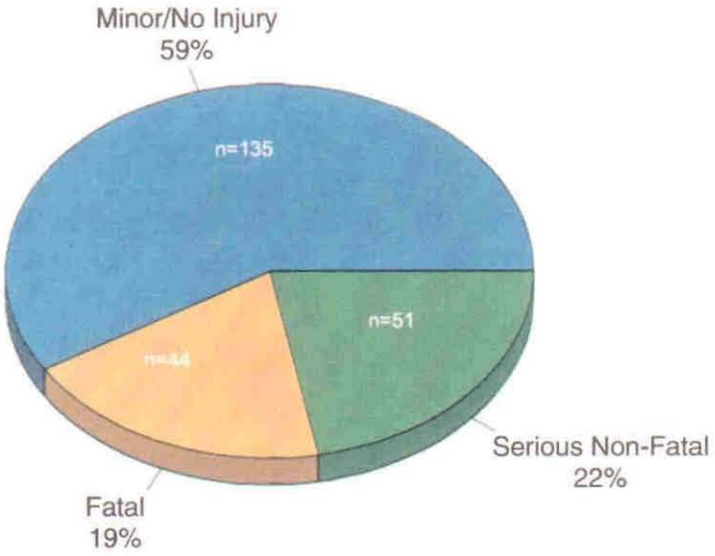
Figure 2. *Helicopter External Load Fatalities and Serious Non-Fatal Injuries in U.S., 1980-1995 by Work Crew (n=131)*



Source: NTSB Accident Briefs 1980-1995

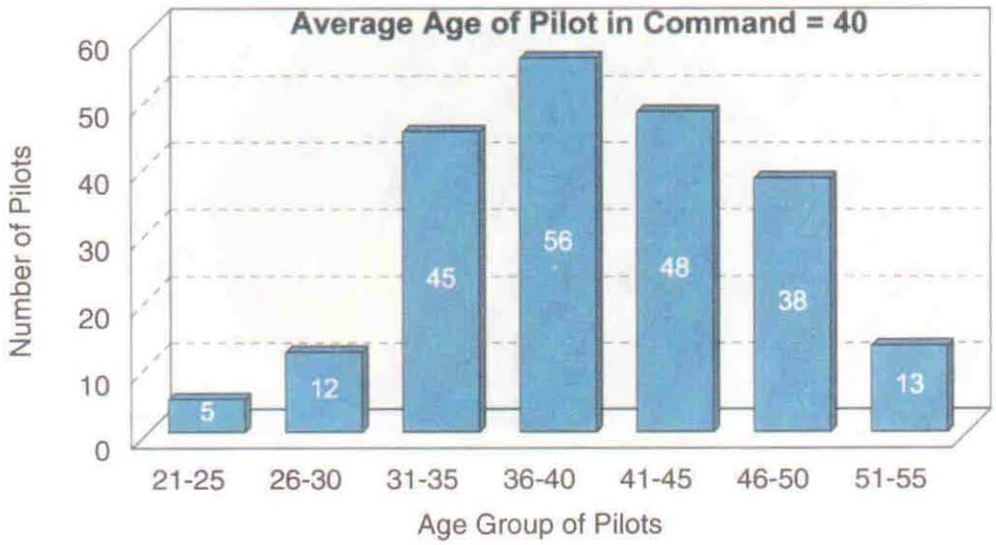
Figure 3. *Helicopter External Load Fatalities and Serious Non-Fatal Injuries in U.S., 1980-1995 by Work Crew (n=131)*

more minor or no injuries (Figure 4). This information indicates an excessively high rate of fatal and serious injury when helicopters crash while conducting external load operations. Although helicopters have the capability of autorotation for emergency landings, because of the location of most external load operations, being able to find an accessible and suitable emergency landing site is difficult. The average age of the pilot in command for 217 accidents (age data was not available for 13 pilots) was 40 (Figure 5). This information indicates a relatively older workforce age among helicopter external load pilots than the national average workforce age of 35 (USDOL, 1996).[22]



Source: NTSB Accident Briefs 1980-1995

Figure 4. *Helicopter External Load Accidents in U.S., 1980-1995 by Outcome of Accident (n=230)*

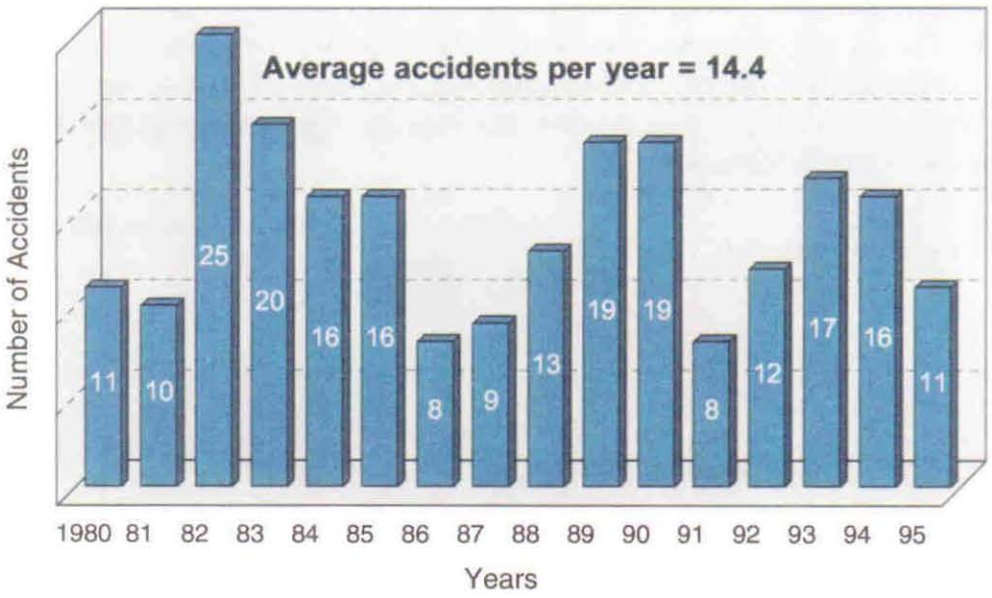


* Of the 230 accidents, age not available for 13 pilots.
Source: NTSB Accident Briefs 1980-1995

Figure 5. *Helicopter External Load Accidents in U.S., 1980-1995 by Age of Pilot in Command (n=217*)*

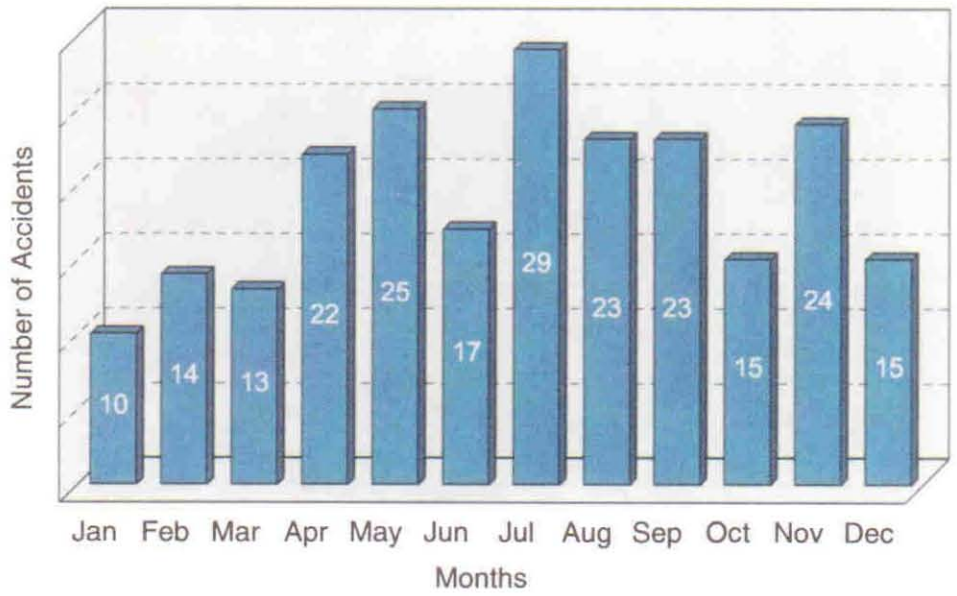
Accident Frequencies

The largest number of accidents (n=25) occurred in 1982, and a mean of 14.4 accidents per year was observed over the 16-year period of 1980-1995 (Figure 6). The majority of all external load accidents occurred during warmer weather, which may reflect the seasonal nature of these operations (Figure 7).



Source: NTSB Accident Briefs 1980-1995

Figure 6. *Helicopter External Load Accidents in U.S., 1980-1995 by Year (n=230)*



Source: NTSB Accident Briefs 1980-1995

Figure 7. *Helicopter External Load Accidents in U.S., 1980-1995 by Month (n=230)*

Flight Purpose

Of the 230 accidents, 65 (28%) occurred during heli-logging operations, and represent the largest portion of all external load accidents by type of operation. This was followed by 48 (21%) with an unspecified type of operation, 42 (18%) for construction, and 29 (13%) for miscellaneous cargo (Figure 8). As mentioned earlier, the 230 accidents resulted in 131 fatal and serious non-fatal injuries. The distribution of these fatal and serious injuries was 56 (43%) for heli-logging, 24 (18%) for construction, 15 (11%) for miscellaneous cargo, and 27 (21%) for all other operations (fire control, agriculture, seismic, christmas tree, and power line operations) (Figure 9). This data clearly indicates that in the event of an external load helicopter accident, heli-logging represents the operation of greatest risk for fatal and serious non-fatal injuries.

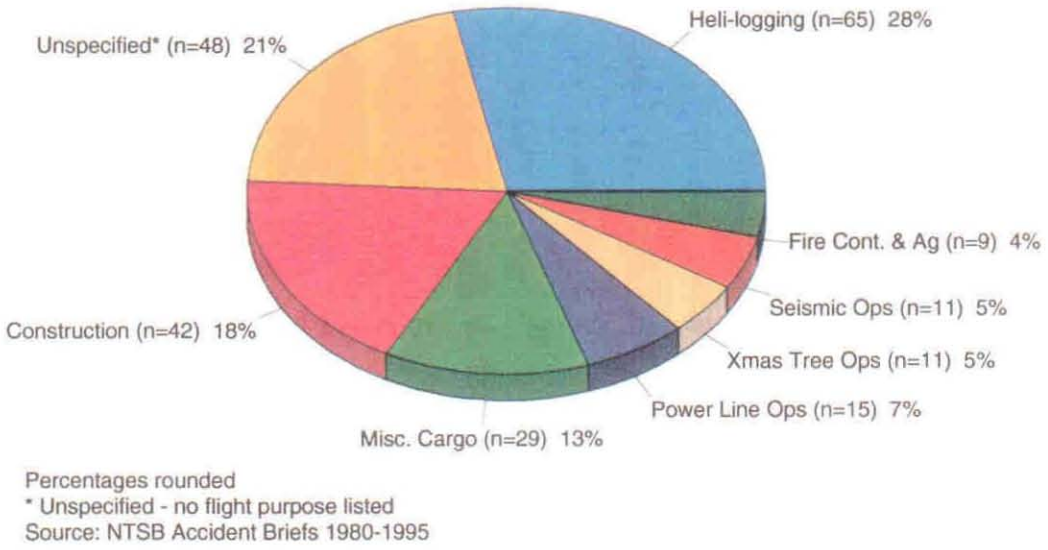


Figure 8. *Helicopter External Load Accidents in U.S., 1980-1995 by Type of Operation (n=230)*

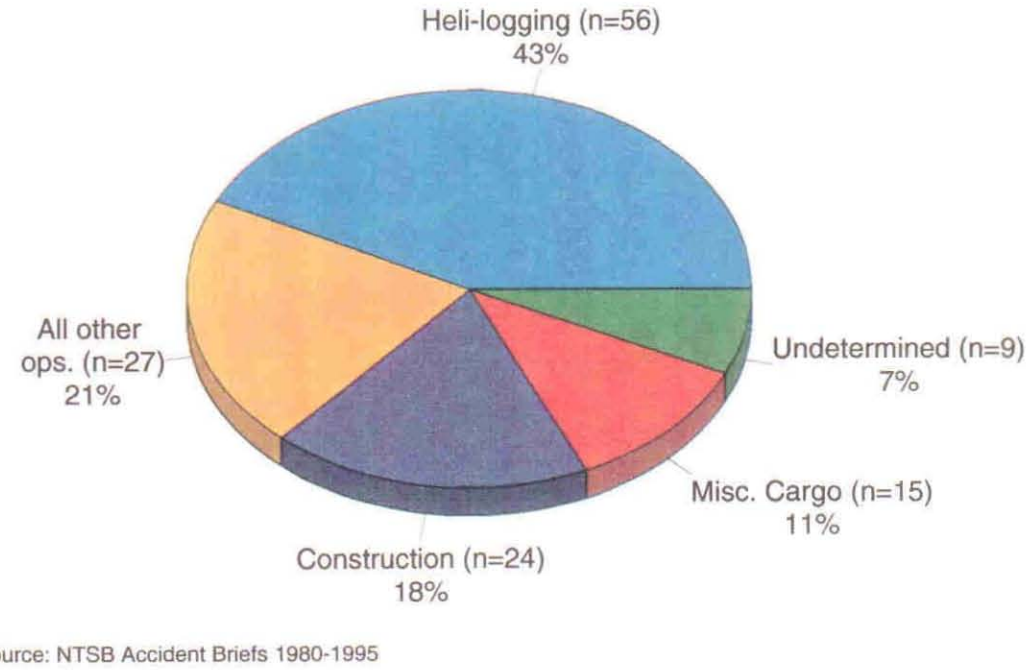


Figure 9. *Helicopter External Load Fatalities and Serious Non-Fatal Injuries in U.S., 1980-1995 by Type of Operation (n=131)*

State of Occurrence

California leads the U.S. in the number of all external load accidents, with 38 (17%), followed by Oregon with 29 (13%), Washington with 28 (12%), Alaska with 27 (12%), Utah with 12 (5%), and Wyoming with 11 (5%) (Figure 10). For heli-logging accidents, Alaska leads the U.S. with 14 (22%), followed by Washington with 11 (17%), California with 10 (15%), Oregon with 8 (12%), Idaho with 7 (11%), and South Carolina with 4 (6%). For construction related external load accidents, California leads the U.S. with 10 (24%), followed by Alaska and Wyoming with 5 (12%) each, and Colorado, Minnesota, and Utah with 3 (7%) each. For miscellaneous cargo related external load accidents, California leads the U.S. with 6 (23%), followed by Oregon with 4 (14%), Alaska, Hawaii, and Washington with 3 (10%) each, and Utah with 2 (7%) (Table 2). As indicated by this data, helicopter external load accidents occur predominately in the Pacific, Pacific Northwest, and rocky mountain states. Specifically, heli-logging accidents tend to occur predominately in the pacific northwest states. Accordingly, the data is consistent with the locations where most heli-logging and construction related helicopter external load operations occur (Proctor, 1994)[16].

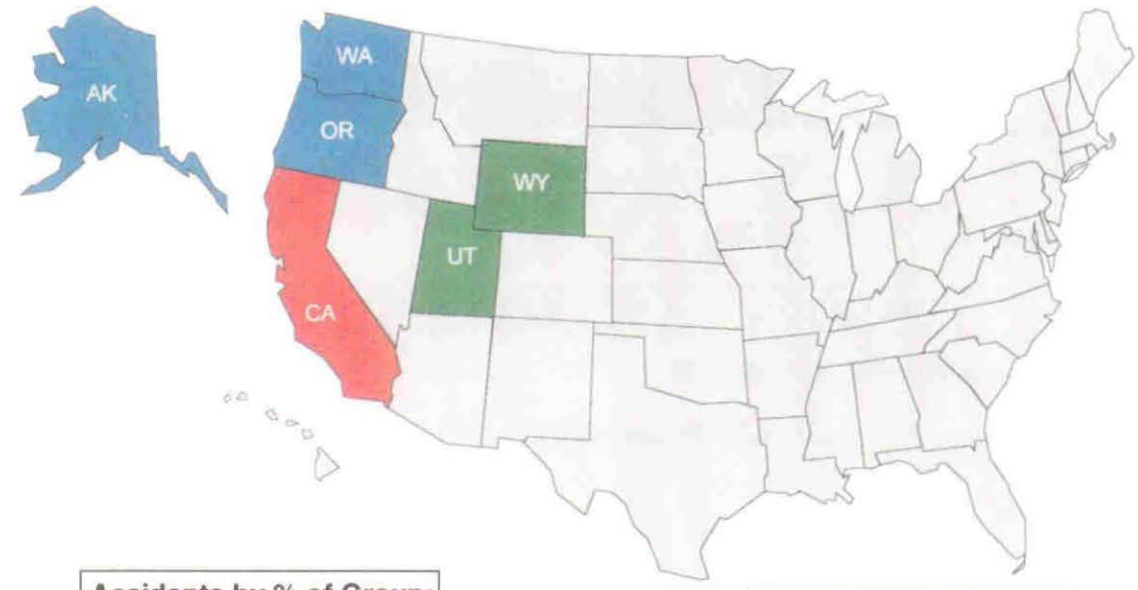
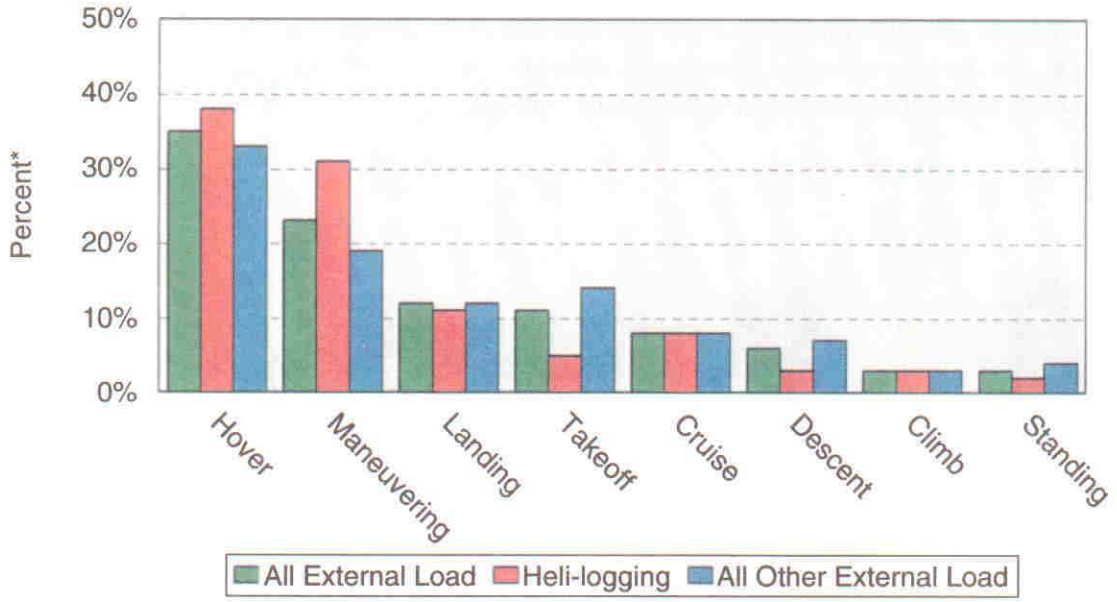


Figure 10. *Helicopter External Load Accidents in U.S., 1980-1995 by Top Six States*

Phase of Operation

Helicopter external load accidents most often occur during the hover and maneuver phases (35% and 23% respectively) (Figure 11). A marked difference is apparent within the maneuver phase between heli-logging and all other external load accidents. For heli-logging accidents, maneuver phases account for 31%, whereas for all other external load accidents, maneuver phases account for only 19%. As previously described, most helicopter external load operations are conducted in the hover and maneuver phases of flight. This places the helicopter dangerously within the height-velocity curve where successful landing is unlikely in the event of an in-flight emergency. The problem is further complicated with heli-logging where suitable emergency landing sites are scarce due to rough, uneven, and mountainous terrain.



Source: NTSB Accident Briefs 1980-1995 *Percentages rounded

Figure 11. *Helicopter External Load Accidents in U.S., 1980-1995 by Phase of Operation (n=230)*

Probable Causes

External load accidents were analyzed for probable cause (Figure 12). Among the 230 external load accidents, the NTSB indicated that flight crew or pilot error accounted for 102 (44%). Mechanical failures of all types accounted for 88 (38%). Improper or inadequate maintenance was cited as the probable cause in 23 (10%) of the accidents, and as a contributing factor in 21 (9%) additional accidents where the probable cause was listed as pilot error and maintenance error.

A considerable difference in the probable cause is noted between heli-logging and all other external load accidents (Figure 12). Pilot error was listed as the probable cause in 29% of heli-logging accidents, compared to pilot error listed as the probable cause in 50% of all other external load accidents. Mechanical failure was listed as the probable cause in 63% of heli-logging accidents, compared to mechanical failure listed as the probable cause in only 28% of all other external load accidents. Accidents due to specific mechanical failures such as engine parts, main rotor drive parts and tail rotor drive parts were more than twice (2.25) as likely to occur as the probable cause in heli-logging than in all other external load accidents. Pilot error was cited as the primary probable cause more frequently in all

other external load accidents than in heli-logging accidents (50% v.s. 29%). The most common source of specific pilot error in heli-logging accidents was fuel starvation (11%). Fuel starvation in all other external load accidents accounted for 9%.

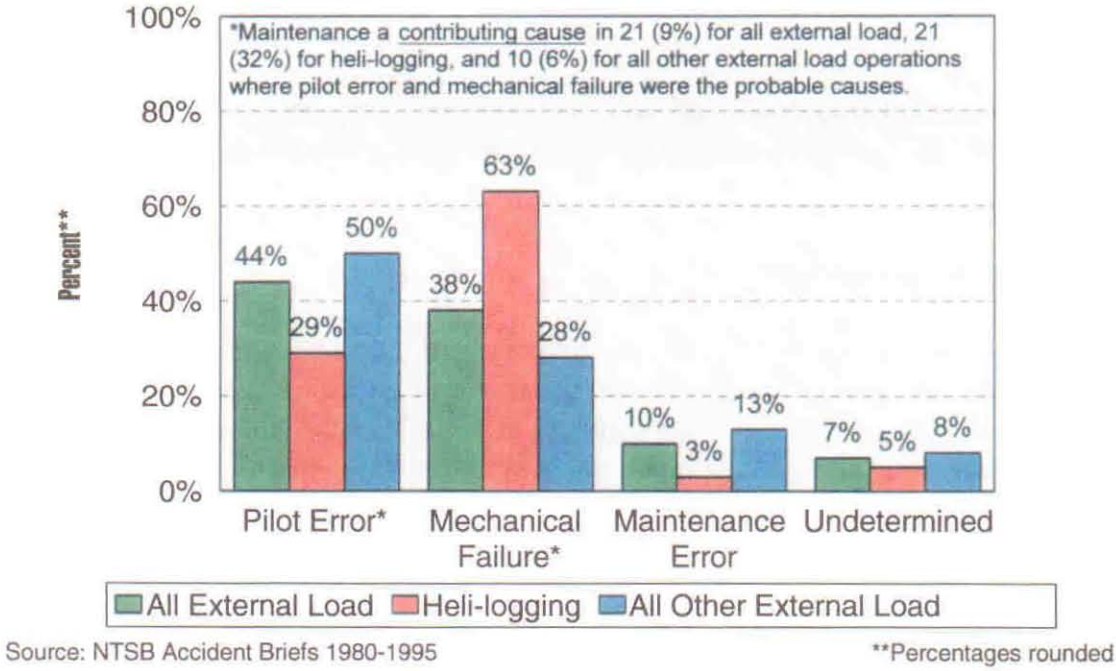


Figure 12. *Helicopter External Load Accidents in U.S., 1980-1995 by Probable Cause Category (n=230)*

DISCUSSION

During 1992-93, six Alaska logging helicopter crashes occurred in an 18-month period. In response, an Interagency Working Group was formed (the Alaska Interagency Working Group for the Prevention of Occupational Injuries). The following illustrates that what started as a response to prevent logging helicopter injuries in Alaska, has the potential to reduce helicopter external load injuries throughout the U.S., and other countries involved in similar operations (Figure 13).

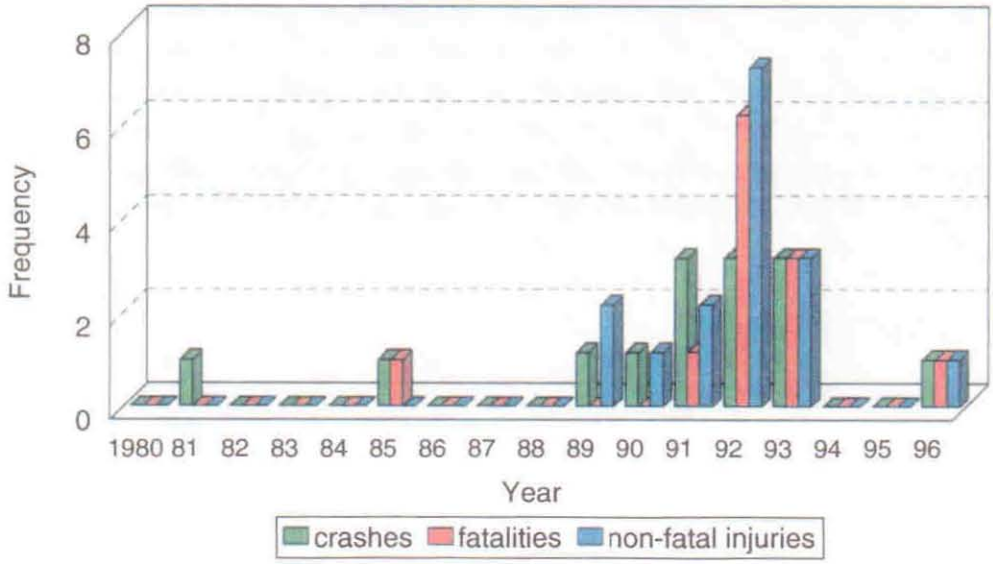


Figure 13. *Alaska Helicopter Logging Operations, 1980-1996*

Emergency Interagency Meeting

Our office convened an emergency meeting in Anchorage on July 8, 1993, to discuss approaches for reducing the number of logging helicopter crashes and ameliorating the outcome of crash injuries. The meeting was attended by representatives from the Alaska Interagency Working Group for the Prevention of Occupational Injuries (consisting of the Alaska Department of Health and Social Services, Alaska Department of Labor, FAA, NTSB, OSHA, U.S. Coast Guard, the U.S. Forest Service, and NIOSH). The working group recommended countermeasures or injury prevention interventions (CDC, 1994).[3]

FAA and State DOL Oversight

During the summer of 1993, the FAA and the Alaska Department of Labor increased their inspectional oversight of flight and ground operations at helicopter logging sites. Also, during this same period of time, two of the helicopter logging companies with the most operating problems, and who each accounted for three of these serious crashes, closed down their Alaska operations. Fortunately, there are other helicopter logging companies in Alaska with outstanding safety records, that had already implemented the safety recommendations made by the Working Group. As a result, there were no logging helicopter crashes or injuries in Alaska from 1994 through 1995, and a single crash, resulting in one pilot fatality and one pilot serious non-fatal injury in 1996, (Figure 13).

Helicopter Logging Safety Workshops

Because of the previous Alaskan experience, a rising concern for helicopter logging safety nationwide, and a projected increase in heli-logging due to environmental restrictions and economic factors, the Alaska Interagency Working Group for the Prevention of Occupational Injuries and NIOSH sponsored two Helicopter Logging Safety Workshops in Ketchikan, Alaska, on March 1-2, 1995, and February 28-29, 1996. The Workshop objectives were to: describe and analyze the risks of helicopter logging; share new helicopter logging practices and technology; foster safety research in helicopter logging operations and technology; review current regulations governing helicopter logging; consider helicopter logging safety training opportunities and options; and draft consensus safety recommendations for helicopter logging (Klatt, 1996).[12] The approximate 100 workshop participants; represented twelve helicopter logging companies, four helicopter manufacturers, four industry associations, five federal agencies, two state agencies, six logging companies, one university, and a representative from the Helicopter Association of Canada. Using a consensus-building group process to determine possible root causes, countermeasures, and action plans, workshop participants drafted additional safety recommendations for injury prevention in helicopter logging (Klatt, 1996).[12] These are summarized in the recommendation section.

HAI Helicopter Logging Committee

The Helicopter Logging Safety Workshops resulted in the formation of the Helicopter Logging Committee under the auspices of the Helicopter Association International (HAI). The committee is composed of individuals from helicopter logging companies, manufacturers, insurance companies, governmental agencies, and other organizations who share an interest in heli-logging safety. According to the Helicopter Logging Committee's Terms of Reference, "The committee was formed to help promote

the safe use of helicopters in all aspects of the helicopter logging industry." (HAI, 1997)[10] The Committee is currently drafting it's own "Helicopter Logging Guidelines," which address four issues: (1) General Helicopter Safety for Forestry Operations, (2) Integration of Ground and Flight Activities, (3) Helicopter Specific Planning, and (4) a Pre-Accident Plan (HAI, 1997).[9]

Helicopter Manufacturers and the NTSB

Other recent strategies for injury prevention in helicopter logging are being planned by helicopter manufacturers and the NTSB: Because of the disparity in mechanical failure between heli-logging (63%) and non-heli-logging (28%), helicopter manufacturers are recommending much more frequent maintenance (i.e., a much lower maintenance cycle life time) for helicopter parts involved in heli-logging operations (HAI, 1997).[8] Also, on January 9, 1997, the NTSB issued four recommendations to the FAA based on a recent external load helicopter crash in San Jose, California which resulted in two pilot fatalities: (1) require all external load pilots to receive regular training in external load operations, and to demonstrate acquired knowledge and skills; (2) require crew safety briefings during pre-flight preparations; (3) require that all external load helicopter flight manuals include procedures for fuel quantity and fuel reserve planning; and (4) require periodic recalibration of fuel quantity indicating systems, and establish appropriate minimum fuel requirements for external load operators (NTSB, 1997).[15]

RECOMMENDATIONS

The following recommendations were developed as a result of the Helicopter Logging Safety Workshop held in Ketchikan, Alaska, March 1995. Although the recommendations focus on preventing logging helicopter accidents, many of them can be implemented for preventing all types of external load helicopter accidents (Klatt, 1996)[12].

Equipment

- The use of multi-engine helicopters is recommended for heli-logging.
- The design, weight & balance, and operating limitations established by the manufacturer must not be exceeded.
- Heli-logging equipment and components should be certified by the FAA, and overhauled in accordance with the manufacturers documentation or manuals.

Maintenance

- The heli-logging industry should establish standards for sound maintenance procedures.
- Adequate facilities should be available for the level of maintenance to be accomplished.
- An FAA-approved maintenance program should be established.
- Only FAA-approved parts should be used.

- All flight-critical components should have accurate historical records.
- All maintenance work should be inspected prior to sign-off by certificated authority.

Human Factors

- The use of a qualified second pilot is recommended for heli-logging.
- Companies should develop and publish standards for maximum flight and duty time.
- Companies should establish and enforce standards and methods to monitor unsafe attitudes and unsafe types of competition.
- The use of drugs and alcohol in heli-logging should be prohibited, and heli-logging camps should be dry.
- There should be random drug and alcohol testing in the event of a mishap.
- The FAA should not be permitted to sanction, by way of irrevocable certificate action, those individuals entering voluntary drug and alcohol rehabilitation programs.
- NIOSH should conduct or sponsor a study of cockpit environment design for improvement of comfort and safety, and chronic injury reduction.

Training

- Helicopter model-specific and flight-specific training should be provided for heli-logging operations.
- Flight and ground crew coordination training should be provided for all heli-logging crews.
- Companies should provide maintenance training in specific helicopter models, special inspections, and documentation of maintenance operations.
- Companies should provide recurrent documented training for flight crews and mechanics.

Management

- A heli-logging association should be established to serve as a forum and spokesman for the heli-logging industry.
- Companies should be encouraged to develop a strong safety culture within upper level management.
- Mid-level managers should be trained on the concepts and responsibilities of developing a strong safety management culture.

- Employees should be encouraged to report safety violations without fear of punishment.
- Companies should specifically designate a safety manager, with a specific job description.
- The safety manager should receive formal training on a continuous basis.
- Companies should establish an employee/management safety committee.
- All employees should participate in the management of safety.
- Company officials and employees should be made aware of the cost-benefits of an accident-free operation.
- Companies should establish task termination safety rules.

Oversight

- FAA must promptly enforce all known rule violations.
- Staff of all local FAA Flight Standards District Offices (FSDO's) should be trained in all pertinent aspects of heli-logging operations.
- Companies should be required to give prior notification to the local FAA FSDO's concerning any proposed helicopter logging operations in their service area.

Interagency/Company Cooperation

- Establish a helicopter logging association and encourage membership.
- Companies should establish communication between each other when conducting heli-logging operations in close proximity.
- Companies conducting heli-logging operations in the same areas should establish joint EMS and emergency action plans.
- Companies and agencies should develop and disseminate a contractor's safety check list.
- Companies and agencies should assist each other in writing and disseminating incident and accident reports.
- Companies and agencies should develop and disseminate Standard Operations Procedures manuals.

Environment

- Companies should provide improved and continual training concerning environmental hazards for all helicopter logging crews.

- Companies should establish improved communication and educate U.S. Forest Service, state agencies, and environmental group personnel concerning the necessity of more adequate helicopter emergency landing zones, and concerning the potentially hazardous combination of danger trees and rotor downwash.

CONCLUSIONS

Helicopter external load operations are expanding in the U.S. and abroad.[7, 16, 19] There is a need to obtain exposure or denominator data (number of flight hours or flight cycles) within the helicopter external load industry so that injury rates can be estimated and compared to other industries. Helicopter pilots and ground crews involved in external load operations, especially helicopter logging operations, face an extremely high risk for severe traumatic injuries in the event of a crash. Inadequate equipment, improper operational and/or maintenance practices, and the lack of adequate inspectional surveillance of helicopter logging operations (to ensure equipment and operational compliance) have been frequently cited as the factors most strongly associated with the risk of crashes. The risks for fatal and serious injuries in all helicopter external load operations should and can be reduced by scrupulous attention to the needs of equipment, pilots, and crew. To minimize these hazards, external load operators (and especially helicopter logging operators) should: (1) adhere not only to existing regulations, but also to manufacturer recommendations for load, lift cycle, and other appropriate applications, (2) ensure that helicopters and equipment receive more frequent and intensive maintenance, and (3) require that pilots and crew receive improved training. The Alaska experience has shown that helicopter logging can be extremely hazardous. However, it has also shown that careful attention to identifying and minimizing the risks and hazards can make all helicopter external load operations safer.

REFERENCES

1. Bisson RU, Lyons TJ, Hatsel C [1993]. Aircrew fatigue during Desert Shield C-5 transport operations. Aviat Space Environ Med *64*:848-853.

2. Bradley P [1997]. Aviation safety statistics. Business and Commercial Aviation *80*(2):43-46.

3. CDC (Centers for Disease Control and Prevention) [1994]. Risk for traumatic injuries from helicopter crashes during logging operations — Southeastern Alaska, January 1992-June 1993. MMWR *43*(26):472-475.

4. Conroy C, Russell JC, Crouse WE, Bender TR, Holl JA [1992]. Fatal occupational injury related to helicopters, U.S. 1980-1985. Aviat Space Environ Med *63*:67-71.

5. Crowley JS, Geyer SL [1993]. Helicopter rotor blade injury: a persistent safety hazard in the U.S. Army. Aviat Space Environ Med *64*:854-858.

6. Office of the Federal Register. Code of Federal Regulations, Vol. 14, part 133. Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, January, 1992.

7. Georgia Forestry Commission. Harvest by helicopter— a new way of logging. Georgia Forestry. September, 1986.

8. Helicopter Association International (HAI). Anecdotal information from the Helicopter Logging Committee Meeting. Anaheim, CA, February 3, 1997.

9. Helicopter Association International (HAI). Helicopter Logging Committee Helicopter Logging Guidelines [draft]. Alexandria, VA, January, 1997.

10. Helicopter Association International (HAI). Helicopter Logging Committee Terms of Reference [draft]. Alexandria, VA, January, 1997.

11. Herlihy DR [1996]. Helicopter logging mishaps: applying lessons in an expanding industry. Proceedings of the International Society of Air Safety Investigators, ISASI Forum *29*(3): 21-32.

12. Klatt M, Hudson D, Conway GA, eds. [1996]. Proceedings of the Helicopter Logging Safety Workshop, March 1-2, 1995, Ketchikan, AK. Alaska Interagency Working Group for the Prevention of Occupational Injuries, Anchorage, AK.

13. Lindamood M [1996]. Helicopter logging from a pilot's perspective. In: Klatt M, Hudson D, Conway GA, eds. Proceedings of the Helicopter Logging Safety Workshop, March 1-2, 1995, Ketchikan, AK. Alaska Interagency Working Group for the Prevention of Occupational Injuries, Anchorage, AK, pp. 76-81.

14. National Transportation Safety Board (NTSB). Code of Federal Regulations, Vol. 14, part 133, Accident Briefs (Helicopter External Load Operations), 1980-95. Washington, DC: U.S. Government Printing Office, January, 1997.

15. National Transportation Safety Board (NTSB). NTSB Safety Recommendation A-96-180-183 Washington, DC, National Transportation Safety Board, January 9, 1997.

16. Proctor P [1994]. Ecological benefits boost heli-logging. Aviation Week and Space Technology *140*:65.

17. Prouty RW [1985]. Helicopter aerodynamics. Phillips Publishing, Inc., Potomac, MD, p.80.

18. Skjenna O [1988]. Cause factor: human. A treatise on rotary wing human factors. Canadian Government Publishing Center, Ottawa, Canada, pp. 40-46.

19. Stehle TC [1990]. Helicopter logging of valuable furniture from natural rain forest in the Southern Cape. South African Forestry Journal *155*:51-53.

20. Transportation Safety Board of Canada (TSB) [1991]. Aviation occurrence report: Hydra Management Ltd. Aerospatiale 332c Super Puma (Helicopter) C-GQRL, Quantam River, British Columbia, 03 October 1987 TSB.

21. University of Southern California (USC) Institute of Safety and Systems Management [1992]. Aircraft accident investigation manual. Los Angeles, CA.

22. U.S. Bureau of Labor Statistics [1996]. Occupational injuries and illnesses: counts, rates, and Characteristics, 1993. Washington, DC: U.S. Government Printing Office.

CHAPTER II
EQUIPMENT AND MAINTENANCE

HELICOPTER LOGGING SAFETY: MANUFACTURER'S CONCERNS

By Roy Fox, Product Safety Chief, Bell Helicopter Textron, Inc.

The helicopter manufacturer generally does not hear from operators of his aircraft except when there are problems. In the safety world, this may be during an accident investigation. Thus we see a variety of operators. As a general trend, those operators with good safety records tend to own their aircraft, operate and maintain them properly, use approved parts, and ensure adequate rest for their employees. Conversely, some of those operators with poor safety records tend to be those who exceed operating parameters, use salvaged parts and surplus parts, and fly in bad weather.

Why do military surplus helicopters have a poor safety record? These aircraft tend to be cheaply maintained and attract surplus parts, bogus parts, and salvaged parts, and are doing low profit jobs. A very cheap operation will tend to use overworked and under-qualified pilots. Although some operators of military surplus helicopters do a good job, many operators do not. Abusive use of the aircraft beyond what it was designed to do safely is a major factor. For example, the accident rates per 100,000 hours during the period of 1986-1992 for military surplus UH-1 aircraft is high compared to civil aircraft (Figure 1).

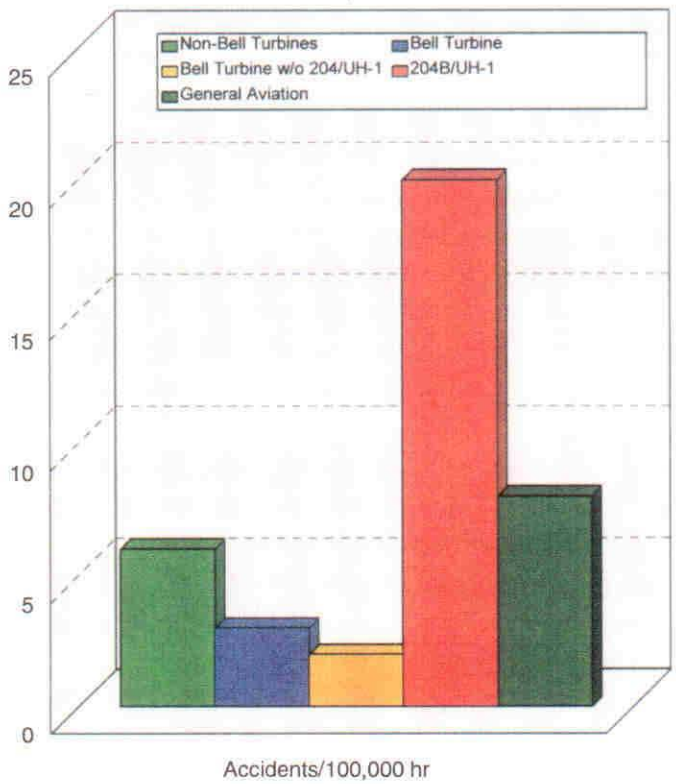


Figure 1. *Civil Aviation Aircraft Safety NTSB/FAA 1986 - 1992*

The 10-place military surplus UH-1 closest look-alike is the civil turbine-powered Model 204B. The worldwide accident rate per 100,000 hours for the UH-1 military surplus helicopter in civil use is over two times higher than the civil certificated Model 204B (Figure 2). Some of these aircraft called 204B are counterfeits introduced by putting a real 204B aircraft data plate on a military helicopter.

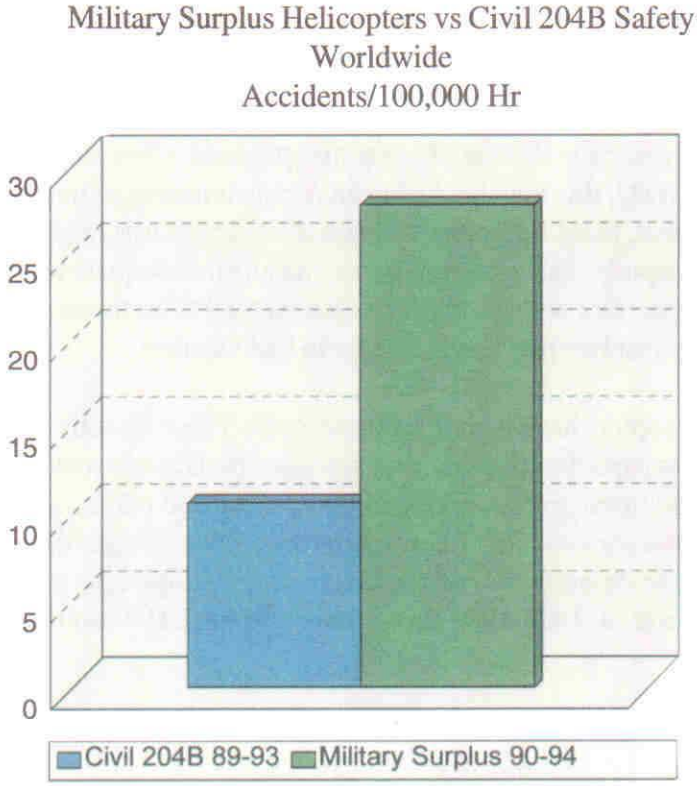


Figure 2. *Surplus vs Civil 240B Safety*

Accident causes are different in external load/logging missions as compared to other types of operations. Abusive use during external load/logging causes part failures. This is related to subjecting the aircraft systems to conditions for which they are not designed. For example, for Bell turbine helicopters (civil and military surplus) in worldwide use for all missions, the Bell parts failures (e.g., parts other than engine) account for 5.6% of the accident causes (Figure 3). For the Bell turbine helicopters used in external load/logging, 17.3% of the accidents are due to Bell parts failing. This large increase is due to abusive overloading in operation, improper parts, and improper maintenance.

Each model of helicopter is initially designed to a mission profile that includes a varying percentage of time spent in each of the flight phases. In some flight phases some components are higher loaded than in others. For example, the tail rotor and its drive train are very lightly loaded while in cruise flight, whereas the tail rotor is providing maximum thrust at an out-of-ground hover. In addition, the helicopter components are also designed to a maximum number of high torque events per flight hour. All of this results in the retirement lives and overhaul schedules of helicopter components. Helicopters operating outside of these design limits have generated part failures. Logging with helicopters can be putting much higher stress on the parts than you realize. A recent development is to determine the damaging flight events and to better calculate when a part needs to be removed and destroyed to prevent in-flight failure. This latest system is the Retirement Index Number (RIN). A RIN basically counts the number of damaging torque events in a cumulative manner. When that part reaches its RIN value, that part is to be immediately removed and destroyed. The RIN also allows an authorized part

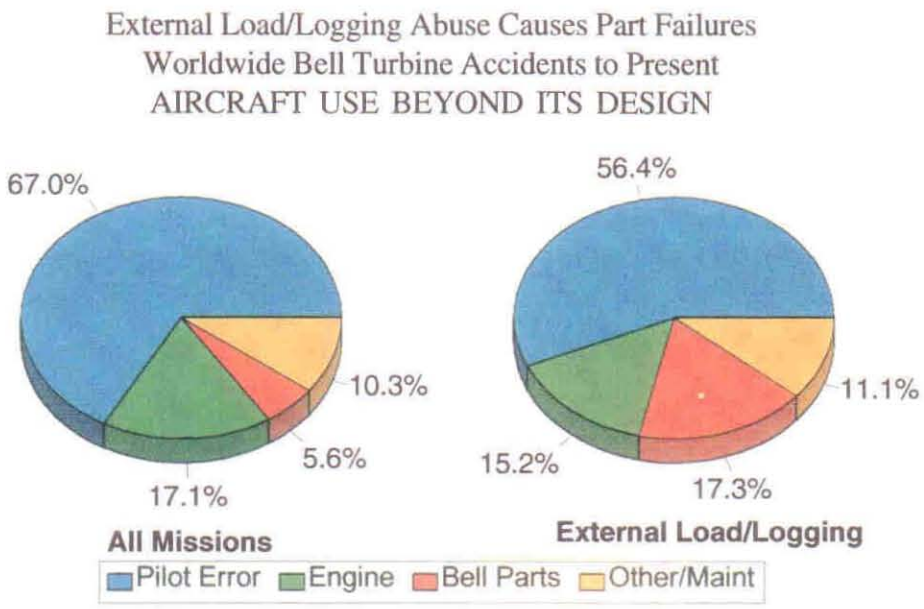


Figure 3. *Accident Causes are Different in Logging*

to be used on several models where the stresses are different in each model. For example, the 204-011-450-105 main rotor mast has a total RIN of 240,000. This mast can be installed in the 204B, 205A1, and 212 with a fatigue life different in each model. While the mast is in a 204B, each takeoff counts as one RIN and each logging lift counts as two RINs. The same mast installed in a 205A1 would count each takeoff as two RINs and each logging lift as four RINs. Similarly, the same mast in the 212 would count each takeoff as four RINs and each logging lift as eight RINs.

In January 1989, Bell sent a letter to the FAA alerting it that the military surplus aircraft were designed to a different spectrum than repeated heavy lift use. Thus the original qualification data is of no value in quantifying the cumulative damage for repeated heavy lift to allow definition of suitable retirement schedules and maintenance practices. NTSB Safety Recommendations A-92-125 and A-92-126 acknowledged this situation by noting that UH-1 was produced to meet military specifications as a utility vehicle. Accordingly, Bell's recommended component overhaul and retirement schedules were based on the UH-1s primary use as a utility helicopter.

The risk to a helicopter is the frequency of accidents per 100,000 flight hours which is commonly referred to as accident rate. This is not the risk to the occupants on board. The Risk of Serious Injury (RSI) is the individual occupant's risk of a fatal or major injury per occupant hour of exposure. It is essentially the likelihood of an accident times the likelihood of a serious (major or fatal) injury. It is calculated by:

$$RSI = \frac{\text{Accidents}}{\text{Flight Hours}} \times \frac{\text{Number Seriously Injured}}{\text{Number of Occupants Onboard}}$$

Considering U.S. registered helicopters for 1986 through 1992 from NTSB/FAA data, the Risk of Serious Injury per 100,000 occupant hours for an occupant in the 204/UH-1 surplus helicopter was 9.48 as compared to 4.18 in a 205A1 and 1.13 in a 206. An individual's risk is significantly higher in the military surplus helicopters being used in logging/external load operations for which they were not designed.

The legendary Phoenix bird rose from the ashes to fly again and again. Phoenix helicopters can too! The aircraft data plate rises from ashes of a destroyed helicopter to fly again. Such aircraft are counterfeits and are not the original aircraft that met the original certification. Counterfeit aircraft are those which have been illegally converted from military surplus or built up from salvaged and spare parts and are being passed off as genuine commercial aircraft. Such aircraft are disproportionately more likely to be involved in accidents. These aircraft do not meet commercial certification requirements. Because of their low cost, they are magnets for salvaged, surplus, and bogus parts. Low cost also attracts poor maintenance. If these aircraft carry people, they will be a serious competitive threat to anyone with a civil certificated helicopter.

The problem will worsen. The U.S. Army is in the process of surplusing several thousand turbine-powered military helicopters. These military aircraft and parts present special problems. The military procures many parts from non-Bell sources which have historically not been required to meet the Bell quality specifications. The military sets the fatigue lives of components which may be different from those Bell sets on the same part in commercial service, because it operates and maintains them in a different manner and in a different operational environment. Military maintenance histories are rarely available with surplus parts and may not be useful if available. The only certainty with military surplus parts is that they do not have the same predictability as commercial parts.

How can you reduce your risk? To reduce the aircraft risk, you should use aircraft and OEM parts that were designed for your environment. Do not use military surplus aircraft or military surplus parts. You should religiously follow the manufacturer's maintenance and operating requirements. Always observe appropriate rest for crew and maintenance personnel. DO NOT USE ABUSIVE OPERATIONAL TECHNIQUES SUCH AS SNATCHING A LOAD OFF THE GROUND. NEVER EXCEED THE EXTERNAL LOAD LIMIT.

How can you reduce your risk of injury? The pilot should always use a shoulder harness with an inertia reel during flight operations. You can still lean to the side to observe the load. In an emergency, immediately sit straight up with your shoulders against the seat back. The inertia reel will take up all of the shoulder harness slack. This use of a shoulder harness increases your non-injury tolerance in a vertical crash by a factor of six times. The shoulder harness will also reduce the amount of upper body flailing in an emergency which should allow the pilot to control the aircraft and possibly avoid a injurious impact. Use the Energy Attenuating Crew Seat (Kit P/N 412-706-001-111) in a 212 to keep spinal crash loads tolerable without injury.

The good news is that for public service aircraft operators, Bell will still provide product support engineering on a par with operators of commercial aircraft. If you are a commercial operator of a military surplus helicopter, you should look first to your Type Certificate holder for repairs, continuing airworthiness support, service bulletins, and manuals. On military surplus helicopters manufactured by Bell, Bell will provide some limited support on a fee paid basis. Bell and other entities can provide maintenance training on UH-1 and OH-58 aircraft.

KEEP IN MIND THAT FORCING AN AIRCRAFT TO OPERATE BEYOND WHAT IT WAS DESIGNED TO DO WILL HAVE SERIOUS SAFETY CONSEQUENCES.

QUESTIONS AND ANSWERS

UNIDENTIFIED VOICE: On a couple of your charts you shared the world versus the U.S. statistics on accidents; why were there no accident statistics available for the 214B in the United States?

MR. FOX: The FAA has a serious problem of knowing what is out there. They lump the 204B and all the UH-1Bs, Ls, Ks, and all those together. In the 214 arena, they lump the 214 ST, a twin-engine, 20-place machine in the 214B, which is a 15-place, single-engine machine that's for a totally different mission.

UNIDENTIFIED VOICE: Well, there's only about one or two 214 STs that have ever operated in the United States. I mean it'd be easy to break those numbers out, wouldn't it?

MR. FOX: It's not a question of being easy, it's the way the FAA operates. When they send out surveys to you guys, I hope you all are responding, because they generally don't get a good response back. That's the way they group their models, and that's why I don't have 204Bs in the U.S. for the same reason, because the FAA doesn't break down the hours. I can tell you the accidents, but I can't do the exposure.

One of the things I'd like to say to you, as an operating group, all you guys together, is put together your flight hours so that you've got some information. You don't have to rely on what you heard this morning. You need to know how many hours you're really flying in logging. That really needs to be pulled together as an industry.

I've mentioned the Gulf of Mexico and the ASAC organization. Well, members of that organization, different companies, submit their total hours for the year, and they're published as a total group for the Gulf of Mexico, and that's why they look so much better. You guys have got to start working together on your overall image.

MR. MARK LINDAMOOD (Carson Helicopters): You mentioned earlier that it wasn't the engine, it was other parts made by other manufacturers. My accident was a freewheeling unit exploding. Several other people that were involved in these accidents experienced the same thing. You're the certification man. I mean your factory built the aircraft and okayed these parts, and they were 204 parts with thyroid injections that boosted them up to a 214 part, and so, eventually, after a few guys got killed field testing the aircraft, then you went to a bigger, heavier clutch assembly. So, I think that Bell should take a little responsibility for that, on that chart, and say that it is your aircraft.

MR. FOX: I understand your sensitivity to this, and I probably would be saying the same thing sitting in your chair. The clutch was not the best we ever did on the 214B. We've learned a lot about clutches since then.

I'm not trying to shirk the responsibility, sir. There's nobody that wants that any more than the operator. You know, the manufacturer has a vested interest beyond the people that got hurt and lost the machine. We have a vested interest because we may have that same problem throughout the world and we need to get the problems corrected as quick as we can. And that's why Bell pays for investigators to go out, at company expense, and support the investigation, to find out what these problems are and fix them.

MR. LINDAMOOD: Well, one other comment about your investigators. On my accident Bell sent two investigators out. Their Bell pilots flew the 214 back into the log landing and they thought it was acting funny so they punched it off from about 100 feet, so that kind of screwed up the accident investigation a little bit, because it had another crash from their dropping it. Then the clutch assembly, the whole clutch assembly was lost at Bell. They couldn't find the parts when it came time to actually get into the thing. So, when a manufacturer goes out to investigate an accident, I think that there might be a little bias in that and we need to have more people from the FAA and the NTSB looking into these things.

If the FAA did their jobs, there wouldn't be a lot of these problems. But they sit on their hands and they argue back and forth between each other's agencies. The FAA and the NTSB need to get out there and investigate these accidents, along with the manufacturers, all of them, Sikorsky or Bell or whatever, but keep an eye on things while they're doing it and make sure that there's no bias or anything that might help protect the manufacturer's interest.

MR. FOX: Well, I must respond to that. Let me tell you what is in place to make sure there's not even a question of that. We do not investigate an accident, we support the investigator in charge. Here in Alaska it will be the NTSB or the FAA. Either way we support that investigator. If it's Forest Service, we support the investigator.

Now, when there's a questionable part we offer our lab's assistance at no cost to the investigating agency or the operator if they want to bring the part to Bell. If they do that, they send it to Bell, and it is under the government control. We call the local NTSB guy, say the part is here, when do you want to look at it? He says, tomorrow. So, tomorrow we open up the box with the NTSB person there and say, "All right, here it is." An inventory's done. "What do you want to do?" The NTSB says, "Let's do this, let's do this, let's do this." And we just go with whatever he wants to do. Then when it's finished, we say, "Sir, where do you want it sent?" And he'll turn to the operator if he's there, and say, "Where do you want this part? Do you want it scrapped or do you want it back?" He says, "Yeah, I want it back. Send it to this address." We box it up and send it.

We do that to make sure that Bell never has control of that part and the investigation is always under the control of the investigating agency, whether it be military, U.S., or foreign, or civil. It doesn't make any difference. We don't take those parts.

Now, what you're talking about is a real old accident. And I really can't speak for that far back. But a manufacturer cannot have people thinking like you're thinking. We just can't. We have to get out there and find out what it is and get it fixed. In one case the investigation was over and our investigator was still looking around. He found a part that broke, so he went and got the NTSB guy and said, "Come back and look at this. This part's broken." We could have kicked the leaves over that, but that's a waste of time; it's a waste of people, and it's going to happen again until we fix it. So, we want it right there, find out what it is, and fix it. That's why we try to get the parts sent to us instead of the NTSB lab, because if a helicopter crash occurs and it's sitting behind a DC-10 accident in the NTSB lab, guess whose parts are going to get the priority for a few months? So, it won't be the helicopter. We need the information now so we can get Alert Service Bulletins out.

MR. WARD WINTER (Helicopter Services, Inc.): In regards to shoulder harnesses and seats, I would really like to see manufacturers do some work in these areas. Whoever recommended wearing

one of those shoulder harnesses for ten hours a day while leaning out of a bubble never tried it, because he won't make it through the day.

Most of the seats that we have in the helicopter logging industry are things that we've juryrigged and slapped together ourselves trying to make it comfortable enough so that you can stay alert and awake for a 10-hour logging day. I would like to see some real advances in that seat design. I've already had a neck operation for this stuff and I don't want another one.

MR. FOX: Yeah. I understand what you're saying, and in fact that 412 seat is far more comfortable than any 212 seat. People never liked the 212 seat, but it's inexpensive. So everybody goes with the cheaper one instead of going to the more expensive one. My second comment on the restraint systems, is that you use a horse collar type where it doesn't go up together as one unit. It comes around kind of as a loop and then it's sewed in back. It's not rubbing on you all the time. You're wearing it, basically. But that's something you can change, too. You can do that on your existing aircraft; you can change your shoulder harness.

MR. LANDY DOUGLAS (Kaman Aerospace): The K-MAX has got an FAA qualified seat for 20 gs down, 16 gs forward. It's designed by Simula and meets the FAA crash standards at this time. The other thing is, we have a collapsible cyclic that helps, and we, as a manufacturer, in K-MAX are addressing the safety issues.

NEW HELICOPTER TECHNOLOGY

By Steve Daniels, Manager Commercial Aviation Operations, Kaman Aerospace

I've got about 22 years of aviation experience. About 17 years of that is commercial, and the last eight years or so I've been involved in logging. I've been at Kaman Aerospace now for about two years, and my title is the manager of commercial aircraft operations at Kaman, but I also head the sales and marketing department.

First of all, Kaman Aerospace is very pleased to be a part of the seminar last year and this year, and we thank all the members that took the time to come here. We realize this is a financial burden on some folks. However, we see some real benefit of the community's getting together and discussing ideas that can improve the overall industry. We'd like to see some serious discussions of what we can do, and one of the things it looks like we've done this year is, we've decided to agree to disagree, but we can go past that and maybe come up with some ideas and some policies that can improve the image of our industry and increase the safety and awareness of our industry, and maybe reduce some injury and death rates.

I'd also like to thank HAI for its assistance in forming a helicopter logging advisory commission. And, Phil Kemp, I'd like to give him a special hand for volunteering to serve as chairman. It's a lot of responsibility. Some of the other members, if you're not aware of who else is on that initial committee, Pete Lance, from Columbia Helicopter has volunteered his time; Dan Stoley, from Scott Paper, which is now Kimberly Clark, also volunteered his time; and Lon Halvorsen is also a volunteer on that group.

Some of the advantages that we see with the HAI is the HAI is a very powerful lobbying group in the Congress, and with the FAA. It's very well respected. We have the ability to interact with the other commissions and committees that they have, the regulatory and safety committees. And the other thing that they have, that we may not have as a group here, is funding. If we have materials that need to be published, could be useful in the industry, HAI has the facilities to publish those materials and help distribute them to a lot of operators.

Something else that we thought would be very effective, would be some cooperation with the Helicopter Association of Canada. It's my understanding that they formed several years ago and have been extremely effective in helping their industry. As Paul Mavrinac mentioned the other day, we see some real benefit of this committee, or the HAI committee, working with the Helicopter Association of Canada.

Going back to Kaman, looking at this from a manufacturer's viewpoint, I think it's an important note to mention, around manufacturers, that we've determined that the helicopters that are designed by engineers won't fly, and helicopters designed by pilots are too expensive to operate. We all know everybody would like to have everything in the helicopter, but there is a law of economics involved, too.

I want to give you a brief history of how we looked at the problem. Charles Kaman, back in 1990, decided that he wanted to diversify a little bit more. He already had a good military contract, which was going to be coming to a close in a couple of years, so he looked for a market that he could go into that wasn't really exploited at the time. He talked to just about everybody in this room, all the major

helicopter operators, small operators, big operators, he talked to a lot of pilots, he talked to a lot of mechanics, and they kind of reached the consensus that the average machine that was being used for helicopter logging had been designed by the military, for the military, in a utility configuration, and had been converted to some special use, in this case logging.

He also saw that the large, old growth timber was becoming less and less available, and possibly in the future that the demand for big, heavy machines to carry big, heavy logs might diminish somewhat, so he was looking five, 10, 15 years in the future, and decided that maybe a helicopter that had a little bit smaller capacity and worked in the second growth timber, the plantation timber might be a little more effective, and he also evaluated the fact that there really wasn't a need for aircraft with a 10,000 plus capability. There were plenty of aircraft that were being used at the time that already met that need.

So, he talked to everybody and tried to find out their needs and wants. What he did was evaluate the different rotor systems that were available. Now remember, Kaman has been making the SH2 Sea Sprite for almost 30 years now, and that's a single-rotor helicopter with a tail rotor.

But he went back to an older design that he had used for years, and it actually was his first design, which we call the Intermesher. The benefits he saw for this industry in the Intermesher were that it operated with a much reduced downwash and that it required a lot less power per pound of lift. That's really where that rotor system came from, back before turbine engines were in helicopters and horsepower was a real weight penalty. So, he looked at ways to get the most lift out of the available horsepower at the time, and that's really where he came up with the Intermesher, where 100 percent of the horsepower that the engine produced is translated into lift. And, because of the way he designed it, it runs at a lower r.p.m. It also has much lower noise signature which, in this day and age, we seem to have neighbors everyplace close to where we're working, and a noisy helicopter becomes a noise complaint. Also, the design that he selected in the Intermesher has a very low fatigue, which gave him the ability to make a blade that has basically unlimited life.

The next thing he looked at was design of the fuselage from scratch. Again, based on the input he got from you as operators, what you'd like to see, he tried to break it down into a couple of areas. One was to make it a very simple design. We have the ability to make elaborate, composite airframes, but they tend to be expensive to build and expensive to repair and maintain. So, he looked at something that used flat pieces of aluminum, simple rolled curves, no complex shapes. But he wanted to build it for this environment, so he built it as a much more rugged machine. The materials are generally much thicker than we'd normally see.

The other thing he did was to take the benefits of the Intermesher and reduce the total of systems in the helicopter. He went back to a very simple idea. Make it simple, make it have fewer systems. The fewer systems you have, the fewer systems you have that might break.

So, with the advantages he had in the Intermesher, it wasn't necessary to use hydraulics, which is another system with a weight penalty, a cost penalty, and a maintenance penalty. He also made a concerted effort to avoid AC power requirements in the aircraft, so he was able to avoid that entire system. There is no AC power. Also, if you take a look at our flight manual, we have a significant reduction in emergency procedures, simply because there aren't as many systems to deal with. The other thing it does for the operator is that the fewer parts on a helicopter means fewer parts to put on site.

The next thing he looked at was building visibility into the aircraft. That's where he selected the airframe that you see now. It gives the pilot unprecedented visibility, which increases safety, he's able to operate out of either the right or the left side of the aircraft, something that isn't capable in another type of aircraft. He looked at your aircraft that you're operating, its outside instrument packages, thought that was a great idea, so that aircraft comes with an outside instrument package to monitor the major instruments and your weight on hook information.

Then, one of the last things they did was decide that this is an industry that is prone to make the most out of an airframe, the most out of an engine, and in some cases maybe more than what that aircraft was designed for. So, we decided to put in monitoring devices, and this is something, another area, in addition to the seats and crash worthy fuel systems that Roy Fox (Bell Helicopter) discussed earlier, that might be of great benefit to some of the operators. There's a number of systems out there that are available that monitor different parameters in the engine, and transmission, and power train, and that's something we decided to build right into the airplane. Torque is monitored constantly. You have a peak value and a time record, and we use that to determine life values on the transmission. We have an EGT monitoring device, in addition to a warning that monitors peak EGTs for each day. There's automatic trend analysis and delta checks on your engine performance. Gas producer is constantly monitored, and that gives a peak value for the day.

Last, and probably the most important for this industry, is the load on hook indicator. We used a load on hook indicator and a system that allowed us to monitor and weigh each individual load to a certain degree of accuracy. If you're interested in keeping the aircraft within its design specifications, this is a good system, and you watch the trend. If the trend starts to go beyond a certain target weight that you've selected, it gives you the opportunity to have some data to show your pilots and tell the owner of the airplane, and how you want it operated.

The other thing that we took a look at was the testing. All the aircraft in use for logging right now were designed for a number of different purposes, but none were really tested specifically for the heavy lift, or medium lift, and the high load cycle that we see in this industry. Some of the things that we did is, our hook is rated for 6,000 pounds. We put one on a test stand and ran it to 8,700 pounds every 37 seconds for 100,000 cycles with no distortion on the airframe, no damage whatsoever, and this was with stress analysis throughout the entire test. This is just one of the numerous tests that we did. The testing was done in the laboratory, so to speak, rather than in the field, and I know some of the larger aircraft that are in use now, over years, you found out what it takes to keep the aircraft in a safe condition, and we think those are very safe aircraft. But, to build a new aircraft, we wanted to make sure we had all that information before you started to fly it.

The next part of the program that we designed before we even had the first airplane was the support program that was going to go with it. We brought technical people in from our SH2G program. We brought in some outside mechanics for advice, and they were integral in the design of the aircraft, like I said, before even the first prototype came out. And the other thing we designed was a technical support team that was big enough and capable enough to stay out in the field with the aircraft with each new introduction, or as any customer felt a need for that aircraft to be supported.

Things that we got from the maintenance folks included a lot of input on design, what they needed to be able to maintain that airplane. We understand that most of you don't get a chance to maintain

airplanes in a hanger. If the airplane's in a hanger, it's generally not making a revenue, so we wanted to build an airplane that was easy enough to maintain in a remote location without a lot of special tools.

You wanted easy access to major components. We built all that with bolt-on panels rather than flush head screws. We went to large rivets rather than flush head rivets. Again, this is an aerial truck. It didn't need to be pretty. It didn't need to go very fast.

When we delivered the aircraft, we decided to keep a technical support staff on site almost for the first entire year that the aircraft was fielded, and forwarded all the field information and statistics. For instance, Scott Paper was our lead in operator, and they've done a very good job for us of gathering data on the airplane. Some of the minor improvements we've made to the airplane are based on their data. The other thing we found out was that the aircraft had an extremely low maintenance man hour per flight hour rate. In some cases less than one hour.

The next group of people that we got some information from were the pilot staffs. Art Plunkett was instrumental in a lot of this information, as were some of the other pilots we talked to in the field.

We decided to design the aircraft with cockpit ergonomics in mind. Since most American pilots are used to logging out of the left side, we oriented the cockpit around the left side of the cockpit. Power instruments and primary function switches are all a lefthand side accessory, and flight gear is on the right-hand side, and, of course, —we decided to put the outside instrument package on the lefthand side. Visibility, as I mentioned earlier, was something the pilots were commenting on. We wanted the seat as close to the side of the aircraft as possible.

In 1989, the FAA Amendment 2725 mandated that any new aircraft that would receive type certification had to have an energy-attenuating seat, which was survival to 20 gs down and 16 gs forward. So, our aircraft has a Simula seat in it. As you saw in the pictures, the energy-attenuating seat has two tubes in the back of the seat which are mounted diagonally, which crush at a uniform rate and decelerate the seat. That also comes with a five-point harness assembly, in contrast to most four-points, and we spent a great deal of time working with Simula on this shoulder harness. Most logging pilots, I know, have a very difficult time getting all the way out that left door with a shoulder harness assembly. We spent a good deal of time designing a shoulder harness that would work for the logging pilot, that wouldn't get caught up, wouldn't get balled up, and wouldn't fall off his shoulder, and we feel now, with Simula, we have a very good product that's going to offer you a very safe environment to work.

Another thing we looked at was impact injuries from the cyclics, and we put a collapsible cyclic in the cockpit. And also, because of the latest changes in regulations, the aircraft has a crash resistant fuel system, which should greatly reduce the risk of post crash fires.

One of the other parts we decided to do was make a more intensive training program than was available before. We feel our program is probably the most intensive in the world right now. Our pilot program lasts about two weeks, and consists of about 33 hours of flight time, and the maintenance course runs over three weeks now, about eight days at Kaman, and then about two weeks for the engine course.

We teach vertical reference to those pilots who are not familiar with it. We've had several foreign countries who come in who use mirrors, and didn't believe that vertical reference was useful. We

taught them that skill, and now they've gone back and are teaching their friends back in their own countries about the benefits of vertical reference.

The other thing we did beyond just teaching the pilots to fly the airplane was develop an intensive course that got into the logging techniques of the helicopter. We even went to a small airport away from any houses or roads, where we have a series of what we call test logs. It allows the pilot to get used to the helicopter, moving logs in an environment that's not a high-pressure environment like it would be on the job site. He also gets a chance to move concrete blocks, water bucket drops, all those type of things. So, by the time the pilot finishes the course, he's reasonably comfortable in the aircraft, has received training in all the emergency procedures, has moved logs, water bucket drops, and understands how the airplane is maintained.

One of the things we feel is really important at the school is trying to instill a degree of self-discipline in the pilots, and that's another area that seems to be a real problem in this industry.

I like what Tim Harper (Erickson Aircrane) had to say yesterday, about TMS, or terminal macho syndrome, and I agree completely. It's a serious problem in this industry. I don't now how many jobs you've all been on where the crew brags about a big turn they pull up and they're popping champagne corks. Well, you're all aware that money is made not by getting the biggest load, but by getting the most per year. So, we try to instill some discipline, or self-discipline in the pilots as they go through the course, to understand how a manufacturer looks at airplane when it's designed, how it's supposed to make its entire life cycle.

What we're hoping we can do is get away from is this ad hoc testing in the field. We have a lot of pilots that, if they pick up the log and the helicopter doesn't go "bang", then it's okay to carry it. That's really what we're trying to get away from.

The other thing I mentioned earlier is the philosophy of safety management, using some of the components of our helicopter as a tool. Using the monitoring devices on the aircraft, rather than a telltale, can be useful for trim analysis. You, as an operator, set a target weight that you want for your turns, and now you have a method to monitor to see if that target weight's being maintained. For example, Scott Paper and Dan Stoley use this tool on a regular basis. Like I said, they're a lead operator. They do as many as 50 to 60 turns an hour with that helicopter down there. He has set certain target weights that he wants the pilots to make, and on a regular basis, because of the lift capabilities, the pilots tend to become a little bit more aggressive and build up those target weights.

He downloads that information every night onto a laptop, puts it a program on Excel that he uses and gets a readout of percentages of loads that are either direction from his target weight. When he sees a certain percentage above his target weight, he literally brings the pilots in, one-by-one, puts them on the carpet and tells them who owns the airplane, and how it's going to be operated. He's been very effective at maintaining a good operation down there that way.

Where we see the future of this program is continued careful placement of the aircraft, monitoring of the operations in the field, technical support, and response back from our owners. We feel it's important that when you, as an operator, see problems with any aircraft, you report it back to the manufacturer or to the FAA. Otherwise, we have very little feedback as to what's wrong with the airplane.

We have had our growing pains with this program. I know most of you have heard some of the horror stories. Most of it is rumor. We've made some improvements to the aircraft, like any new aircraft introduction. I will say we have not had any ADs issued against the aircraft to this date, and that's due to a couple reasons. One is the terrific response we've gotten from our customers, and their cooperation. The other is that we've worked very hard to cooperate with the FAA when we see a problem, and we address it quickly and fix it.

I'll close with a rule of aviation that used to be in force, and I think you've probably heard it. Rule number one of aviation: if it flies, it breaks. Rule number two: pilots and mechanics can't change rule number one. I'm hoping that we can move on a little bit and maybe change that rule as we progress in this industry.

QUESTIONS AND ANSWERS

DR. CONWAY (NIOSH): What's the curve for autorotation on the K-MAX?

MR. DANIELS: It has an excellent height velocity curve, but I don't have that information with me.

DR. CONWAY: I was wondering if you had looked at typical logging operations, and whether or not those occur inside or outside of the typical height velocity curve for your piece of equipment?

MR. DANIELS: I think it's pretty obvious that most logging is conducted in that height velocity curve. We did look at that. Rather than focusing strictly on engines, we looked at the entire aircraft as a system, and its base, the engines, tends to be the most reliable component of the helicopter. We found that there are other systems that cause just as many accidents, but I'm not going to go into those systems now.

The overall concept, remember, was to keep the aircraft as simple as possible, reduce the number of systems, and we feel very comfortable with that application.

HELICOPTER ADAPTATIONS FOR EXTERNAL LOAD OPERATIONS

By Randy Erwin, Chief Pilot, Erickson Aircrane

Let me start off by saying thank you to Jan and Mike for having us all here. I think our conference is quite beneficial. This is probably better than the Helicopter Association International, although maybe not as much fun as Las Vegas.

I am not a logging pilot, never have been, probably never will be. I do have about 8,500 hours in helicopters, and a great majority of those hours have been spent with an external of some type hanging below me. My remarks here are directed to those people who have come here to learn about the helicopter logging industry or external load industry, and not necessarily to all those people out there who have been doing it forever.

I'm reminded of a plaque on the wall of the chief flight instructor's office of my first job. It said, "Those who claim to know all there is to know about aviation are particularly annoying to those of us who actually do." Having said that, I hope this audience will not be too annoyed.

The helicopter is really a unique machine. Whether it's got one, two, or three engines, its capabilities to hover motionless in space and go up and down and fly around like an airplane lend themselves to a tremendous variety of applications: medivac, observation, cargo delivery, survey work, seismic, gravimetric, magnetometry, electronic news gathering, EMS, and search and rescue. All these things a helicopter can do, and do exceptionally well. Long-line logging may be the most unique application for the helicopter.

The military should take credit for having paid for the initial development of the helicopter, but I don't think anybody in here would argue the point that the commercial operators are the ones who really exploited the unique capabilities of the machine, from hauling bank paper around rooftops in downtown Los Angeles to setting crab pots and harvesting them out here in Southeastern Alaska.

But, each of these tasks, each of these helicopter applications, requires different capabilities, different skills by the pilot. External load and vertical reference skills, I believe, are among the most demanding in the helicopter industry, although some may argue that IFR work or some of the other things are equally as difficult. Regardless, the pilot has to have these unique skills to take advantage of the helicopter. The operator also has to have some unique skills or different practices to exploit the machine. As another presenter pointed out, the maintenance practices are definitely different for a logger than they would be for a Part 135 charter outfit, or a news gathering company, or a flight school.

Logging helicopters, as I've told many people on several occasions, are better maintained, better looked after, than any other 135 helicopter that I've ever flown or am aware of. Helicopters used in other operations may have prettier paint jobs, get washed more regularly, but as far as maintenance is concerned, these logging helicopters are maintained to a much, much higher standard. It's because the bottom line is profitability. You can't do this business without being safe and efficient about it. It's just too expensive.

What I'm here to talk about is how the unique capabilities of the helicopter relate to external load operations. I've been trying to think of an example to give to those of you who are not helicopter

pilots, who have never flown a helicopter, what it's like to perform an external load, vertical reference operation. If you get in your car, line it up in the right-hand lane, with the centerline, the yellow line just outside your left door, then open the door up, stick your head out and drive away, just watching the yellow line to keep yourself on the road, you might be doing the task equivalent of long-line logging. Driving that way might give you an idea of what the helicopter pilot does when he's trying to navigate and control the helicopter by looking straight down.

When you learn to fly, you have a horizontal reference which you use to keep the helicopter level. When you want to move it from level, you change the attitude of the helicopter reference to the horizon. But when you look straight down along this long-line, you lose that reference. You no longer have any kind of reference as to what is level, what's flat. So, your mind's eye starts taking pictures of this long-line as it departs the helicopter, the angle it makes on the skids or the landing gear, the fuselage, and that's how your mind figures out what is vertical. If the long-line is vertical, then that must mean that you're horizontal so you're going to stay in one place until it starts swinging. This is where these unique skills develop in the long-line pilot. He's constantly having to keep track of where the load is, whether it's an empty hook or an 18,000 pound log or a bucket of cement, where that is in relation to the helicopter, what the long-line is doing in relation to the helicopter, and whether the helicopter is level or in some other attitude. When he gets this angle figured out between the helicopter and the long-line, then he can exploit the mass of the load and the inertia, to allow the load to swing around and let it go where it wants to go, and then get on top of it. This way, the pilot controls the load. At least that's what he tells the copilot, "You know, I meant to do that."

As Mr. Lindamood so aptly pointed out, a guy in a single pilot operation is real busy. He's trying to keep track of all of these things, plus keep track of his power management with his little calibrated elbow there, and talking to people on the radio, and worrying about obstructions that he can't see but he remembers, or he thinks he does. These are extremely demanding tasks.

I flew helicopters for about eight years doing external load work before I ever saw a bubble. I thought that was the neatest thing since sliced cheese. Bubble windows that protect the pilot from the elements were a tremendous advancement in this business. So were arm rests, torso rests, shoulder rests, things to make the helicopter pilot more comfortable so he can sit in the helicopter for ten hours a day. It would be nice now if they came up with some kind of a restraint system, a shoulder harness that you could wear and still perform your function.

Outside instruments were another advance. If you're hanging your head out, you can't see the torque, NG, T5, NR. You can't see the caution panel. I've never been in a helicopter with an audio caution panel, but in any of these things, you're constantly dividing your attention between the load, and the line, and the belly, and the guys on the ground, and the obstructions, plus all the equipment in the helicopter, so outside instruments contribute greatly to overall safety.

Load cells are another improvement. This one instrument, which doesn't have anything to do with helicopter operations normally, tells the pilot how much weight is on the hook. It doesn't weigh the helicopter, it just weighs from the hook down. It's a pretty neat device.

Operating the helicopter from the left-hand seat is another change currently used by Hughes aircraft, that has resulted in safer operations. Flying from the left-hand seat makes it a lot more comfortable. You're not leaning away from the collective, you're on top of it. English or American helicopters,

have a normal lean to the left, so if you're sitting on the left, particularly in larger helicopters, there's a lot of freeboard, like inside an S58 or a 61. Sitting on the right-hand side really makes it difficult to see what the hell's going on down there. There have been a lot of modifications done to the seating on Sikorskys to better adapt them to this left-seat operation.

Remote hooks are another improvement. A remote hook is another pretty dandy device that allows the pilot to control what's going on at the end of his hook rather than waiting for a ground crewman to come and unhook him. It contributes to the overall safety of both flight and ground crews.

FM radios have also evolved over the last ten or 15 years, allowing the pilot to communicate with the people on the ground. I've heard stories that at one time, one logging operation only allowed one radio out in the whole unit. Now I think just about every person out there has a radio in a vest so if he has a problem he can tell somebody about it. And there's a lot of problems to be told.

Some of the other things that have been mentioned were specific to the airframe adaptations. Long-line logging is probably the most abusive thing that you can do to the helicopter. I don't mean to imply that anybody is willfully abusing the helicopter, but it is just intrinsically an abusive thing to do to the machine.

So when the inevitable part failure occurs, you replace the most frequently-failing parts with something better that doesn't break as often. I think Thomas couplings on Bell products were a problem so they put K-flex couplings on them. The exhaust extensions on the 64 had a big problem with engine stator veins cracking, so we put harder mounts on.

One of the neatest things though, I think, that has been adapted to the helicopters was designed by a guy sitting right here in this room. Dale Hoke designed a logging shock. It cut down tremendously on the wear and tear.

MR. HOKE (Aerial Crane Systems): I can only take part of the credit.

MR. ERWIN: Anyway you look at it, the external load operation is an incredibly demanding task for the pilot and the operator. One of the habits that any successful external load pilot has developed, is a real thorough preflight planning. He'll make sure he's got enough fuel to finish the job, he'll be aware of the condition of his helicopter, and he'll conduct a good preflight. The operator has to have a real commitment to safety as well. He will ensure that the pilot has all the tools he needs and that he contributes what he can to make sure his camp is a safe environment. A safe environment is a less costly environment in the long run.

HEALTH AND USAGE MONITORING SYSTEMS

By Bruce Conn, Out-of-Production Aircraft Program Manager, Sikorsky Aircraft

Yesterday, while listening to some of the presentations, I thought I should make a few comments about usage monitoring systems. Manufacturers are routinely called upon in crash investigations to examine failed parts and determine if retirement times, overhaul intervals, or maintenance practices should be revised. Changes to times or intervals are not done arbitrarily, but rather are based on a fairly exacting science of safe-life calculations, based on the hard data derived from the crash investigation. These data can include, but are not limited to, answers to the following questions: Was the aircraft operated in accordance with the flight manual? What were the operating hours on the failed component or components? What was the maintenance history on the aircraft, or the components? What was the mode of failure?

We also conduct metallurgical lab analysis of the failed parts. From these data we calculate new or revised safe-life for components. Calculations are based on torque cycles, loads over time, along with the operating limits of the aircraft. If you look at the data used in the calculations, the one data point that is probably the most variable or nebulous is whether the aircraft was operated in accordance with the flight manual, within the flight envelope of the aircraft.

This is my lead into a discussion about monitoring systems. What can monitoring systems do for helicopter logging? Certainly it can help to clear up most of the mystery about how the aircraft is used, and thus make the safe flight calculations more accurate. What are the recommendations for a minimum specification system, torque cycle counting, load sensing, exceedence monitoring, pilot alerts -- both audible and visual -- as well as crash survivable memory? How much will it cost? Certainly cost has to be a consideration on these systems. There are high-end systems, such as HUMs (Health and Usage Monitoring Systems) that can cost upwards of $100,000. I've had discussions with Phil Kemp from Silver Bay Logging on this issue, and Phil indicates that there are systems that at least meet the minimum specification requirements for around $5,000.

At the high end of the spectrum, HUMs systems can provide a much broader range of monitoring by analyzing the vibration levels of all the dynamic components in the aircraft. These systems, widely used on the S61s operating in the North Sea, have been maturing over time, and providing additional capability by ensuring early warning of impending failures.

Sikorsky has been performing analysis of HUMs-recorded data and establishing correlations between the data that has been recorded by the HUMs systems, and what we see when we tear down components at overhaul. We have accumulated a significant amount of data on the S61 with these systems installed. Over time this will help us to refine the algorithms that are used to establish thresholds and alerts.

I found out, when I was down at the HAI convention in Dallas, that we have a unique situation in that one of the logging operators has recently purchased an S61 that formerly was operating in the North Sea and has a HUMs system installed on it. I've encouraged this operator to keep the system operational so that we can look at the data from that aircraft as it is being used in logging operations.

The fundamental question to ask is what are the financial incentives for you, the logging operators, to purchase and install these systems? It was mentioned yesterday, in some of the presentations, that safety equals productivity equals dollars. If monitoring systems can contribute in a positive way to the safety equation, I think there will definitely be a payoff.

Additional payoffs could be realized at the time of overhaul and repair. If the aircraft is being operated in a less stressful way, it should reduce scrap rates at overhaul. When gear boxes or rotor heads are flown outside of the envelope, component wear goes up exponentially.

And finally, I would defer to the insurance companies as to what reductions in premiums might be realized on aircraft that have these systems installed.

In closing, I think that the logging operators are certainly in the best position to determine how these aircraft should be operated when performing the logging mission. Manufacturers, on the other hand, are in a better position to understand the loads and the stresses that are induced on the aircraft while performing the logging mission, and what their effects will be to the dynamic components.

The ability of manufacturers to assess these loads with health and usage monitoring systems, or even the lesser monitoring systems, could certainly help us in determining, more accurately, what safe-life should be on components.

In regards to the S61, Sikorsky can certainly help educate operators on the capabilities of those monitoring systems, as used on our aircraft, and I would hope that you would avail yourself of the knowledge and expertise that we have on these systems.

Certainly, Sikorsky will continue to work to ensure continued airworthiness on all our aircraft, regardless of what mission they are performing.

I am not proposing that monitoring systems are the only rope out of the tree, but they can certainly contribute to the safe operation of helicopters used in logging.

This ends my discussion on monitoring systems. I'd be more than happy to facilitate technical briefings on the subject at either next year's safety conference, loggers conference, or at HAI.

Another topic I would just like to briefly touch on is the use of military surplus aircraft. As a manufacturer, we are very concerned about the use of these aircraft in the logging mission, especially due to the fact that the government promoted breakout parts on these aircraft. I submit that maybe this is a topic for discussion by this forum or other forums dealing with logging. I also think that bogus parts are becoming more of a problem. On this topic I would ask the FAA what is being done to help prevent the introduction of bogus parts into the system?

ALTERNATIVE AEROLOGGING TECHNIQUES

By Dale Hoke, Owner, Aerial Crane Systems, Inc.

After four years as a pilot in Army helicopters, I worked in the heavy helicopter industry for over 18 years. I grew up in it; started logging on logging sale number one, using helicopter number one with Wes Lematta in the late 1960s. I have piloted just about every make of major heavy lift helicopters in the country. About eight years ago, I started developing a system to replace the use of long-line helicopters and to address the issues of safety and costs.

The company I represent, Aerial Crane Systems, Inc., offers an alternative to helicopter lifting. The alternative system promises to benefit the forest products industry. The aerial crane system is constructed with an aerostat tethered to light weight lines controlled by four winches.

Our basic concept was an aerostat of sufficient lift attached to a payload. If the aerostat and payload weight are balanced exactly, the payload can be held with your hand and walked wherever you want to go. We took the concept, used winches to move it, enough aerostat to lift payload, minimum tension on the strings, and enough horsepower in the winches to bring it down to drop off the payload. By using high tech lines, we can gain distances to half a mile, maybe as much as a mile, and do it at significantly less cost than by using a helicopter, without the rotor wash, dust, and vibration that cause helicopter pilots to go gray rapidly.

We constructed two prototypes. We micro-scaled it and found it was so easy, we couldn't help but wonder why someone hadn't built it before we did. We shifted to a little larger scale and modeled it again. We learned that as we got bigger, things got better. The good parts of the system became better, and the troublesome parts didn't get any worse.

We reached a point where we needed to construct the system on a significant scale, because people weren't going to get excited about a system hauling logs that only weighed a few ounces. In the spring of 1992, I obtained funding to build an 800-pound prototype. The 800- pound limit was partially determined by the size of an available used aerostat; the aerostat is one of the significant costs of this system. The 800-pound size also compared favorably with the early Jet Rangers which also weighed around 800 pounds and with which I was very familiar. I knew what the Ranger lifted, what it cost to operate, and what it cost to buy. Thus, in the Ranger, we had a good comparison to our aerostat.

We finished the system, tested it, and had it up and running (inflated the aerostat and had all the winches deployed) by the 26th of June, just six months and two weeks after the start of cutting metal. The history of lighter-than-air (LTA) vehicles is replete with projects which suffered because the systems people involved worried so much about getting the machine running, they didn't learn how to handle it. Systems like the cyclo-crane came to an end because no one could control them in any kind of weather. They were huge and unwieldy. The forces of Mother Nature are immense, and in the woods, there are no 100-acre parking lots in which to moor and park these LTAs.

Not only did we want to make the system work, but we wanted to be sure we totally understood how to handle it, how to take care of it, and how to deploy it in the woods where ground access such as a convenient road system is unavailable. We inflated on the 26th of June with a very basic analog

control system. The third day up a thunderstorm hammered us but we survived -- just barely. Then we commenced with actual operation, going from point A to point B, which, in just a few minutes, got very boring because it was so easy. We found we could even put an inexperienced operator at the controls of the system, and in a matter of seconds, he would hit accuracies with 200-foot lines, which would take a helicopter pilot weeks, months, and sometimes years to attain.

One of the reasons for this ease of operation was the point in space, defined by the common point connected to the four winches by the control lines. The large and quite rigid triangles formed by this arrangement hold the point in space as stable as a line on a large land crane would, regardless of balloon oscillations. While the balloon moves around in the wind, these movements are not transmitted down through the long-line. If your accelerations and decelerations are ramped as a function of long-line length, which is what a helicopter pilot does unconsciously to dampen out oscillations, this point in space -- this long-line hook assembly -- is rock steady; it just stays there like it's nailed in concrete. This was a significant confirmation of the micro-model work.

We learned that establishing some pretty firm tension control limits, such as minimum and maximum tension on the torque of the winches, we couldn't overload the system. If you hook onto something that's too heavy and try to ascend with it, which is lengthening all these lines, they go down to their minimum tension limit and nothing happens. You cannot over-torque it, you cannot over-extend it, and you can't tip it over. These were gratifying revelations; we were pleased to know about the ease of doing these operations, especially from the standpoints of safety and cost control.

On the second operational flight, the confidence factor was so high after just a few minutes that my daughter, who doesn't like heights or airplanes, went for a ride. As we operated the system again and again, trimming the flight control system and developing better rules, it became boring to operate the machine.

We kept the aerostat inflated 114 days. Our operating costs were about a quarter of that of an equivalent-sized helicopter. We had no night operating restrictions. Fog didn't bother us. We learned to move the aerostat by hand, grab a winch, and transport the system over inhospitable terrain, where there are no roads to the deployment sites. We even worked out a procedure for fueling and maintaining the system at remote sites. We spent most of our time learning how to manage the detail procedures, because the details have killed other LTA projects. This concept has been made possible by the recent advances in material and control technology, much of it from the military and NASA. It means we have the capability to build this system with off-the-shelf equipment in a manner which wasn't possible just a few years ago.

QUESTIONS AND ANSWERS

MR. RANDY ERWIN (Erickson Aircrane): Is this controlled from a gondola, or is it from the ground?

MR. HOKE: Wherever you like. All of the control stations, equipment deck, and winches are electronically linked, whether it's hard cable or RF data link, which is also linked to the control van, so it really doesn't matter.

And, as a sideline to that, you can have multiple control stations. The next step is to get this data stream into a communications network, so you actually can monitor and operate this thing from anyplace in the world. It's got eyes and enough intelligence to know where it is at and where the operator wants it to go.

MR. ERWIN: Wind is not a problem?

MR. HOKE: Certainly wind's a problem. However, if you'll go back through the Forest Service's early balloon logging experiments, the experience of the "Flying Scotsman," and the people who have had large aerostats in the field for extended periods of time, wind is not operationally a problem, any more than it is for a helicopter. When it's too windy, you quit and go do something else. But there usually is enough calm and low wind conditions in most places of the world, enough revenue time that's within your weather limits, that weather is just a minor inconvenience. This is not a good generic system. This is a very, very good site-specific system. In other words, the system would not be the same if it was used on the west side of the Cascades or the Southeast Alaska coast. Two different systems would be used, because you've got different weather parameters to deal with. If you're going to the high-wind environment, the Queen Charlotte Islands for example, then you are going to need a streamlined aerostat, which raises the cost, but the basic concept stays the same.

UNIDENTIFIED VOICE: Does the system require any certification?

MR. HOKE: Not as you know it from the aircraft industry. It's an unmanned vehicle. It comes under the general rules that big cranes come under. We think of it as a big crane with 2,000 foot of reach. We don't think of it as an aircraft. Under current rules it does not have to be certified, and we would have no need to certify it.

MR. MARK LINDAMOOD (Carson Helicopters): How does the system work in snow and heavy ice?

MR. HOKE: The system is bedded down. It's parked.

MR. LINDAMOOD: Bed it down at night, but if it snows a little and freezes?

MR. HOKE: For normal operations, when you're just getting through to the next day, and you're not running a 24-hour shift, the long-line is hooked to a deadman and the control strings are un-loaded; it just sits there.

MR. LINDAMOOD: What about the safety aspect of it? If you've got a real light load, you could sit in the gondola and run it, but can the operator see the man hooking up the turn? What about if it's a light load, smashing the guy in the turn with an updraft of the wind?

MR. HOKE: This system, dynamically, is backwards from a helicopter. It takes the least amount of power to operate when it's loaded. It takes the most amount of power to operate when it's empty, because it has to pull the system down against the full lift of the aerostat. Therefore, when it's in the hook-up mode, there has to be high tension on all the lines. So this place is locked and it doesn't move. The hook is the most stable thing you've ever seen, comparatively speaking. Wind oscillations which move the system around don't transmit down to the hooker. Also, the whole system has a

navigation system built into it. You can go anyplace on the sale within 30 centimeters of accuracy without hand flying it.

MR. LINDAMOOD: If it's a light load and the guy is in the middle of an eight log turn and he's hooking it up, is there a possibility of one of the lines coming loose, or the operator doing something that could move it since he can't watch the guy on the ground, like a helicopter pilot can?

MR. HOKE: This operator is going to be able to see right down this line. He's watching the operation on a monitor. You're assuming there is a hooker, and I'm not so sure that with this system we would do that. There's other methodologies we can use.

UNIDENTIFIED VOICE: You were talking a quarter of the cost. Can you give us some kind of production figures?

MR. HOKE: I can give you what I feel we can do, which is about the same production as a helicopter or maybe a little bit less. We won't get production per hour to the equivalent size helicopter, because we can't physically go through the air that fast. This system starts going dynamically unstable, in this size aerostat, somewhere around 30 to 35 miles an hour, so about 2000 to 2500 feet a minute is about the best you're going to do. We're going to operate longer hours, and if we want to, we can operate at night.

UNIDENTIFIED VOICE: Is this the same concept they tried in the early 1970s?

MR. HOKE: No, it's totally different. The conventional balloon logging to date, unless there's somebody that's done something I don't know of, has been hooking a balloon to a standard wire carriage to a standard wire system. They can't lift the whole wire off the ground because it's too heavy, so the wire's in the air as the balloon goes by. It then lays back on the ground with all the associated hazards they go through. So their production is quite slow. They have to set up and move like any other wire setup has to do, whereas our system is fully three dimensional.

We imagine we can cover half mile chunks of real estate with a 9 to 10,000 pound system. Again, depending on the topography and the ridge lines and other considerations, the system must be set up to use all those factors to its advantage. We don't see any technical problems there.

There are ways to do this with central power plants. We've gone to four power plants, one on each winch. One of the reasons we went to the four-wire system is not necessarily due to the increased coverage you get from a four-wire system versus a three-wire system, but primarily because if we lose one of the winches we've still got control of the aerostat. We can still get it down, hold it, and control it. It's not a catastrophic accident. We tested that scenario with the model. It was one of the last tests because it was hazardous. We had the machine winch down tight with one line taking all the tension when it broke, and away she went. But it did exactly what it was supposed to do; the other winches detected the over tension and they spooled out line until it was under control and got it slowed down. It was a non-event.

In the forest products industry, on tough ground, on the shorter sides, this system is a viable alternative to helicopters. There are some things that helicopters do better, but some things the aerostat will do better. Our system can make a significant impact on woods safety, because of its precision, and the

direct control the operator has. The hooker in the bush can operate the system. He can have a small control station to give commands to do whatever needs to be done such as giving a stop command to place something precisely, or drift it five feet up the hill.

UNIDENTIFIED VOICE: What's the cost of the system?

MR. HOKE: We feel we can get a bare bones system to a logging job, for about $125 to $150 per pound of payload, or, roughly, a third the cost of equivalent size helicopter. Helium's getting very economical. It's about to come off the world reserve list. That's going to release a tremendous stockpile.

UNIDENTIFIED VOICE: What's the mobilization and demobilization time for the whole system?

MR. HOKE: Mob and demobbing is, to a large degree, like the helicopter or any other setup, in that you know how much preparatory work you have to do. At the winch sites, for example, if the anchors are installed, it can be something as simple as putting a padded choker around a big tree stump, or it can be something as complicated as drilling and putting in a rock anchor. The anchor technology comes out of the power line industry. It's well proven, and is a relatively minor item. If that preparatory work is done, such as building helicopter landings and those things before you get there, you should be able to deliver the system, set it up, and be operational in a matter of a few hours, depending on the topography and accessibility, how many winches you have to fly, and how many you can drive out. We have designed the system where we can leapfrog it across country with no roads. That doesn't do you much good, because you've still got to get the product out of there, but we took a serious look at that procedure for places such as Panama. People want to be able to look at spots in the jungle without leaving any footprints. We spent considerable time and effort on this mobilization and demobilization process. We sized components to go on standard highway trucks. Aerostats can be moved inflated, and don't have to be deflated, within reasonable distances. One of the purposes of the aerial heavy lift system is to work in a particular drainage or area of the country, and be able to stay for long periods of time.

HELICOPTER MAINTENANCE IN HELICOPTER LOGGING OPERATIONS

By Ron Smith, Maintenance Foreman, Erickson Aircrane

I've been in the industry for 16 years, and most of that has been in helicopter logging. I have some strong feelings about maintenance issues that I'll share with you. Almost all helicopter maintenance is performed on-site. Everything involved in maintenance -- personnel, tools, supplies, parts -- works out of a van located on-site. The size of the helicopter determines the level of service. Larger units are served by both a day and night crew.

Finding qualified people for helicopter maintenance can be difficult; experienced personnel are hard to come by. Thus, we do a lot of training, usually on-site.

The day shift typically arrives at the service landing with the pilots, helps get the helicopter going for the day, and spends the remainder of the shift fueling the helicopter and fixing any problems that come up.

The night shift arrives in the late afternoon and relieves the morning shift. The night shift does any scheduled inspections or heavy maintenance that's due. It really has to pay attention to everything. In logging the helicopter is being used on more arduous tasks than it would be if it was just flying light sling loads. Stress from the constant vibration shows up in the airframe, in components, in the wiring; it shows up on just about everything on the aircraft. The maintenance crew needs to inspect the aircraft thoroughly, right back into the furthest corners, to find any defects, repair them, and have the helicopter ready for use the next day.

At Erickson we run a five-person maintenance crew. Two mechanics are on the morning shift and three mechanics are on the night shift. The third night person is usually in training. He might be in training six months or longer before he's actually able to sign off the aircraft and return it to service. It takes quite a while to get a mechanic trained for helicopter maintenance. You pull new mechanics out of the general aviation sector, put them into large helicopters, and the first month is pretty much just standing there looking at it flying by. They're all in awe of what's going on.

Helicopters use lots of parts and pieces. Logging with a helicopter tends to identify the weak areas in its design. At Erickson, we've changed a lot of the design flaws over the years. Our policy has been to identify the problems, and not just try to live with them from day to day, but change to a new and better design. When I first started working on Skycranes, for instance, it was very difficult to fly them eight hours a day. We spent half the day working on this model. Today, however, after many design changes, we have a good dependable helicopter that can fly all day.

Maintenance personnel should give inspections a high priority. We should always look to find that one extra thing that's a potential problem. From the pre-flight in the morning, to the post-flight at night, to the phased maintenance, or the 100-hour, to what the overhaul shops are doing on the gear boxes or the engines, inspections tell you the health of your helicopter. A lack of trained inspectors is one of the weak links in your overall system. When maintenance is a company-wide priority, everybody can contribute to overall safety.

Another safety concern is the smaller and smaller landing areas. Within this limited area, besides the helicopter, there is a maintenance van, at least one fuel truck, several pickups and maybe other vehicles. If a pilot attempts to make an emergency landing, a little extra room could make the difference between a successful landing or an accident. The same limits affect log landings. A little extra room could make all the difference in an emergency.

I heard the comment made that no matter what part of the world that you're in, all parts are the same. That's not true. The climate makes a tremendous difference on the storage of parts, especially those that contain magnesium. In less than optimal storage conditions magnesium parts pit and start getting weak areas where cracks occur. Right now we're working in Southeast Asia to learn how to preserve parts in those climatic conditions, and how to keep them ready for use and in serviceable condition.

In Alaska, rainy weather is a problem, and I'm sure the rain causes corrosion problems. Thus when a helicopter is secured for an extended period of time, its iron will rust while its magnesium and aluminum will corrode. There's lots of training to be done about adaptation to weather conditions.

QUESTIONS AND ANSWERS

MR. DALE HOKE (Aerial Crane Systems): When you compare the book maintenance requirements to what you actually do, how do you vary from the written regulations? I'm assuming it's more, that you're doing more maintenance than is legally required by the book on that particular aircraft.

MR. SMITH: Oh, you definitely have to do more than is required by the book. If you were to look at phased maintenance, and try to inspect the aircraft just according to specifications and not go further than that, you would have serious problems in no time at all. We look at many things much more often than the manufacturer's recommended guidelines.

MR. MIKE BARR (University of Southern California): What is the turnover rate for your mechanics? How long do they stay there before they move on to the next place?

MR. SMITH: I've been very fortunate in keeping qualified personnel. We're expanding right now, and since I pull a lot of my personnel from our overhaul shops and hangar, they're generally people who have worked for the company for quite a while. My turnover rate is next to nothing, actually. I've had maybe two or three people in the last year who have moved on to other companies. Qualified people make the difference in this industry.

MR. TIM HARPER (Erickson Aircrane): One of the things you talked about was changing the way you do things through inspection. The sense I got was that the management in maintenance has to accept responsibility to gather data and get the pertinent information back out to field mechanics. One procedure in which this takes place is through maintenance memos. How can we use the memo to greater advantage? How do you gather that data and put it together so that you can advise all the crews of potential problems that they should look for, as we conduct logging operations?

MR. SMITH: I think such a policy has to come from within the specific industry. I don't know how to address this issue for the helicopter industry as a whole. You have so many different types of aircraft, so many different types of companies. Each industry has its own system. If, within our com-

pany, we have a repetitive defect, we gather up information about that defect and we try to eliminate it. If there's an airworthiness problem, we want to know about it and we want to cure it as soon as we can. I'm sure Bell has lots of methods for addressing the safety factors on each model they have. How do we do this risk-reduction industry wide? I think that's what we're beginning to discuss today.

DR. GEORGE CONWAY (NIOSH): When you have a finding about either additional maintenance or changes in equipment, do you share those with the manufacturer if it's anything that requires approval?

MR. SMITH: To explain our procedure, you should understand that there's two parts to Erickson Aircrane. We bought the type certificate on the skycrane. The manufacturer is upstairs and the repair station is downstairs. We keep a lot separate between the two entities, but when safety's an issue, we're able to directly influence the phase, the inspections, and different things, almost immediately.

DR. CONWAY: Do you regard those changes that are made as proprietary, and therefore, a property that you'd want to hang onto, or do you share findings about additional maintenance?

MR. SMITH: Most of our findings related to safety issues are shared with the other operators. Most of the skycranes out there have the same modifications on them for product improvement, regardless of who owns them.

Legally, if the manufacturer makes any changes with paperwork or anything that's done with that type certificate, those modifications have to be shared with other 64-E operators.

HELICOPTER MAINTENANCE MANAGEMENT

By Phil Kemp, Maintenance Director, Silver Bay Logging

In the 10 years I have been involved in helicopter logging operations in the United States and Canada, I have been fortunate enough to work with a variety of operators, mechanics, and pilots that provided an extremely intimate insight, not only of the current, successful, refined helicopter logging operations, but also of the evolution of operators, aircraft, techniques, and philosophies that have produced the helicopter logging operations of the 1990s.

Over the time I've been involved in this portion of the business, we've seen a number of changes, both in the perspective of how we operate, perspective of how the FAA views and regulates us, and also how the manufacturers are viewing contemporary helicopter logging operations. My focus in this presentation concerns the maintenance considerations of operating a helicopter in the helicopter logging business. As this presentation proceeds, it will become apparent that every maintenance activity and the way it is accomplished affects the overall profitability and viability of the entire operation significantly. The ability to predict, project and deliver controllable costs on the aircraft is perhaps the greatest challenge to any operator involved in helicopter logging operations.

The first and primary consideration is the selection and acquisition of the helicopter deemed appropriate for the operation. We must consider how to make it into a piece of equipment that can be used safely, be utilized profitably, what kind of modifications will be necessary to fulfill the mission and the planning and considerations necessary to continue to operate in the long term.

The first choice, as operators start to select a piece of equipment, is the initial performance issue. Does the aircraft have one or two engines? Does it have one or two rotors? Will it perform hot and high? Will it survive the climatic extremes of operating in the open all the time? How old is it? How has it been maintained and operated in the past, and perhaps the best measurement, how well are other operators of the same type faring in an operating environment similar to your own.

Generally, in helicopter logging, it's true to say that the lowest cost in the operation is the cost of purchasing the aircraft. Even prior to the larger numbers of military surplus machines coming on the market, this statement held true. An operator's lowest expense will be the initial acquisition of that aircraft, and it just gets worse from there. So, if that's scaring you, you probably want to stop at this point to reconsider.

The second consideration in costing the operation is the cost of the operation of the aircraft. What are the cost of parts, maintenance, overhaul, fuel, and insurance? What does it cost in terms of manpower? What will skilled pilots and mechanics cost, plus travel, accommodation, training, and expenses? What are the costs of adequate housing of people and equipment to permit your operation to run? What are the basic overheads of running your business? What is the cost of fueling, ground and safety equipment, service vans and service equipment necessary in the field? Beyond the basic aircraft you will need to hire or contract a cutting, hooking and landing crew to work the logging end of your show.

What are the true costs of owning and operating this piece of equipment? Helicopter logging, with one exception, is built around mature, out-of-production aircraft. The K-MAX will be very interesting to

watch, as the economics and operating database expand, and compare the projected and actual costs. As a new production aircraft, there may well be unpredicted expenses; however, with the level of manufacturer participation, there may be unpredicted savings downstream.

For the older aircraft, a whole new area of prediction arises. The model may not be in current production; additionally, it may not enjoy support from the original manufacturer. On these aircraft, parts range from abundance to total unavailability. It may be necessary to manufacture replacement parts in order to operate, and as time passes, the high usage parts are the first to decline. What is the current availability of parts? Who has them? What are the prices, and where are those prices projected to go? The operating cost of one operator may not be a true reflection of another, despite operating essentially identical equipment.

Performance is, of course, a primary consideration. Can the aircraft operate safely and efficiently for your mission? Some aircraft maintain exceptional performance at altitude and in high ambient temperatures, while others may depreciate so significantly that they cannot be operated viably in hot and/or high conditions. In consideration of the overall performance of the helicopter, how will the airframe and systems perform in a logging environment? If maintenance and repair time are significantly affecting the availability of the machine, then the selected aircraft may have worse performance than one that simply suffers from degradation in specific prevailing conditions. All of the twin-engined helicopters, currently utilized in logging operations, configured for logging, can perform any maneuver on one engine, including taking off and hovering. All helicopters configured for logging are stripped so light that they have truly remarkable performance. The entire load is disposable load, resulting for many types in an improved external load gross weight over the standard gross weight. This exceptional performance margin has contributed to a major part of the overall safety record for the twin-engined logging fleet. This is not to suggest that such a performance margin makes any type immune from the possibility of an accident, as many accidents occur for reasons other than engine failure. It does, however, allow the safe recovery of the aircraft, following a power loss in one engine, and many helicopters have been successfully recovered due to the second engine and the performance margin provided by the logging configuration.

The final consideration in selection is whether, where permitted, to operate a restricted category or standard category helicopter? In logging operations there may or may not be a benefit to either, dependent on where you intend to operate and what else you intend to do other than hauling external loads. Currently, there is a choice and many operators are choosing to operate restricted category aircraft. In the United States a growing number of operators are operating both restricted and standard category helicopters side-by-side, operating them to identical standards, operating them in the identical manner.

Once the decision is reached as to which of these you can afford or is best suited to the proposed mission, consideration must be given to the basic modifications required to perform logging operations. Based on industry experience of other operators with the same type of helicopter, what airframe modifications are required to configure a productive logging helicopter?

These are beyond the modifications that the manufacturer, other operators, or the military, if they were the former operator, have performed. They are the modifications that operators of the same type have developed to make that aircraft into a utilizable, maintainable aircraft to operate in the logging field.

These airframe modifications range from very minor to very extensive major reworks. They range from expensive proprietary modifications to off-the-shelf equipment you can install and certify yourself. They may affect the overall performance of the aircraft, or they may affect its ability to function in a logging environment. Many of these modifications are designed to eliminate problems in known trouble spots in a particular model.

These modifications range from shortening the entire airframe to simply adding skin doublers. The following nondefinitive list, details the most prevalent modifications, common to most types:

Bubble windows, allowing vertical reference operations.

Logging Seats, modifications to allow a degree of pilot comfort.

Radio and Avionic installations, as required for the operation, FM radios are required to permit communication with the ground crew.

Load cells. Providing cockpit indication of the weight of your load (and the current gross weight of the aircraft/load combination). The available cargo load increases as the fuel load is burned and decreases.

Cargo hook systems. The means of attaching the upper (aircraft) hook to the helicopter, may be modified from the manufacturer's original configuration. Lower hook systems, although technically not part of the airframe, need to give consideration to single or double hook systems, load beam or nubbin hooks, or grapples. Some systems are using shock absorbers between airframe and hook.

Sirens. A siren, an OSHA requirement, provides the ability to warn personnel on the ground of impending danger. A further modification allows the siren to key the FM radio, to automatically transmit the siren signal, any time the siren is keyed. This improves the capability of the siren system, and allows all personnel on the job site to hear it, every time.

External gauges. A feature of almost all logging helicopters, this system duplicates the cockpit instrumentation, outside the aircraft, in the pilots line of sight. Essential for single pilot operations, where the pilot is looking out of the aircraft at all times, engine compressor and turbine speed, temperature and torque figures, along with rotor rpm, load cell and a master caution (all systems), warning light are amongst what may be displayed. Most of the twin pilot aircraft have some external gauging on the aircraft, though not as extensive as on the single pilot, most of the twin pilot aircraft have some external gauges to bring into the view of the pilot whatever parameters the operator selects. The combination of a pilot and copilot working together in the aircraft may negate the necessity even to have any installed, utilizing the copilot as an active monitoring system in the aircraft.

One of the greatest expenses incurred in preparing an aircraft to go logging is to reduce the empty weight of the aircraft by removing all extraneous equipment in order to maximize payload. The means of reducing weight range from simply removing all the wiring and avionics and interior installations installed for previous nonlogging operations to modifications such as replacing the retractable amphibious landing gear of the S61 with a lighter fixed gear. Some of these aircraft that have come from

various operations around the world, especially in the offshore business, could see reductions of 200-300 pounds of wiring out of the aircraft. Not boxes, just plain wiring. Add in everything else that's removed and it's significant.

And finally, ground equipment. Equipment to perform maintenance, service vans, special tools, manuals and reference materials, fuel storage and handling equipment, generators, lighting and trucks. This portion seems limitless, dependent on the location and scope of the job. How do you maintain the helicopter in the field? We work from small clearings in the woods. You'll have water out of a creek. You have no comforts. Some places you have telephones; other places you rely on radios; other places you have to drive down the road to the nearest point of access where the telephone system does exist.

The key part of this is the personnel. Who do you select? What attributes do you look for? In my own experience we have success with selecting the right people, not solely the level of experience, but the level of self-motivation and the quality of their work.

Oftentimes your service facilities are going to be limited. Generally, these are remote locations, getting further and further from town, to where there's not really much point in even trying to get to town anymore. You may end up with your entire crew living on the job site.

Your level and quality of field maintenance reflects directly on the utilization of the aircraft. Some types are notoriously difficult to maintain; not that they're unsafe or any worse, they just take a lot of effort to maintain them. The maintenance requirements for the type will dictate the size of your maintenance crew in the field. That's a major expense. How many mechanics do you need? What kind of rotation are you going to work them on? Are you going to put them out in the field for a year or are you going to put them out for a week or two weeks? Every operator has his own answer on how to maximize the utilization with the available crew, all with the goal of cost effectively maximizing utilization, while always ensuring an airworthy, quality helicopter.

A final consideration in field maintenance is quality assurance. How do you assure the quality of your product? How do you maintain the quality of that aircraft? How do you assure its airworthiness? How do you assure that your employees are not exposing you to a breach of the various regulations encompassing the operation. Quality assurance can prove difficult to maintain, and it depends upon personnel. How do you manage your operational and control systems? What are your own internal systems to monitor the airworthiness of that aircraft every day? It is simply not practical being in the field watching every action as it occurs. The importance of initiating a quality system that ensures and promotes mutual confidence in the activities of the operator and its employees cannot be over-emphasized. You should have selected the right people, but what are your methods of ensuring that you're turning out the product that you would like to be turning out every day?

Another issue is the operational maintenance of logging. There's a significant focus right now being given to calculating the effects of logging operations on each type of helicopter and engine. In the helicopter logging industry, General Electric was probably the first of the manufacturers that truly addressed this issue. General Electric responded to problems observed in the CT-58 engine, which has probably built more hours in this industry than any other; General Electric got involved rather than ignoring the problems, and for a long time have led this portion of the industry. As it evaluated the life limits of rotating parts in the engine, it determined that these failures could be avoided by redefining the

cyclic lives of these items. By formulating the ultimate lives for operation in Repetitive Heavy Lift, lives could be determined and adjusted that would still maintain the design safety factors.

As the business has expanded, each manufacturer has derived some form of counting cycles, because no two are the same, to account for the effects of the repeated cyclical high and low power settings encountered in this mode of operation. As operators, we are able to observe each individual engine and airframe manufacturer's approach to the problem and we can perhaps gauge it better than the manufacturers, because we are exposed to each of the solutions they use to ensure the safe operation of their product.

How do you calculate a cycle? We have to figure that there is one power event as you pick the load, and then no matter whether you fly the load downhill or uphill, wherever you go, when you come to the landing and hover again with a load with no airspeed on the aircraft, you have another power event there. So essentially, for every load there are two power cycles; how do we detail this consideration into our operations and maintain a factor of safety on these parts that doesn't expose them to failure?

Some parts of the helicopter rotate at a constant speed. Essentially the drive train -- from the free turbines powering the system through the gearbox and rotor head -- rotates at a constant speed irrespective of load. The power being transmitted, however, varies significantly.

Currently a lot of work is being put into calculating transmission and rotor head cycles, to ensure that cyclic loading does not erode the design safety factors. This is an area right now that could potentially impact your operating costs. It is essential that operators and manufacturers work together to achieve realistic, economically sound solutions to calculating loads, lives, and limits. This area has potential to increase the safety aspects and the factor of safety on the components on your aircraft whilst satisfying the risk reduction and evaluation programs that are a feature of every major manufacturer in this business.

The effects of exceeding approved limitations have been discussed here in Ketchikan. I think that the effects of exceeding approved limitations have been demonstrated to everyone attending these meetings. There is no benefit at all to exceeding the helicopters limitations. Any perceived benefits are lost to any crash, overhaul, or repair prior to any safety issue. They're lost in the availability and the maintainability of your helicopter. And if, in looking at your own operation, you figure that you really have incredible production on your aircraft for the first part of the month, but during the second part it's in the shop getting repaired, you're probably doing something wrong. There's some really good, clear indicators.

As we operate this helicopter, if we see problems arise, if we see structural cracks, if we see premature failures or rejections of a part, then we can figure that if we modify that part, we may eliminate the process of repair and replace. The elimination minimizes the risk to the aircraft and the air crew. It maximizes our utilization. It also increases our operating availability and thus decreases our overall cost of operating, not only that particular part of the entire machine. Some of these modifications may be very minor, but some of them may entail extensive redesigns of major systems within the aircraft.

As we go through the overhaul process, we get the same thing. In the overhaul we get within our components, inspect and rebuild them. We know on a day-to-day basis what they're doing outside;

now we get on to what's going on in the inside. And it's the same thing -- eliminate the problem areas through process or part modification.

There are a number of tools available to operators to assist in the continuous evaluation of components in operation; filters, chip detectors and oil sampling may permit the early detection of problems and provide the means of anticipating failures prior to their occurring. You catch them at a much earlier stage, maybe before a part is ever rejected, and where it's still repairable. Maybe a very simple repair. But you're one step ahead of your problem. Health and Usage Monitoring Systems (HUMS) have been used in nonlogging operations for the part few years; now, there is interest amongst operators and manufacturers in developing portions of the systems for logging operations. This is particularly true for accedence monitoring equipment, for the power and load parameters of your operation to control costs by observing the limitations of the aircraft.

As we go through the full overhaul process we tear down parks to detect signs or wear or failure. Why did it fail? We have to analyze the facts there. What can we do to improve it? What can we do to maintain the availability of that component? We have to look at material and quality failures. Not only do we suffer failures here just from regular helicopter operation or logging operation, but we also have to look hard at material failures and quality failures from within the manufacturing process. How do we eliminate those? Those will occur. These are machines, pieces of equipment made by human beings. There's room for error in everything we produce.

The success of the overhaul modification program has been with operators who have specialized in singular types of aircraft, in-house and who have developed very extensive salvage, and repair, and overhaul processes of their own. And where you have a large number of similar aircraft in the market-place where they have been worked in conjunction with the manufacturer.

Now we take the complete maintenance cycle. This ranges from our day-to-day maintenance to major inspections where we totally disassemble the aircraft, paint strip it, replace major parts, and get in-volved in our major modifications. We get into customized maintenance. The manufacturer has a maintenance schedule for his aircraft, for what he believes it's going to be used for. In helicopter logging, customized maintenance is very important. The purpose of it is to get involved in the problem areas in your aircraft. How can we eliminate them to achieve all our operating goals, to increase the safety, the availability, and the profitability of our helicopter? All these things tie together. We come back to the facts that safety does not cost you anything. Safety is probably the greatest investment that you can make in your business, and you can quantify it.

Customized maintenance should reduce maintenance costs. You're ahead of where the problems are, so you're eliminating them or dealing with them in whatever manner is necessary. So they should reduce your operating costs and allow you to perform the work during slow times of the season, instead of when things go wrong -- generally when you most need the equipment.

They should improve your utilization. They should improve the maintainability of the aircraft. You're not back fixing the part that goes wrong all the time. You're involved in your overall operation of your aircraft. It makes your mechanics happy, and you'll get more productive work.

Customized maintenance will give you greater margins of safety. You know where the problem areas are, so you can focus on them. Even once you've resolved them, you can still focus on them, and you should be there ahead of them. Ahead of major structural or dynamic failures.

The key to maintenance in helicopter logging, because of the utilization that we are looking for, and because of the expense of having a whole logging crew sitting around if the aircraft isn't available, is proactive maintenance. There is no other factor that is more important. You need to be fixing these problems before they occur, and that comes back to the selection of your mechanics. Have you selected individuals that are self-motivated? Because if they're not self-motivated, you've probably got the wrong people on your payroll. They're not going to work out for you. It's hard work. It's demanding work. Start early in the morning, finish late at night. No one really gives you any thanks for it. But, if you select the right individuals, the return can be greater than any other maintenance investment. You can have the greatest pilots in the world, but if your helicopter is unserviceable all the time, you're probably going to lose them, because they'll go work for the operator who is doing it right. Maintenance is the key to a successful sustainable operation.

Most operators develop and customize their maintenance schedules to meet the climatic or geographic problems that they meet all the time. There's problems we have here in Alaska that someone logging in the Sierras is unlikely to hit, and vice versa. So, you have to adapt it to a manner where you can maintain your aircraft to make it meet your operational needs.

In the engineering field, when we try to resolve these issues, we look for the weakest link. Where, in this system, is the whole thing breaking down? We have to consider our operational factors. What are we doing that's making the aircraft break down? We get into engine problems. Are these problems within the engine specific to helicopter logging operations? If they are, we need to see if we can resolve them and take care of them, eliminate them completely.

Drive trains, drive shafts and gear boxes pose the same challenge. The continuous process of modification and improvement, adopting and adapting new technologies. We may be working equipment that is 30 years old, but new technologies allow us to continue to operate these parts into the foreseeable future, able to bring them through our maintenance and overhaul cycle and keep them in safe service for a long time.

The rotor system and heads, in the logging business, haven't been a specific high problem area. They have been problems in the overhaul or in the overall operation of helicopters, but not specifically in logging operations.

Every operator in here probably has his own structural repairs and modifications that he has carried out. Some eliminate the problem, some exacerbate the problem, because it moves it off to another location where you either can't see it, or it affects some other related structural part that was not anticipated.

It is important to be very thorough as you deal with these structural problems, to ensure they do not come back to haunt you. For the most part these helicopters have very rugged construction methods and materials, and you need to ensure that you don't compromise the strongest areas of the aircraft and chase the problem into the weakest part. The modified, refined helicopter in the logging operations of the 1990s is generally a far removed item from that delivered from the factory.

One of the areas of discussion here in the last two years is to consider what happens if the weakest link in that whole system is the operator himself? We get back down to defining and eliminating the problem, but no one has ever successfully been able to come up with a cure for the operator as the cause of the problem.

The FAA has a number of means it uses to regulate the operators themselves, including operating certificates, and FAA has a number of means to regulate the equipment that we operate. And as a number of surplus aircraft in operation has grown, the number of type certificates for the same product has grown extensively, and airworthiness directives have become a very valuable tool in controlling the same part and application in essentially different aircraft. The purpose of an airworthiness directive is to legally mandate actions on an aircraft or engine. The FAA is going to regulate items that pose a safety risk to the product, but only the interaction between regulators, operators and manufacturers can ensure that items requiring attention are positively addressed and resolved. The interaction within the industry is essential. We have seen in one instance of a manufacturer actively asking the FAA to mandate an inspection -- one that is still moving through the process some two years later.

At the HAI meeting in Dallas, it was resolved that point 1 of the HAI Helicopter Logging Committee is that no further regulation be imposed on the industry. No further regulation in any form. The existing regulations, adequately enforced, are capable of ensuring safe logging operations.

Interpretation of regulations is also going to be a subjective matter. The Federal Aviation Regulations are written to provide an outline format of a particular regulation. Some are very clearly defined, but most are open to some form of interpretation. This allows for operators to develop the rules with the FAA to meet the particular needs of their particular operation. The down side is that sometimes the regulation doesn't have a stated intent, and thus may not assist in attempts to take enforcement action.

The airframe and engine manufacturers are increasing their participation in the logging industry with the logging operations. Helicopter logging is a mature industry. This is not some fly-by-night concept, or a group of companies that appeared in the last three or four years. The most successful of the operators that are presented here have been in business for a long time. They've been very successful at what they do, and are leaders in the entire helicopter world, not just the logging end.

The manufacturers are looking at this in a different light. It's a welcome change, and it really will have great benefit to both operator and manufacturer in the future. In the light of the current issues of liability for all industries, it is time for the whole industry to realize that the active participation of the manufacturers is in the interests of both manufacturer and operator. By ignoring the problems, they will not go away, but by working together we may share information, resolve the problems and see a real improvement in safety. This should be a satisfactory outcome for all parties involved, and meets all the requirements in 1990s risk management, evaluation and reduction.

The HAI Helicopter Logging Committee is endeavoring to bring all the parties together, to provide the means that all parties can get together in an informal manner so that we can actually get things done. Let's work together to create the environment to make these things happen. Constructing databases for information, utilizing the resources of the HAI to make these things happen. Operators tend to be pretty secretive about what they do and how they do it, and there's good reason for that too. But there is some shared information that is valuable, some that is essential . We get back to the same thing. If

you want to avoid regulation, then somebody's going to have to provide information to quantify what we are doing, when it is successful.

Currently there are a lot of changes in the way that liability claims are being handled between companies and manufacturers; they negotiate settlements rather than go to court in some acrimonious dispute that leaves everyone with a bad taste in their mouth. If we're able to sit down with all the parties involved, we should be able to come up with constructive solutions to what are destructive issues. Litigation is very destructive. It does not result in positive relationships. If we can cooperate effectively, I think we will see a great advancement in the industry.

Safety is worth every cent you spend on it, and the Maine 200 program that was referred to in Ketchikan proves you get a lot more for your money by putting a safety program in than paying fines. You get nothing with fines. You just get a bad reputation and you've got to try to change it.

We have high safety standards on the ground and in the air. The operators that have been around in this market for a long time, and by particular types, have a record that exceeds the record for that same type in other operations, offshore, utility or whatever.

We have anomalies to that safety record, and that's what we need to focus on and deal with. We need to deal with those aspects of our industry that are not working to everyone's satisfaction.

If we look at our safety history compared to our utilization, there's another fine set of numbers. Our utilization is second to none. In helicopter logging our utilization of the aircraft is unmatched. There are operators in here who fly 10, 12 hours a day every day in the logging season, and they do it with a very minimal amount of support in the field and produce an airworthy product every day. That's an achievement. That's a major achievement. It stands comparison with anything else that is done in the helicopter world, anywhere in the world.

Doug Herlihy talked about some of the aspects of dealing with an accident. Part of the perception of helicopters within the logging business has been the way that the media portrays the industry; you seldom read in USA Today, for instance, that a log truck driver got killed because his log truck came off the road, but you're going to read about the pilot that was killed in the aircraft on the same operation. We need to change that perception of what we do. This isn't some hugely risky business we're involved in. If it were, none of us would be here. It can and should be a very safe way of making a living.

Where are we going? Where's the future taking us? Helicopter logging is an industry. Within the logging industry, helicopter logging is an industry. It's growing. It's growing constantly. It's growing worldwide. It's a line of business that was pioneered in the Pacific Northwest, but it has gone worldwide.

We have new machinery available. That's something that hasn't happened in a long time. We have surplus machinery available. That's something that's been going on for a long time, and is a major issue. A lot of the established operators are not very happy to see some operator or former customer set up for a tenth of the cost that they did with the same equipment.

Accidents have a very negative effect on the industry and on the perception of helicopters within the logging industry. They have a bad effect on the people that are involved in it. If you work for a company that has a lot of accidents, its not a nice place to work. So, the effects of the accident go way beyond the cost in dollars; it affects employees, families and business, and how people perceive our industry.

Insurance has been an issue, and probably will continue to be an issue, but we can work on that if we demonstrate how the majority of operators function, and replicate those standards industry wide so that the insurance companies will pay attention.

If helicopter loggers can take themselves seriously, then the helicopter industry will take them seriously and provide it the place it deserves in the industry.

CHAPTER III
FLIGHT AND GROUND CREW

HELICOPTER LOGGING FROM A PILOT'S PERSPECTIVE

By Mark Lindamood, Chief Pilot, Carson Helicopters

I work with Carson Services, based in Perkasie, Pennsylvania. I operate our Jacksonville office in Jacksonville, Oregon, where I'm in charge of the helicopter logging.

I'm licensed in both the United States and Canada as an air transport pilot with full instrument privileges, and I'm type rated in the Sikorsky S58, 61, and 64. I have 29 years experience and more than 18,000 hours of logging. I've spent the majority of that time in external load work, using vertical reference.

Except for the war, most of my flying has been in large, over 12,500 pound, multi-engine helicopters. In the late 1970s, I started as a logging pilot, flying a Bell 214. I attended the factory school and listened to all the propaganda from Bell Helicopters about the safety of the aircraft. I flew approximately 960 hours in a Bell helicopter when the clutch assembly failed. The engine began overspeeding and automatically shut itself down. We were over tall trees and steep terrain when this occurred and so a hovering autorotation was impossible. I suffered broken bones and spent a year recuperating. I still suffer with back pains today.

The next aircraft the company purchased was another Bell 214 which only lasted about 265 hours. When it crashed, Gary Morden was seriously injured with a broken back. We were, however, very lucky. Bill Fife, Kevin Dahl, Carson Snow, Kurt Zuwalski, Tom Lights, Roland Maxwell, Billy Bliss, Joe Cook, Tim Wiltrout, and many, many more men did not go back to work after their accidents in single-engine aircraft weighing less than 12,500 pounds. These men died from injuries as a result of these crashes, leaving behind grieving widows and fatherless children.

I believe that 90 to 95 percent of all cargo tons of logging weight is flown by large, twin-engine helicopters. These aircraft are mostly Sikorskys and Boeings, safely flying millions and millions of tons every year. Our Sikorsky S61s average 1,000 tons a day, six days a week, for over 2,000 hours each year alone. Columbia Helicopters must do at least ten times that much. Erickson Aircrane, Solar Brothers and Croman Corporation all operate large twin-engine aircraft designed to safely handle heavy external loads.

The small, single-engine aircraft operators (those operating aircraft under 12,500 pounds) which are predominately Bell Helicopters and a few Kaman aircraft move the remaining five or so percent of external logging material. These aircraft were designed for rescue missions, aeromedical evacuation, transportation of personnel, and light internal cargo. The hooks on these aircraft were an afterthought.

When we are logging, we are almost always in very rugged, steep, mountainous terrain, among tall trees. If we weren't, we could use other, less expensive means of harvesting the timber. In logging there are usually very few suitable, safe landing areas where the pilot can land the aircraft in the event of an emergency.

Notice I said "in the event of an emergency" and not "in the unlikely event of an emergency." That's because helicopter logging is very, very hard on the machines, and there will inevitably be times when the pilot must react to mechanical problems. The suitable safe landing area that I spoke of is usually the log landing or the service landing, which is often the only flat piece of clear ground nearby. It is busy, with noisy, heavy equipment, and men scurrying about pulling chokers and operating loud chain saws.

If the pilot is forced to execute an emergency landing to the log landing or service landing, this may not seem to him at the time to be a very suitable landing area. Helicopter logging engines are cycled from flight idle to full speed every minute and a half. Just imagine accelerating your automobile engine from idle to full throttle 320 times a day, six days a week, 52 weeks out of the year. Engines do quit. Clutches fail; inputs fail; fuel pumps stop pumping; accessory drive shafts break; power plants do stop running, and most always at times when the pilot least expects it.

However, if a pilot is flying a twin-engine helicopter, things are a lot easier to handle. He doesn't have to crash into the trees or try desperately to execute an autorotation to the log landing hoping that the loader operator and the ground personnel are able to hear above all the noise and can dive for cover to avoid getting their heads chopped off or seriously injured by flying parts and pieces of the rotating systems of the helicopter as it crashes right in the middle of their work space.

I know this because I've had at least 12 power plant failures. Only one time was there any damage to anything or any people, and that was when I was flying a Bell 214 single-engine helicopter.

Jim Lematta of Columbia Helicopters once told me over the phone that he had a pretty good engine overhaul shop. I told him I thought it was the best engine overhaul shop of its type in North America. He then said that if he were operating single-engine helicopters in a logging environment, he would have lost his whole fleet by now. That made a lot of sense to me.

The large twin-engine helicopters have two pilots rotating back and forth between the pilot in the left seat and the copilot in the right seat. This not only reduces fatigue, but also enables the copilot to monitor the engine temperature and pressure gauges, the warning lights, fuel quantity, and the weight load cell. He can relay to the pilot the actual weight of the load while the pilot is picking it off the ground. The pilot is then able to concentrate on flying the aircraft and watching for trees and ground personnel. The copilot can also keep the tail rotor and main rotor blades on the blind side of the aircraft clear of obstacles, and alert the pilot of any ground personnel who may have inadvertently gotten in the takeoff path of the aircraft's external load. The copilot also keeps a close eye on the power level, and informs the pilot when he's approaching maximum takeoff power. The copilot does this by lightly applying pressure to the collective pitch, or reading out the power instrument, or both.

The small single-engine aircraft usually only have one pilot, and he normally flies all day long. He must divide his attention between the engine temperatures, pressure gauges, power gauges, warning lights, fuel quantity, and the weight cell, as well as watching his load to keep it clear of the obstacles and ground personnel, and his rotor blades out of the trees. While concentrating on these tasks, he very often lifts too much weight and over-grosses the aircraft before he realizes it. If the pilot already has a load flying down the hill, making an airspeed-over-altitude takeoff, he just continues to fly the load to the log landing. It's not long before this dangerous procedure becomes a habit with him and he does it several times a day, day after day.

The large, twin-engine aircraft were designed to carry heavy external loads safely. These helicopters have two engines, two inputs, two servo systems, two electrical systems, two fuel systems, and two pilots. It's very important to remember what I said earlier, that I believe 90% to 95% of all external load weight is safely carried by large, twin-engine aircraft, and the five or so remaining percent by small, single-engine machines.

If you men and women here today of the NTSB, the FAA, and other agencies will review the facts that you already have at your disposal, I'm quite sure that you'll soon realize that five percent of the small, single-engine aircraft are responsible for 95 percent of the serious and fatal injury accidents.

Bell Helicopters' UH-1 series, its 214, Kaman Huskies, and even the new K-MAX Air Truck, are, in my opinion, flying death traps when used in helicopter logging. They are constantly operated inside the shaded side of the height velocity curve, the "dead man's curve", where executing a successful hovering autorotation is not practical even in an optimum environment such as flat, clear ground, let alone steep hillsides and tall trees.

This height-velocity curve is in all the flight manuals. It's an area of flight where continuous operation is not recommended, yet that is exactly where many helicopter logging operations take place. With twin-engine helicopters, the danger from this height-velocity curve is almost completely eliminated. Single-engine helicopters must be prohibited from performing external load work. They simply must be stopped.

In the mid-1930s the government took a bold step. It wasn't afraid to act. It cared more about human life than about what a few aircraft manufacturers said. They enacted a rule that all scheduled passenger service would have to have at least two engines. Parks and Fairchild and others thought the government had gone way too far, that they were way too restrictive. But look at air travel today, all over the world. It's safe and reliable because of the concern and guts that it took, at the time, for a few people in government to enact a rule that they knew would save lives.

They were, perhaps, in a meeting much like the one that we are attending this week. There will be those today who will cry that increased regulatory oversight is going to put them out of business. Well, let me tell you something. They'll be out of business before long anyway. No one I know who operates single-engine helicopters for the purpose of aerial logging ever lasts very long. Sooner or later, after killing a few pilots and wrecking a number of helicopters, they all go out of business.

The problem is that the owners and managers are usually not the pilots who are flying the aircraft. When one crashes, their insurance covers their losses. However, no amount of insurance that I know of can cover the loss of that father or husband who was killed trying to make a living doing the thing that he loved most. If these were Sears table saws, there wouldn't be any more home woodworking projects. If these machines were Singer sewing machines, there wouldn't be any more homemade dresses.

The U.S. Coast Guard replaced its old Sikorsky Cyclops with an S62 multi-engine Dalphine helicopter. The Army replaced its Huey with a twin-engine Sikorsky helicopter. The Air Force and Marines operate multi-engine helicopters because they realize the importance of redundancy while operating in a hostile environment. All helicopter logging takes place in a hostile environment.

I ask, as an experienced helicopter external load pilot, if there are to be any regulations to be written as a result of these meetings, that they include one that prohibits the use of single-engine helicopters for the purpose of conducting external load operations. There are enough deaths already caused by single-engine aircraft to warrant a regulation that states that all external load operations shall be conducted with multi-engine helicopters...period.

You ladies and gentlemen have the wherewithal and the responsibility to safeguard these flight crews and ground personnel, and to keep them out of harm's way. All you have to do is get one regulation submitted and passed, and with the stroke of a pen we can almost completely eliminate these unnecessary injuries and fatalities.

Yesterday on the way up here, I talked with an engine man from Kaman. I said, "You know, as an engine man, you should be happy about such a regulation. You should ask for four engines on a machine, and you can make more money." As a representative of a helicopter company that manufactures single-engine helicopters for logging, this gentleman replies, "There's a financial penalty for having two engines." Well, what's the financial penalty? You know if you've got two engines it's safe. You know you can get out of that "dead man's curve". Believe me, I've flown back to the service landing many, many times and landed with one engine. It's not always the engine that quits, it's the input, or something else that fails. That second engine will get you back. The financial penalty seems a cheap price to pay if we're going to save some lives and save some money on liability insurance and workmen's comp.

QUESTIONS AND ANSWERS

MR. ROY FOX (Bell Helicopter): I certainly didn't come here to debate the single versus twin issue. That certainly was not my intent of coming here. Mine was to talk about the overall helicopter industry and what indications we're seeing in the overall logging area. But, since Mr. Lindamood has brought up a very strong point about single-engines, I just want to caution you, that although I agree with some of the things he says , you must remember that there are more parts than just the engine. There are some places where a twin-engine is the best choice for a mission, and I agree with that. There are other places where it may not be the best. It just depends upon the mission and on the environment. You must remember, there are a lot of parts on that aircraft that are not engine-related. I do like your idea of a second pilot though. I do totally agree with that portion.

When our company looked at the risk per occupant hour, the single-turbines and twin- turbines were exactly the same. The risk per 100,000 occupant hours of someone being seriously injured or killed was the same for any kind of material failure.

I'm just saying there are a lot of issues here that may affect aircraft safety. It's not just a matter of how many engines we're going to stick on them.

MR. LINDAMOOD: The database that you're talking about, of twin-engine versus multi-engine, is over the whole spectrum of helicopter use. All we need to look at here is external load work. Granted, the 206 is a wonderful aircraft for flying people back and forth, but when you start hauling repetitive external loads, something is going to fail. If you've got two engines, you've got a backup.

Industry officials, of all people, should be wanting that redundancy, because you spend a lot of time in court and a lot of money on out-of-court settlements, over this same problem.

MR. FOX: Yes, we do spend time in court, but for many reasons. In fact it's rare we're in court over the number of engines, but we spend a lot of time on other things.

The industry is concerned about the safety issues that you've brought up. ICONX 6 is trying to mandate single-engines basically be prohibited from flying over congested areas, meaning cities, recreational areas, and other populated areas. That proposition, basically, may be a kiss of death for the helicopter industry. Now, for the short term, manufacturers would like this proposition, because you can sell twins, and there's a whole lot more money in twins than there is in singles. But, when forming a helicopter industry, you've got to start out in the smaller aircraft and work your way up to the larger ones.

MR. LINDAMOOD: I'm not just talking about the two out of the six total crashes that happened up here in Alaska last year. I'm talking about 20 years of data. I'm talking about putting a long overcoat on a lot of guys after the engine failed, the fuel pump failed, the inputs failed. When you've got an input failure on a Sikorsky S61, the engine quits on that side, so you go back, you land, you take it apart, you put it back together, and you're logging the next day.

MR. FOX: Furthermore, I object to the use of the term "deadman's curve". It's not a "deadman's curve", it's a height-velocity curve, period. The terms that are in there by all manufacturers is, avoid this region. That's there for a purpose. If you get over that line, it doesn't mean you're dead. It means that you are likely to bend the machine in an autorotation. Bend it, not hurt yourself.

This ties back to the twin-engine. The twin-engine height-velocity curve is smaller, but it's still there. And basically with the twin-engine, you just have power en route to the ground. So, that's not necessarily a cure. The reason people go with single-engine aircraft has to do with its being more effective to use one big engine if you're just pulling loads. Now, when you get to extremely large aircraft, then you go with the twin-engines, because it's a matter of getting an engine that will fit the design. So, I think you ought to ignore the single versus twin issue.

MR. LINDAMOOD: There is a "dead man's curve", you guys that fly know that.

MR. DALE HOKE (Aerial Crane Systems, Inc.): My only point is about this height-velocity curve business. Mark Lindamood and I have spent many hours in the cockpit together beating each other over the head, because most logging helicopters of the multi-engine variety are operated at a very, very low empty weight. So, at most reasonable altitudes there is no height- velocity curve. If you lose a power plant, you can sit there and hover on the good one.

MR. LINDAMOOD: You can climb out.

MR. HOKE: Or climb out, and that's a very comforting thought. This is not necessarily true of some passenger carrying twins, because they've got seats and other equipment in them, but at the logging weight of a multi-engine helicopter, you can dump the log and you're in fat city.

MR. DOUG HERLIHY (former NTSB crash investigator): I didn't want to get in between the adversaries of single and versus multi-engine. You've got great points on the multi-engine issues. But we can't overlook the fact that there are some human factors in here other than just the machines that have failed.

MR. LINDAMOOD: It goes back to what I was saying about small, single-engine helicopters, those aircraft under 12,500 pounds. In the not too distant future I believe there's going to be a whole bunch of 204s and 205s released from the military for surplus. I want to see surplus equipment on the market. It has to be. We need parts and pieces. But, when you get small, single-engine operators who can pick up an aircraft for $50,000 or $100,000 and instantly become helicopter logging operators, our insurance rates go up. These accidents really do affect us. Look at the penalty on that extra power plant, look at the penalty that raises two or three percent of insurance on your hull insurance . These things far outweigh the cost of having another engine. We move most all the logs with large, twin-engine helicopters. When single-engine people come in, poof, the accident rate goes to hell.

MR. MIKE ABDALMASEH (Kaman Aerospace): I'm the guy that Mr. Lindamood was talking to on the airplane yesterday. I'd just like to clarify my part of the conversation. We believe that the Kaman K-MAX is designed for the repetitive lift scenario. The hook wasn't an afterthought.

MR. LINDAMOOD: No. I agree with that. I said on some of them, the manufacturers appear to have regarded the hook as an afterthought.

MR. ABDALMASEH: Kaman went through extensive testing to verify that. I have to take exception to single-engines being called a flying death trap also, and I'd like to think that everybody else out there would too.

MR. LINDAMOOD: I said that this was my opinion.

MR. ABDALMASEH: I understand, but I just wanted to put that in.

MR. LINDAMOOD: Thank you. The engine on your aircraft, as you said yesterday, was D rated. It still hits its 100 and some percent of N-1, but the temperature was lower to give you less horsepower, right? So you're still speeding it up and slowing it down; speeding it up and slowing it down. We don't have enough time on this aircraft. We're going to field test this aircraft to see if it's going to kill anybody. That's an issue that I am concerned about. I know you've got some time on your craft that will allow for study. But I'm talking millions of hours of data that we've got on twins.

MR. ABDALMASEH: Well, again, I have to take exception. I don't agree that all the twins were designed for the repetitive lift cycle. They were certainly designed for heavy lift, but not the repetitive, with the load on, load off. You're talking about a different load scenario there, and I don't necessarily agree with that either. But again, I don't want this to be a debate about it.

MR. LINDAMOOD: Well, aside from the single-engine logging, we have to be concerned about the single pilot in the aircraft. This man is experiencing information overload. He's got to sit in there and go through all his tasks; he's in a constant running conversation on the radio with all the people. "I've got a three-logger up the hill with two stringers running uphill; two stringers downhill that weigh 8,500 pounds." "Here I am, 12 o'clock, 12 o'clock." "Here, you're flying over me." He's listening to all

that, plus he's doing all his work inside the cockpit and outside the cockpit so this guy's bombarded with stuff.

MR. ABDALMASEH: Excuse me, if I could just comment on that also. I think that falls into the human factors rather than the helicopter design, and I think that the K-MAX was designed for that mission.

MR. LINDAMOOD: I just wondered who is the weapons officer in a K-MAX? Who's handling those radios? I hope that everybody really understands what I'm trying to say and gets some information back to the people who make these decisions. It would really impact the accident rate.

HELICOPTER LOGGING FROM A GROUND CREWMAN'S PERSPECTIVE

By Jim Neal, Safety Manager, Aerial Forest Management Foundation

Thank you for the opportunity to be here. As has been stated by quite a few speakers already, I think that the answers to the industry's problems, or perceived problems, are in this room.

Born and raised in a logging camp, I consider myself an experienced logger. I've worked on the rigging, on the landing, and as a timber faller, under yarders, and behind Cats. Since 1971 most of my woods work has been under helicopters. I started in 1971 setting chokers, then worked as a timber faller and as a woods boss.

My experience leads me to disagree with the problem statement we're working on tomorrow. It states that workers involved in helicopter logging are at an increased risk of serious or fatal injury. What is the comparison group? Is a choker coiler at more risk than a bartender in a bad part of town at night? Is a pilot at more risk than a loader operator? In general, from a ground crew's perspective, helicopter logging is the safest form of logging in the woods. Everybody out there has visual and radio contact with the yarding engineer or pilot at all times. Nothing moves until he says to go ahead. Experienced pilots with whom I have worked may at times see something I didn't. Then even if I've already said "clear", the pilot won't clear or start picking up the load.

I have two boys; the oldest one is 22, and they just broke into the woods with my uncles in the last three or four years. I was much more concerned about their breaking in under a yarder than I would have been had they had the opportunity to break in under a helicopter.

From a landing perspective, sale designs are a concern. Normally helicopter landings are larger and more complex operations than government agencies, typically the Forest Service, will allow for yarders. To me, a yarder landing in general is a much more scary place to be than a helicopter landing.

It's hard to say that cutting is more dangerous on a helicopter job. Because you tend to be on steeper ground, all the dangers associated with cutting on steep ground apply to helicopter logging. You tend to do more partial cutting. Thus, in one sense there's some increased risks, but in another sense, because you've got a lot of stems standing there to prevent logs from rolling, it's actually safer.

I'm fairly amazed at some of the comments I've heard. I said I started as a choker setter in 1971, but I've heard today from a couple people that this is an emerging industry. As early as the 1970s, Columbia had fantastic training programs as did Erickson and Croman. I was trained in the woods by my uncles, and my dad. I've trained I don't know how many people in the woods myself, rigging crew people, cutters, landing people. I've never read a rule to them, nor required them to read a rule or regulation. I think we kind of have to ask ourselves, "What is the real purpose of rules and regulations?"

Part of what I do now with Aerial Forest Management Foundation is travel around the country helping public and private land managers lay out and design helicopter logging sales. One of the questions I'm constantly asked is about helicopter safety. I always ask them, "What do you mean? Are we talking about saving lives, or are we talking about not being subject to fines?" These are two completely, and sadly enough, unrelated items in many cases.

There's certainly a place for rules and regulations. I think we have to sort out, as a group, what we expect them to accomplish. Bureaucratic agencies tend to see problems and work toward their solutions. It seems like whether we're in land management changes, or safety, or whatever it is, the answer ultimately ends up including a bunch more rules and regulations. I think we have to be very careful about using that to solve our problems.

On the industry side, if we don't want the government to come up with rules and regulations, then we've got to police ourselves. I think the operators that have been around a long time have done a good job of this.

I would just caution this group that I think we really need to ask ourselves what are we going to use rules and regulations to accomplish? My partner, Jack Montgomery, hooked the first helicopter turn ever. He has compiled a list of things to look out for, for different jobs, and it's written not in the form of rules, but suggestions. "If you're a choker setter, watch out for these kinds of things, and here's some things to keep in mind."

One regulation that's probably helped this industry more than anything is the policy regarding drugs. The drug test does appear to influence safety in our industry, and it's nice to be sober.

OPERATIONAL AND AIRCREW FACTORS IN HELICOPTER APPLICATIONS

By Robert Bertoldo, D.O., M.P.H., Flight Surgeon, United States Air Force

I would like to address a few models of analysis with you today. Earlier this morning one presenter described the public health approach -- agent, host, environment. I call this the dynamic environmental approach -- man, mission, and machine -- matrix or triad. My focus is on the changing environment that affects all three of these areas continually.

I will need to define a few terms that describe operational factors or mission-oriented factors, the conditions related to how a specific mission is accomplished. Then I'll discuss the air crew factors or human factors, and how they impact a mission.

We've already identified some of the problem or potential problem areas in regulations and directives. Problems occur when regulations are not exceptionally well spelled out. There are some other ideas concerning directives that I have found in the literature and I'm basically presenting information from general aviation and military aeromedical literature on these subjects. But the literature suggests that perhaps an instrument rating currency, although initially required, should not necessarily be maintained throughout the term of employment.

Insurance companies are evaluating the risks in flying in mountains and asking if pilots should be required to study a curriculum for mountain flying, have some designated areas, and require pilots to be certified in this training, before they provide coverage.

Helicopters are inherently deadly. According to 1990 NTSB data, the rate of fatal crashes per million aircraft hours flown for unscheduled events or unscheduled flying, is 14.5 for helicopters versus a rate of .82 for all other aircraft. So, almost 18 times a greater rate. The numbers are awfully high, but I verified that they were reported correctly in that literature.

Let us look at some of the other things concerning equipment, crash survival ideas and concepts. When we look at helicopter crashes, for example, fire becomes the most significant predictor of death. Fires might be involved only ten percent of the time, but associated with 56 percent of the reported fatalities. So, crash-worthy fuel systems I feel are very important, and the military has done extensive training and research in this area, and for the cost of 11 gallons in fuel space and the added weight of 25 pounds, the military can ensure a crash-worthy fuel system in its helicopters.

Many civil, commercial operations use pre-1970 technology with respect to crash-worthy seats and fuel systems. We feel that with the existing technology, 95 percent of the current crashes could be survivable. The Navy and Army have done extensive energy attenuation research and have systems designed, tested, and deployed in their experimental models. Their newer concept aircraft can withstand a 58.5 foot per second deceleration, which includes 99 percent of all accidents. And that's consistent with about 56.6 vertical gs impact.

In addition, there's been extensive work on helmets and the protective features of the helmets. One thing they've been trying to get away from are the hinge fractures at the base of the skull, which have been a continual problem.

Now I'd like to discuss training. In the past we've considered a reactive approach. Once there was a mishap or something happened, then we got all excited and started looking at all the concerns and all the possible solutions and what was impacting it. In the future we want to be more proactive, and I think we're coming to an age where this has become a lot more sophisticated, and we really are including a proactive approach. We're teaching air crew and aviation leadership the effects of stress on safety and accident prevention. We're looking at the human system as an integrated system in the development of an overall aircraft system.

We notice that also in training, the Army reported 92 percent of their mishaps occur in the daytime, with experienced people. In general aviation, more instructor rating is consistent with about a 50 percent decrease in the predicted accident rate. Also in general aviation we notice that younger pilots even with more hours tend to be more willing to accept risks than reject a mission. And we have another observation that in the military at least it seems there might be a negative byproduct of flight training. Maybe this might bring on some overconfidence in one's skills and judgment, and an unrealistic optimism regarding the chance to avoid harm through personal control.

A study that looked at preflight planning and supervision in general aviation reported no flight plan was noted in 83 percent of accidents. This lack of preflight briefing and the potential for in-flight hazards and threats, emergency items or changing weather conditions, going into IMC conditions, just adds one more stress to the pilot who is already taxed with a lot of things. We feel that it's important to recognize in planning and supervising, that we match the flight plan to the experience in the model and with the familiarity of the local flight environment and the mission of that aircraft.

The duration of flight mission is another important aspect to consider in operations. Mission stressors may not be actual flying, but circumstances of irregular meals, fatigue, or the fatigue of prolonged flight. We notice significant changes in ability to function and cope, and increasing fatigue, after up to seven hours of continual operation, according to a study of 24 flight crews doing C-5 operations during Desert Storm.

Under climatic conditions, we notice in general aviation that 92 percent of crashes occur in VFR conditions; 84 percent occur in daylight. We feel like the issue of "pressing" in the face of deteriorating weather conditions is the most common cause of fatal general aviation accidents. Training in IMC conditions is essential to maintain currency.

In helos, the number one weather-related accident cause is associated with wind factors. The number one fatal accident cause is associated with fog, low ceiling, and rain. Sounds like a lot of what we've been talking about.

Next, if we look at vibration and noise, we notice a condition where severe vibration can actually cause a type of spatial disorientation that cannot be recovered from. This doesn't happen too often. Usually it's associated with the total breakup of the airplane, something catastrophic happening to the flight controls. But the low grade continual noise and vibration, which is present in all helicopters is a form of stress, and it is also, in certain frequencies, a contributor to low back pain.

Lastly I'd like to talk just briefly on work site environments. The stress of a work site, which is a remote site, is a recognized stressor. We look at the environment of handling an aircraft, that is equivalent to one of the highest task stressors of a helo pilot over other aircraft pilots.

In selection, customarily and traditionally, we've always looked for the "right stuff". Generally we've identified an older pilot as a safer pilot, while the younger pilot, regardless of his experience, is willing to take more risk. And we've decided that pilots attending safety clinics score high on internal locus of control. Well, these are the kind of characteristics that we want to be selecting for.

Under crew changes and rotations, there's an added stress from an absence, or a period of absence. And this risk needs to be recognized and it needs to be included in the supervisory aspects.

Under requirements for crew rest and nutrition, the Air Force has a standard of 12 hours of crew rest, four hours of free time and eight hours of sleep. We surveyed some of the C-5 transport crews and found that less than four hours of sleep, pre-mission, contributed to the following behavioral degradations: fumbling with radio frequency changes; slowed speech, slowed decision time, dry mouth; impaired judgment; difficulty comprehending controller instructions or frequency changes, and poor acknowledgment; diminished checklist discipline, decreased cross checks, decreased crew coordination and increased irritability.

Nutritionists have noted for a long time that lack of protein and calories is a recognized stressor. I recently received a briefing from one of our medical commanders from the air transportable hospital which was stationed down in Cuba with the refugees. The military set up a huge tent city and surrounded it with wire to contain this group. The prisoners were getting two meals a day. They had beans and rice for breakfast, then had an MRE for their last meal. This went on for several months. Finally, some of the refugees broke out of the wire, and went up into the hills. They just disappeared, then came back with three-foot long banana rats, and added those to their diet. In nutrition matters, variety is also important.

Under task management and fatigue, it's noted in the literature in general aviation that greater than 50 percent of the accidents occur from faulty decision making. Also it's noted that a male pilot is two times more likely to experience an error or a pilot error mishap than a female pilot.

Increased quantity and complexity of tasking in flight, which are secondary to in-flight changes, contribute to fatigue. The military noted in helos that the more tasked a pilot becomes with aircraft control, the more challenged he is by any kind of unexpected change. It's just that the normal workload is so much, and especially for a single pilot. We fly some special mission single-pilot aircraft in the Army but primarily all our cockpits are dual piloted.

We find that excess emotional stress caused by family problems, social stress, career instability, recent or near aircraft accidents, and difficulties with flight schedules, creates a failure in a pilot to cope, or at least challenges the coping mechanism. This can lead to clinical depression. It can lead to self-destructive behavior in which a pilot externalizes his feelings, acts out, and blames others. When you see expressions of defensiveness, arrogance, hostility, financial irresponsibility, excess routine habits, these all lead to, and are spelling out, fatigue and it's time to recognize that there will be decreases in pilot performance. There will be increases in risk taking that follow, however, and we all know what follows that.

Judgment training, or "aeronautical decision making," has more safety improvement potential than total elimination of all airworthiness failure causes, according to Mr. Roy Fox. I have a lot of respect for him making that kind of a statement.

There are three determinants of pilot performance: ability, personality, and attitude. When we look at ability, we can only teach and instruct so much. There's only so much talent and ability in a person to grasp and actually have skill and do things. Personality is fixed early in childhood. Where we feel we can get the most bang for our buck in the military is in the aspect of attitude. And this is where we direct our current aircrew coordination training.

Now I'd like to discuss spatial disorientation of which there are three types, one, two, and three. One is recognized, two is unrecognized, and three is incapacitating. It's also called the vestibular-ocular disruption. The most likely form that we see in pilots who fly helicopters is in the type two, unrecognized. Customarily this is in the period or phase of flight of hovering. And it has to do with the lack of some of the vestibular inputs that tell you that you are moving, and it is interesting to note that type two is the one that seems to be the most picked up in helicopter operations in contrast to other aircraft, fighters, and so forth. And this type two, unrecognized spatial disorientation, is generally noted in the context of a high workload environment.

I'd like to just talk briefly about ergonomics: sitting in an awkward position, flying a helicopter and being task-saturated for hours on end. Originally, it seems man was an afterthought. The machine was designed, man was then inserted into it. A good example for me, being in the aerospace medicine environment, is Alan Shepard's Gemini capsule. If any of you have ever seen it, it's an engineering marvel. However, I also think it's a marvel that a human being was able to fit inside one of those and actually function. And I think it's aptly named, a capsule. Now we're looking more and more towards fitting the job, or the work station, or the tool, to the operator.

A helicopter is a rotor-winged aircraft platform, which is an unstable flight platform just by nature. Meaning it cannot be trimmed to fly itself. It requires constant pilot control during all phases of flight. And this is a setup for more fatigue from increased workload.

Lastly, a look at emergency crew functions. A helicopter pilot must be psychologically prepared to ride it to the ground. A successful autorotation will result in the dramatic decrease in longitudinal and vertical velocities. Imagine then, if this process or this event is not practiced with some kind of currency, it's not being done, and then suddenly the pilot is caught being faced with a situation requiring it. I think that's another added form of stress.

Finally, crew health and medical conditions. I just want to remind everybody that in general aviation more than ten percent of fatal accidents are related to alcohol.

I'd like to also just mention that if the crew has been down for more than two hours, or if the aircraft went down secondary to sudden failure, this will increase the time to rescue. If it also went down at night, it increases recovery time eight times. If it goes down in the mountains, it increases the rescue difficulty and time to recovery six times. In IMC conditions, four times, and if there are fatalities, an additional 3.5 times.

You might be interested in some of the helmet improvements that the Army has done. They've improved their impact protection, and this is from a flat impact spread out over a large surface area, but basically making it twice as safe, or twice as able to sustain gs.

At greater than 500 hours flying time, we start to see a drop in mishap rates. But up to that, the mishap rate is higher. The Army integrated a program for expert pilots, to find out what their judgment process or development process was, and to try to make that part of training. And what they noted was that there was a reversion to the basic airmanship skills. Basically, there was no substitute for experience. But even with experience, there's a need to keep coming back to the basics.

In summary, I think there's a lot of things that we can learn, a lot of parallels that we can make between general aviation, military aviation, and what occurs in the aerologging industry. I offer those for your consideration. Obviously, we need to make specific applications depending on the mission.

QUESTIONS AND ANSWERS

UNIDENTIFIED VOICE: What about crash resistant fuel cells? Are they self-sealing?

DR. BERTOLDO: Self-sealing. Yes. They have a valve system.

MR. ROY FOX (Bell Helicopters): The self-sealing is a misnomer. The military have it in the crash-worthy fuel system. It is a bullet proofing. There's a layer of natural rubber between the two outer layers, and as the bullet goes through, and the fuel comes out, the natural rubber swells up, seals it up so you don't leak gas, so you can fly home. It does you no good whatsoever in a crash. None. Zip. There is a commercial crash resistant fuel system and it is now regulations, finally. We've started them in our aircraft. Back in 1976 we put a military one in, but it weighed so much we couldn't tolerate it, so we went to a civil version, which is what the FAA rules are now.

Basically, going from a standard bladder, say an old 212, to a 412 with a commercial crash resistant fuel system, it'll cost you about three times the weight penalty per square foot of bag. To go to the full military, like the Army did, it'll cost you about eight times. But you don't gain any extra live people. So, in the commercial world we said we don't want this extra capability. It doesn't save any extra lives. So that's when we went with the lighter weight material. Our experience shows we've cut our post-crash fires by about half, and that's including the non-survivals as well.

MR. PHIL KEMP (Silver Bay Logging): Most of the helicopters don't have crash-worthy seats, and most of them have no head restraint system on them. Did I pick up that a neck hinge injury is one of the most common injuries, serious injuries?

DR. BERTOLDO: It is the most common serious injury. It's more of a hyper-extension injury than a flex forward injury.

MR. KEMP: Most of the seats, unless installed in a helicopter with a bulkhead immediately behind it, there's nothing. Your head's going to go right back over that seat.

UNIDENTIFIED VOICE: And then if you hit the bulkhead, it's probably going to do you no good either. It's going to injure you further.

UNIDENTIFIED VOICE: There's the requirement you have a headrest on the aft facing seat. The requirement's in there.

UNIDENTIFIED VOICE: Right. But we have not seen this extension problem that way. Our problem has been in the forward direction and the lateral, and if you don't wear a shoulder harness it ain't going to work anyway. You just as well have taken it off.

UNIDENTIFIED VOICE: Right.

DR. BERTOLDO: Lateral is a real problem, and the new helmet was strengthened on the side to take more gs.

UNIDENTIFIED VOICE: Most of the new helmets, to my mind, weigh too much. Like I mentioned before, I've had my neck operated on for this stuff. I had nerves pinched off at C-5 and C-6 that started an atrophy in my left arm, and now I'm down to a David Clark headset with a David Clark beanie cap on for the light weight. When I lean out and put my neck out all day long, that's about all I can take.

UNIDENTIFIED VOICE: I can remember back when we first got the doors on the 61s for the cockpit. I felt like I could log about four hours longer than I could before that because of the noise reduction in the aircraft, plus the fumes and everything else that used to come forward through the cockpit while you were logging, because comfort and noise reduction probably, for the pilot, would give him a lot longer hours, safe hours, in the cockpit.

DR. BERTOLDO: I agree. The helmet, the new helmet, is a half pound lighter. I don't know what it's total weight is, but it's lighter than the old model.

UNIDENTIFIED VOICE: Flight Suits Unlimited has one that's only 21 ounces, which is quite a bit lighter. That's about the half the weight of an SBH-4.

DR. BERTOLDO: What you have to do is look at the g protection, what kind of protection does it give you and what kind of sound attenuation do you get. You have to check out the specs, because it doesn't make any sense to wear one if you're not going to get some kind of protection from it.

HUMAN FACTORS

By George Warren, Vice President of Safety, Columbia Helicopters, Inc.

Nearly all twin-engine helicopters have a copilot. Years ago we didn't think too much about the copilot, he was just there -- one of many new things that came with a large, twin-engine helicopter. When we originally started helicopter logging, the only requirement of a copilot was that he have a license, a current medical, and a pulse.

J.P. Johnston (US Forest Service) touched on cockpit resource management yesterday, and that's a subject that's become a big issue with the FAA and others, and justifiably so. We haven't thought too much about it until just a few years ago because most of the literature that deals with it is concerned with airplanes and scheduled operations. In the last few years, however, cockpit management has become important to us and we now address it in our training.

There's a great deal going on when you're logging with a helicopter, as many of you know. I think that if I were flying in an aircraft that didn't have, or didn't require, a copilot, I'd still want one, just to ensure that all essential duties are accomplished. Many single-engine helicopters, or single-pilot helicopters do have outside gauges that the pilot can look at while he's looking out at his load. But it's impractical to put everything out there that you may need when you're logging, and it is a bit of a comfort to know that there is another pair of eyes watching the gauges while you're hanging out the bubble. The workload in a logging helicopter can be intense. If you're working a pumpkin patch that's a quarter mile away from the landing, and you're cranking out 25 to 30 turns an hour, it's pretty hard to divide your attention between what's going on in the unit, en route, on the landing, and in the cockpit. It's better that the copilot see a slight, but abnormal, drop in transmission pressure, for example, before you start hearing grinding noises from the gearbox.

The copilot can also assist in power management. Copilots in our Chinooks and the Crane routinely pull pitch for each turn that comes out. Copilots in our 107s pull pitch when directed by the pilot. The reason we do this with the Chinook and the Crane is because of the ease of overtorquing or overgrossing these aircraft. We've been able to eliminate a large percentage of overtorques and overweight turns by having the copilot pull in the power once the pilot has gotten centered over the load and has pulled in a certain amount of power and is ready to pull pitch and depart. The pilot is still monitoring the collective, of course, and can override the copilot, but the copilot is looking directly at the gauge when he pulls in pitch, making it much more unlikely that limits will be exceeded.

The copilot will sometimes pull pitch in the 107, particularly in situations while working at low density altitudes and the aircraft is torque or weight limited. At other times, when the engines are temperature or speed limited, it becomes less critical and the pilot can pull his own pitch. Aircraft equipped with GE T58 engines can actually set the topping and the crew can be even less concerned about exceeding speed or temperature limits.

The pie charts enclosed with this meeting's handouts are interesting. I don't know if everybody looked at them, but you'll notice there's one chart showing accidents and accident rates in logging helicopters. It's interesting to note that by far the largest percentage of the accidents occur during takeoff, approach, landing and hovering. Not too much happens at cruise.

The point is that if we compare a logging helicopter with an airplane, the work load on the pilot is much higher. If you're engaged in more conventional type flying involving take off, climb out, level off, flight for 15 or 20 minutes, descent, and landing, you're just not going to be burdened as much as you are while helicopter logging. You're making as many takeoffs and approaches in one day as an airplane driver does in a month. This further emphasizes the need for a copilot, who can be assisting the pilot at all times.

Yesterday Tim Harper (Erickson Aircrane) talked about pilot safety-related responsibilities. I don't want to belabor the point, but it is highly important. One thing we try to impress upon our pilots, is pilot responsibilities. We don't want people that are just climbing into the helicopter, flying a shift, landing, going home and that's it. We expect people to be looking around at what's going on on the landings, and in the woods. If they see things that need correcting, we want them to say something, and not be afraid to shut the aircraft down if something's unsafe or needs changing. That's all part of the pilot's responsibility. Many things that need to be dealt with to enhance safety can only be seen from the air.

Mark Lindamood mentioned something that I thought was significant. He talked about using the hooker on the ground to determine when the aircraft is clear. This is a practice we have always followed but apparently it is not common practice in some operations. The essential purpose of vertical reference is to have the pilot looking directly at what he's doing, and making all decisions based on what he actually sees rather than what a belly man or somebody on the ground is either telling him over the radio or is signaling to him. He's looking directly at the action.

The only exception to this during helicopter logging occurs after the load is hooked up and the hooker is clearing himself. We rely on the guy on the ground to tell the pilot by radio that he is clear. You can't always see from the cockpit if something's touching something else and if log A moves log B, log C will roll down the hill. The guy on the ground can see that, and he's the best judge to determine when he's clear, and when the pilot's clear to move off the side of the hill with the logs. We don't even want our pilots to pull the rigging tight until the guy on the ground has told him that he's clear. You tight line a hooker one time, and you're going to hear about it.

The last subject I'd like to address is the drug and alcohol testing plan administered by the FAA. There's a curious paradox here, at least to my mind. We've been on the drug plan for several years, but not until last year did we go on the alcohol plan. We probably adopted them in reverse order of importance.

Both alcohol and drug abuse are of serious concern. However, if you look at the data, there's very little evidence of a significant drug problem among pilots. I think there was more of a problem years ago than there is now. The recent data indicate that positive drug tests of pilots is below 1 percent. That includes preemployment testing.

Originally, there was a requirement for a 50 percent sampling plan for flight crews. That's extraordinarily high for a test program of this sort. Because of the limited population being sampled at most companies, the same names to be randomly sampled will come up frequently. Not long ago, one of our pilots got tested about four or five times in one year. I think we established pretty conclusively that that particular man was not a junkie. I would hope that the drug plan will be evaluated by the FAA, and a more reasonable sampling plan be enacted.

Alcohol problems, on the other hand, are more prevalent. There always has been a problem with alcohol in aviation. Anybody that was in the military knows full well that it was part of the culture to get drunk every other day, just to prove what a man you were. And, if you've ever seen data on the number of alcoholics that are airline pilots, it would give one pause before getting on an airliner. Many of these, of course, are non-drinking alcoholics, but it is a problem area and should be tested for.

As so often happens in programs that are directed at the aviation community, a program or a regulation is enacted that works just fine if you're targeting large airplane crews working out of airports. It doesn't work too red hot if you're working in a float camp stuck out in the middle of Southeastern Alaska somewhere. If the alcohol testing program is to be made workable, it must employ testing methods that provide accurate information and aren't so heavily dependent on the timing of the test. A good start would be to replace the breathalyser now being used for testing with a blood test. Other actions such as this are needed to make alcohol testing a practical tool to insure aircrew safety in the helicopter logging industry.

CHAPTER IV
SAFETY TRAINING

SAFETY TRAINING PROGRAMS

By Larry Benner, Ground Crew Trainer, International Heli-Logging Training Institute

The background for our organization really started probably almost two years go when my partner, Don Smith, who was then working for Canadian Aircrane, sustained an injury that put him off the job. The injury was, in an indirect way, the result of working with inexperienced, green people. The "7-11 kids", as they refer to them. At that point he decided that it was time to maybe sit down and try to make a difference in this industry. And he started out by meeting with Bob Hawthorne, who I'm sure many of you are familiar with. Bob has a long background in this industry with people like Coulson and Canadian Aircrane, flying different types of helicopters. The two of them started to talk about potential solutions to some of the issues of training on the job.

Historically this industry has done that, trained on the job, and have done, I think, an adequate job. But part of the challenge of training on the job is an issue of production versus safety, and historically safety, unfortunately, has taken a back seat to production, for whatever reasons. Don then proceeded to draft a curriculum of training that would help to address the issue of providing controlled training for individuals entering the industry. Not necessarily the people that were in it, we'll talk a little bit about that later, but the people actually entering the industry.

In addition to Bob Hawthorne, Don talked to a number of other pilots in the industry. He also talked to people like project managers, ground crew people, rigging people, and other people that had worked out there for a number of years about some of the issues that needed to be addressed in a training curriculum. And ultimately out of that came our five-week training program, and we're going to go through, just very quickly, what's included in that five-week program. But basically our organization was really set up to provide training that would deal not only with the production issue, but with the safety issue as well.

The program uses and includes in it a number of different training aides, and one of the things that we tried to establish up front is, what is the typical person who works in this industry? Can we mandate, for example, that they have to have a minimum level of education? Well, the answer to that, after many rounds of conversations with a lot of people, was no. But one of the prerequisites that did come up in every conversation was the issue of physical conditioning. So we made that a prerequisite to getting into this program.

Then we designed the program to deal with different learning styles, different learning capabilities. And that meant we went out and, in fact, developed a very comprehensive training video. We have approximately two hours of training videos that have been developed out of almost six hours of shots that were made at an actual heli-logging operation. Most of it full speed, some of it controlled. When we went out to do the training video, we wanted to capture a real live operation because ultimately that created for us an opportunity to show people not only what they should be doing, but also things that they should be aware of, and things that they shouldn't be doing.

I'm only going to show you our marketing video today, but in our training videos themselves, there are things that I'm sure that WCB and some other safety regulation people would not be happy to see. But that's the reality of this industry, and it's that reality that I guess we're trying to make an impact on.

So, ultimately, we use videos, audiotapes of the communication between the pilot and the ground crews, and classroom presentations as part of the training process to show them how to do certain rigging practices, for example, right in the classroom. And then, at the permanent site that we have in the Comox Valley on Vancouver Island, we actually take students to a controlled fall and buck site. This is a cleared piece of land that we've put about 12 or 13 truckloads of various sizes and species of logs on, and tried to create, to the extent that we can, what it's like to work on a hill. And we take these students out to that site and we have them actually performing the coiling techniques that they need to learn, actually rigging the lines together, putting turns together, and so on and so forth.

The other thing that we have an opportunity to do, and we've done at least two of these already, and that's "on-site" training. The great advantage of doing "on-site" training is getting access to say 1,000 cubic meters of wood that can be fallen and that we can put a helipad on. Then we can actually use that as a training site, and ultimately, at the end, take the training one step further by bringing in a S-61, or S-58 or an appropriate helicopter, and actually log to a landing. This gives us an opportunity to build on the classroom experience, the controlled fall and buck site experience, and actually have the students working under a helicopter.

What I wanted is, just very quickly, to give you an overview of what the basic program looks like. This is a five-week, comprehensive program that starts out with an introduction to Forest Practice Code. And, for the U.S. people, that's something that you don't have to deal with. But ultimately, in talking to several people around the room, it's still issues that are talked about. It's forest management. It's dealing with some of the environmental issues that we all have to deal with, and are dealing with more and more every day.

And then we get into things that WCB requires. Occupational first-aid, Level 1 with a transportation endorsement. We give them an introduction to power saw operation and maintenance, and to some basic bucking skills. One of the things we don't do is certify people as fallers. But the reality of the industry in British Columbia is, and in the interior in particular, there is a need for people to be able to do some bucking on the hill and in the landing operations.

Fire suppression, which is something that we just introduced this year, is a one-day certification program. Finally, a class IV unrestricted driver's license which lets the student drive a crummy.

This part of the program represents the first seven straight days of training for us. We then shift gears and start to get into the actual rigging practices. And one of the first things that we focus on is alcohol and addiction awareness. We give the students a one-day presentation, not on the basics that they should join AA, but on the basis that there are some serious concerns and issues out there in the industry when it comes to alcohol and addiction. What we do is try to focus them on the impact on them and their safety, and the safety of the people around them. What kinds of things do they want to look for? What is the impact of somebody showing up on the job that's been out drinking all night, or that has a drug problem? What happens to their peripheral vision? What happens to their depth perception. Knowing those kinds of things helps our students recognize those people on the job, which ultimately, we feel, will create a better, safer, environment for them to work.

We then get into the things that you would say are fairly obvious here. Orientation. We look at the overall area of operation. We get into the terminology.

We then get into such things as safety equipment and hazards. We spend a lot of time in this program talking about safety and safety awareness. What we try to do, in our program, is focus students on those particular activities so that when they go out to the landing they are looking for potential hazards and dangerous situations.

We get into the helicopter identification. This is an area where we spend a lot of time telling these students about every piece of equipment that is out there in the industry today, including the Kamov. We talk about their lifting capacities, their lifting capacity at the beginning of the cycle, the end of the cycle. We talk about putting turns together that are efficient and effective. We talk about better cycle management. The ability to get as much wood off in each cycle, versus how much wood can you load on each turn.

Radio orientation. In addition to having students using radios throughout the program, we actually have audiotapes of an actual live operation where we can have these people listening to the conversations that go on so they know exactly what to expect.

Clocking the helicopter. The 206 support ship orientation is approximately a half a day. We have a 206 pilot come in, or equivalent. They spend approximately two to three hours talking about safety and evacuation. They show the students how to take the seats out and put the spine board in. We then get the pilot to take the students for a flight around the training site, landing them on the helipad, showing them how to get in and out of helicopter safely.

Tree species and related weights. Many people coming into industry really don't have a lot of background in forestry. So, in order for them to make good decisions about putting a turn together, they've got to know a wet piece of wood from a dry piece of wood, that hemlock is heavier than cedar. If they come from a forest industry background of any kind, they typically have that knowledge.

Coiling and choking. We spend a lot of time on this area because in most organizations, most new people start on the landing. And we spend a lot of time teaching them how to work safely in that environment.

Rigging techniques, turn construction, strip running, hooking operations, chasing duties on land and water.

We talk a little bit about the advantage of recurring safety training. This is an area that we are looking at as the next evolution in ground crew training, and I know that we're probably being somewhat of a leading edge in this area, but one of the things that was talked about by Phil Kemp from Silver Bay was the need for ongoing training of existing personnel. The industry in British Columbia sees the same need for some kind of recurring training. Some of that happens as a result of WCB rules and regulations. A lot of it doesn't. And one of the things that we would like to start to do, is to try to convince industry that they should have regular yearly re-training of their employees in some of the rigging practices, dealing with issues of job safety breakdowns. One of the things that we do in our program is bring in people from industry to talk about things like safety. We bring in the safety

coordinator from Canadian Aircrane, who spends his entire day talking to these people about accidents; why they happened, what could have been done to prevent them. Again, safety awareness.

Another example of recurring training could be Level 1 OFA with a transportation endorsement, 206 support ship safety presentations, fire suppression, alcohol and addiction awareness.

Before we continue, I want to take a second to see if you have any questions about the basic ground crew training program that we're offering.

MR. KEMP: I have one question. It's not directly related to training. Is drug testing a standard practice in Canada now, in the forest products industry?

MR. BENNER: No.

MR. KEMP: I just thought I'd ask that, because that's one of the things in the States that really changed the direction of the accident rate. It just wiped out a major part of the problem.
How much is the course?

MR. BENNER: The five-week program is $3,863 Canadian. You know, if could wave a magic wand, you know, it would be marvelous if we could take every one of the people in this room and have them come in and sit for a day to kind of walk through the program that we offer, with the instructors there, showing some of the video and some of the stuff we do, because it's really hard to get into something like this that is so new, so innovative, and try and explain to people how in-depth we go with this program. And we have one instructor, for example, who's had 22 years' experience in the industry. He started out in the States, an American that was one of the first ones working with Evergreen, when everybody was sort of looking at everybody else, saying, "What do we do next? Oh, gee, look. The log's actually going up in the air." You know, that kind of person brings incredible knowledge to this training process.

And one of the things that we want to try to do is contact everybody, ultimately, in this industry to talk to them about the training that they do internally, because, historically, that's where it's taking place. And one of the only ways that we can make sure our program is adequate and addressing all of the issues of ground crew training, is to find out more about what you're doing, and what you historically have done.

I echo the sentiments and the comments that were made earlier about the importance of participation. I think for this safety issue to be addressed in a very positive way, and this issue of accidents being reduced as quickly as possible, is for a sharing of information about what the expectation is of you, our customers. We think we've got a lot of it covered, but we're not perfect, and this is an evolving situation for us.

The second thing I just wanted to touch on very quickly is the faller training program. One of the things that we have been able to identify is a lot of the safety issues that are out there today are a result of inadequately trained fallers used by the wood licensee. In talking to people, bull buckers that have been in this industry for 25 years, they will identify that in most cases when they're out with a crew, 80 percent of those people don't have any idea of some of the unique differences that apply to helicopter logging. They bring their conventional mind set. They go out and they cut, and they don't worry

about some of the issues that are there for helicopter logging. And if we can train these fallers to do a better job, I think ultimately there will be downstream benefits to the ground crews, to the pilots, to the wear and tear on equipment, and ultimately, to the bottom line, of the companies who actually own the wood.

So, one of the things that we are looking at and have refined now, is a training program that basically takes five days. It looks at helicopter support and presentation, pad construction to WCB standards, falling, bucking, and other procedures specific to helicopter logging. Again, alcohol and addiction awareness.

We'll stop there for now because I wanted to show you our marketing video, and we're running out of time. Currently in British Columbia about 12 to 13 percent of the harvesting that goes on in the province is done with helicopters. The expectation is that that will be 30 to 40 percent in two to three years. That kind of growth is going to create huge challenges for the helicopter industry. For the pilots that fly in this industry, and the people that are working on the ground. And we hope that, through training like we're offering, and potentially can offer to industry, that we can address some of the issues that are going to come along with that kind of growth. And I can tell you, from talking to industry almost on a daily basis, that there are people coming into this industry who have no background whatsoever in helicopter logging, but see an opportunity and are going to get into it. And they're going to get into it without a lot of industry knowledge. Conventional logging companies that are now seeing less and less licenses available for them are going to start bidding on helicopter licensing, and they've got a brother-in-law who just happens to have helicopter. I think that has to be a concern for the industry. And I think the kind of explosive growth that they're looking at is going to create those kind of challenges for us.

So, for me to be here and to hear some of the things that have gone on in the last couple of years was absolutely marvelous. It's an exciting industry. It's got lots of opportunities for employment for people that love the outdoors, love the forest industry, and we want to be a part of the solution. Any questions?

MR. HICKS: What's response been like for your training?

MR. BENNER: Well, when we started last June our objective was to, I guess, attract people through advertising, and by the end of December last year we had trained approximately 95 people. We also had completed the first "on-site" training program, which was done for a conventional forest company that was training their conventional people for helicopter logging. One of the things that's happening in British Columbia is that conventional people are partnering with industry, the heli-logging companies, to secure jobs for the future.

GROUND CREW SAFETY TRAINING

By Roger Lansden, Safety Training Coordinator, Columbia Helicopters, Inc.

I would like to thank everyone for this opportunity to discuss ground safety and training programs for loggers, and how they directly affect the bottom line of a company's success. Safety and training have always been long-term investments which will benefit all of us. I've been involved in all facets of the logging industry for over 20 years, with a vast majority of that relating to helicopter logging. As a matter of fact, today would be for me 19 years and 12 days underneath a helicopter.

In June of 1992 I was relieved as the field supervisor and retained as the safety coordinator to define and support our training and safety programs at Columbia Helicopter headquarters. At the present time I've assigned a designated trainer to each of our logging sites to work with all new hires, employees given new job assignments, and whenever new substances, processes, procedures, or equipment are introduced to the workplace and represent a new hazard. The trainers' duties are to include a job orientation, hands-on training, and initiating all paperwork to reflect the trainee's progress. In most cases they are first aid instructors who also teach the blood borne pathogens program.

During orientation of a new hire, topics such as the company's safety and health policy, and loggers' basic safety rules are discussed and thoroughly understood by the trainee. A visual tour of our job site will be given to the trainee to show him how our logging operation works, and the importance of each job function. One-on-one training is conducted by the trainer, and closely monitored at two, four, six, and eight-week intervals.

I brought some of our training forms here that I'd like to go over with you. The first one we have that comes in our new hire packet, that's given to the new hire, is our job orientation guide. As the new hire demonstrates adequate knowledge of each item on our job orientation guide, we check it off. At the bottom there's a place for the signature of the trainer, a signature block for the trainee, and they're dated.

We give each employee a copy of our safety policy. We also give them a copy, which comes in our new hire packet, of the loggers' basic safety rules. We go over required personal protective equipment; emergency medical procedures; basic onsite signal systems; a general overview of the operation, equipment, job hazards as they relate to the specific job sites and duties; lines of communications and responsibility between crew members and crews on the job site; the names of first aid persons and the locations of our first aid supplies and materials; how, when, and who to report injuries to; basic lifting and pulling techniques; basic onsite fire fighting equipment, tools, and procedures; serious and potential hazards related to horseplay; and a visual demonstration of the employee's minimum skills. Once the trainee has completed this and it's checked off, we send it back to the office.

Another training form I brought with me is our basic loggers' safety rules which is in our new hire packet, too. When we give it to the new employee, we expect him to read it, and then the trainer thoroughly goes over this information with him. It covers nine sections. The first one is helicopter and related items. It talks about rotor downwash, static electricity, emergency routes into the helicopters, things like that.

Number two is about approaching and departing helicopters.

Number three pertains to riding as a helicopter passenger.

Number four is about working with logging helicopters in regards to getting underneath of a load, keeping your eyes on the hook, things like that.

Number five is about working in the woods itself, as far as setting chokers, hooking turns, and pre-planning escape routes.

Number six is about working on landings, authorized personnel only, so forth.

Number seven addresses personal protective equipment.

Number eight is transportation, riding in company vehicles, horseplay, and things like that.

The last one, number nine, deals with emergencies. We want everybody to know the locations and phone numbers of our medical facilities, our personnel with first aid or other medical training, and the proper use of our litters.

So, that's our loggers' basic safety rules. That's gone over thoroughly with the new hire. Once he understands all of our rules, then that's checked off on our orientation guide.

The next phase of our training program is the actual hands-on training. That's where the trainer takes the new hire and goes out into the brush with him. Up until about 3-1/2 years ago, we didn't really have a documented training program. That's when I came along and wrote these training programs. We have a training program for each job duty out there, whether he's a hooker, choker setter, chaser, lead chaser, knot bumper, head knot bumper, wheel loader operator, shovel operator, security guard, ticket person, whatever, we have an individual training evaluation form for each one of them.

The first page of the evaluation form is a cover sheet where we put the employee's name, the date we hired him, his starting position, other positions held, his current status, what he will be training for, the from and to dates, the day he started his training, the day he completed it, and then a place for the trainer's name.

Number two, we'd like some previous experience and training. We're not real interested if he's a hamburger flipper or a shoe clerk, but if he's got logging experience and some training, we record and document that.

Number three on the cover sheet addresses job objective. The one that I brought here is the hooker/ choker-setter. The objective is to train and to increase safety awareness of hookers and choker-setters while working in the woods. We want to influence hookers and choker-setters to work around felled and bucked timber in a safe and efficient manner and to be aware of potential hazards.

The next thing we address is our personal protective equipment. For the hooker it'd be approved hard hat of high visibility with a chin strap, upper body cover of high visibility, eye protection, proper gloves, proper footwear, and ear protection.

Number five, is just our periodic evaluation; U for unsatisfactory, S for satisfactory, and E for exemplary, which I'm going to remove. There isn't a trainee out there that's an E. I'd like to see the guy that's been out there for two weeks and has an E. He's better than me, and I've been out there for 15 years hooking logs.

I've broken down the evaluation basically into safety skills and regular job task skills.

Under safety skills, number one is to understand and to adhere to all of our loggers' basic safety rules. Like I said, we grade them at two, four, six, and eight weeks. At the end of each two week interval the trainer grades the new hire, they discuss the trainee's performance and the trainee initials the performance evaluation.

So, number one is understanding and adhering to all of our loggers' basic safety rules. Number two addresses the following: walking correctly on logging slash, steep terrain, felled and bucked timber; keeping an eye on hook and choker drop while chokers are being placed in position by pilot; identifying potential hazardous conditions, widow makers, snags, spike top trees, and loose and unstable logs; properly uncoiling spring loaded chokers and looking for choker barbs; knowing correct lifting and pulling techniques; building safe flyable turns with chokers cinched tight and held by a stick in the bell with the chokers set approximately two feet from the end of the log; setting chokers safely on the uphill end of the log; using hand signals, signal mirrors, mini-mag lights, and correct radio procedures; stringing or tagging away from potential hazards; maintaining good footing to prevent slips and falls; looking for, and being aware of, potential hazards when first entering the area; preplanning avenues of escape and clearing zone prior to hooking turns; keeping eyes on hook and continually monitoring surrounding area for flying or falling debris on hook approach; safely and efficiently clearing turn area prior to giving a clear signal to pilots; being aware of atmospheric conditions that cause static electricity in the hook; using hooker gloves; properly dressing for existing weather conditions; being aware of existing conditions that can cause animal bites and insect stings; and knowing the locations of first aid kits, first aid trained personnel, and medical facility phone numbers. And the last one, number 21, is the proper use of our Stokes litter and medivac procedures.

Those are our safety skills, and I'm in the process of upgrading them. We've got some new federal logging rules that I want to incorporate into this. I don't like to isolate myself, so I go out there in the brush myself all the time. I still go out and set chokers, and I love to hook turns, so I'm still learning myself after all these years. Anyway, we'll just say at two weeks we've signed the trainee off for that. Then we've got a comment section where the trainer can write his comments on how the trainee is progressing, if they need work here, or they're doing well in this area.

When we hire a new person, the level of training he receives depends upon the experience that he brings with him. If he's pretty much a new guy, we definitely run him through the eight weeks. If we hire somebody from Tim Harper (Erickson Aircrane), like he just hired somebody from us, it's not really necessary to run him through an eight-week period. We still stick him out there with that trainer, though. We look at him, we observe him, we watch him, and we can close him out at two weeks, or four weeks, or six weeks, or if we feel he needs it, we run him all the way through the eight-week program. We also have a place for signatures of the trainer and trainee, and the dates, to make sure we're in compliance with OSHA regulations for documentation.

The second part is just basic job skills such as knowing how to hook logs and being prepared for the day's work. That's pretty important. Making sure you've got a good lunch with you, you're not hung over, things like that. Being ready to go out and work all day. Just being prepared for the day.

Understanding lift capacity and building turns with scale tape for optimum production in relationship to your cycle time of the helicopters is extremely important. You don't want to be pumping 10,000 or 25,000 pounds on at the beginning of the cycle, so you've got to know where you're at in relationship to your cycle. We're using scale tapes out there to build our turns, so we're working with new employees on that.

Preplanning turns and properly marking out choker drops for correct placement is also very important. Understanding different techniques of setting chokers is emphasized to include the following: tags, squaw humps, bonuses, double stringers, gypsy tags, Howard humps, and Swedes. We teach our people out there how to properly set tags and stringers. We also teach them when not to set unnecessary stringers and tags because those can cause production problems down on the landing by stringing out of a turn. We teach them to set chokers on the uphill end, or the end that pulls towards the landing and prior to hook approach, to position themselves in an open area for easier identification and hook approach. Our training stresses to use two men on the hook when possible, to know where the other choker setters are located, to work well and with other people to avoid utilization cleanup, to understand indicators that cause defects in logs, and to identify different types of defects by using and studying grade scaling books, center and heart rot charts, and learning log quality, utility, and special cull.

We like to evaluate the new employee on the use and maintenance of the personal protective equipment that we issue them, whether they work well and efficiently with others, adherence to our job site rules and safety rules, utilization and care of our company equipment, their attendance record, and last of all, pride in job performance.

That's pretty much our training program in regards to the initial new hire. We continually train. Many of you have been out there just as long as I have, and you know that things change. We can hire a guy over in Idaho on the east side, and he can stay there for four or five years, and he's the best hooker in the world over there. You get him over on the west side, in Oregon or Washington, it's a whole new ball game. Different timber types, different ground, different hazards. It's completely different. So we're continually working with our people. We've got trainers out there assigned to each job site and we might have a guy out there hooking two or three years, but when we get in a new area, we have to work with them again.

Idaho is cut and dried. Your cull over there is basic, real simple. You know, learning your defect. You get over on this side, you get into special cull, and peelers, and stuff like that. Well, hey, we've got to work with these guys, because they've never had the opportunity to see it before. So we're continually training in that sense. The last day I hooked a log, I was learning still that day. So, we're continually training. It's very important.

The logging code for Division 6 of the Oregon Forest Activities basically states that once you've got a person trained, you have to also evaluate them periodically. Oregon defines periodically as once every six months, so we also have an on-going evaluation performance for each employee.

During the six-month evaluation process, we review violations of safety and health programs committed by the employee, and any disciplinary action taken. We also review any unsatisfactory attitudes or activities demonstrated by the employee and any corrective action taken. Additional training needs would be identified. Positive aspects of employee's safety performance that were an example to the rest of the crew, and contributed to a safe and productive workplace would also be documented. And then an overall safety performance rating of U, S, or E, would be assigned along with any comments from the supervisor. The performance evaluation is kept by the management office for about 10 years.

Tim Harper (Erickson Aircrane) stressed that they work with us, and we work with them, and there should be no secrets when it comes to safety. Nobody wants anybody hurt. I've been hurt myself. It's not fun.

I go out and monitor our trainers and our loggers all the time. I was somewhat ineffective in the beginning because I used to come up to them and say, "Well, OSHA says this and OSHA says that, and by gosh it's a $2,000 fine. We can't afford that." I don't think that was the proper way to come on to them.

I woke up on the fourth day after my accident, in intensive care in the hospital, and the doctor was standing there, with my wife. The doctor said I had a 20 percent chance of living and my wife told me she was pregnant. I had no job, I had a house payment, a car payment, and a pregnant wife. Workers' comp doesn't cover that, you know. It's no fun being hurt, and that's why I'm coming on to our people out there. I just don't like to see people get hurt, and I think that by talking to them in that way, they seem to pay a lot more attention.

Our training program has been in effect for about 3-1/2 years, and in the beginning I was real gung-ho about it, and I expected instant overnight success. Well, it didn't work that way. It took a while. This year we've had a major reduction in our comp costs. I think things that I've set in place are finally starting to take hold, and this year will tell us what's really happened. Hopefully we're going to have another good year at what we're doing.

I think each of our field operations are, and I'm sure yours are too, uniquely different due to many variables. They may include the terrain, weather, equipment, contract requirements, types of timber, and turnover rates. This requires a tremendous amount of cooperation between our trainers, project managers, and me, to have a successful training program.

I feel that a positive attitude towards training is a must if a training program is to be successful. Management, as well as the crew itself, have to have this attitude. Safety, training, production, and quality are all important for a company to stay in business, and the importance of each one is dependent on the other over the long run. Thank you.

QUESTIONS & ANSWERS

MR. MANWARING (NIOSH): CFR, Part 133.23, on knowledge and skill reads "except as provided in paragraph (d) of this section the applicant or chief pilot designated in accordance with 133.21 must demonstrate to the administrator, [the FAA], satisfactory knowledge and skill regarding rotor craft

external load operations as set forth in these paragraphs (b) and (c) of this section." It then breaks into two parts, for demonstration of these skills, which is a test of knowledge, which may be oral or written, and also a practical, hands on type.

It says the steps to be taken before starting operations "include a survey of the flight area, proper method of loading, rigging, or attaching external load, performance capabilities under approved operating procedures and limitations of the rotorcraft to be used, proper instructions to flight crew and ground workers, appropriate rotorcraft load combination flight manual". And the test of skill -- then it says the test of skill requires appropriate maneuvers for each class requested. "The appropriate maneuvers for each load class must be demonstrated in the rotorcraft prescribed in this section. Take offs and landings, a demonstration of directional control while hovering, acceleration from a hover, flight at operational air speeds, approaches to landing or working area, maneuvering external load into the release position, demonstration of winch operations, if a winch is installed, to hoist the external load."

And then it says, "The compliance with these paragraphs of this section need not be shown if the administrator finds, on the basis of the applicant's, or his designated chief pilot's, previous experience and safety record in rotorcraft external load operations that his knowledge and skill are adequate."

The question that comes to mind when reading that, for all of you doing this, Columbia, Erickson, and others, this may be adequate. But, is this adequate for those companies that may be unscrupulous? I'm not suggesting a change in the regulation, but do you think that it's adequate?

The quick second part to my question pertains to the two-part demonstration of knowledge and skill. What are the mechanics of how you accomplish that? Do you do that -- does the chief pilot demonstrate that to the FAA inspector, and then people that work under the chief pilot demonstrate to the chief pilot, or does everyone have to get certificated? Or in other words, what is the actual certification process?

MR. MAVRINAC (Erickson Aircrane): It depends on how you set up your training. We have standards and a training program with our mentoring. We'll put a pilot with a senior pilot. He will fly with him for 1,000 hours, 700, 500. He will get to demonstrate to that senior pilot that he's flying with, through the course of a year or two, that he can duly demonstrate his capabilities in all these things, his airmanship, his attitude on working with the people that he's with, how he lands the logs on the log landing, will he slow down when those guys are encroaching into the landing with this thing or will he just sort of crash in there and only be focused on his own production instead of his complete situational awareness, which has to grow as you give someone the command of an aircraft.

MR. MANWARING: How does FAA link into that? Do they initially certify the chief pilots, or how does FAA enter into what you're talking about?

MR. MAVRINAC: We have, at Erickson Aircrane, and I'm sure Columbia has, a FAA licensed, registered designee that will go and give them a check ride.

MR. MANWARING: Okay. The FAA checks him first?

MR. MAVRINAC: Yes. The FAA would definitely.

MR. HERLIHY (The Herlihy Group): On the cases we investigated that were discussed in '92 and '93, that type of checking for the chief pilot was waived by the FAA because of direct knowledge of his skill. I found since those investigations, other operators where accidents have occurred, but they've been small operators, single-pilot, single-engine, that demonstration of skill, airmanship, and proficiency, also were waived by the FAA.

So, there's a consistent pattern of waiving by the FAA that we found in the single ship, small operator, single-engine operations. I don't know whether this is a pattern, but this is what we're finding, only as a result of accidents, that the FAA is waiving that due to their knowledge of their background and capabilities.

MR. MANWARING: Apparently the paragraph here gives them that option to do that.

MR. HERLIHY: That's correct.

MR. WALLACE (FAA): I'm the national helicopter specialist for the FAA from Washington, D.C.

First of all, we feel, as an agency, that there is, right now, sufficient regulation that is in place. We had a similar problem with the aeromedical industry back in the mid-80s where we had a tremendous number of accidents. It became so bad it was front page news, and then we got tremendous congressional pressure to go ahead and regulate that industry. What we did was we worked with the industry, the aeromedical side, and what they did, through self-regulation, through the National EMS Pilots' Association, NEMSPA, through AMS, Air Medical Services, and through the HAI EMS committee, was set up standards for their own industry. And, instead of writing a regulation, we came out with an advisory circular that was very general, and then the EMS committee went ahead and took care of their own problems. We didn't have to step in and regulate them any further, and they were able to turn the industry around.

It's my recommendation that this industry do the same thing. I suggest establishing recommendations through HAI and that this self-regulation will achieve what we all want.

MR. LAREW (ERA): The point I'm trying to raise here is if I had a logging company and I wanted to train people to the minimum standard that the feds required, I could cover all those subjects probably in one day, couldn't I? Not to the standard you're working to, but I mean to the minimum government standards.

MR. LANSDEN: How long did it take me to read them to you?

MR. LAREW: That's my point. As in most quality companies or training programs, it's not what the minimum is that the government has required of you, it's what you need to do your job. If you're going to have a successful operation, it's based on the needs of your business and then you have some minimum standards that have to be met. Just like when the people out here in the audience got their pilot's license, or their A&P license, you have a minimum standard, but when you have a pilot that just finished his commercial helicopter with an instrument rating, are you going to put him out there IFR in a helicopter flying off shore? No, of course not.

The point I'm trying to make is, the regulations we have cover the minimum standards. Okay?

Now, each company that specializes, as they get better and better, needs to look at what training they need to do so that they can properly train their folks to do the job and be successful. And believe me, if you work to minimum standards on everything, you're not going to be successful. You're going to have problems, you're going to have accidents. And I think we don't need more regulations to tell us how to do it, because there's nobody outside of the companies that are doing this business that are really qualified to come in and sit down and say this is what you need to do. That's why the federal government has manuals, that's why you get your own check airmen, ground training people, that's what it's all about, because they recognize that the real experts in this business, are the ones that are out there doing it. And that's why they give you this authority, and they try to control and regulate it in the public's interest. I think that's what it's all about, and that's why we're concerned when the State starts looking at regulating.

And last year, if you look at the minutes, I said we don't need more regulations. We need to enforce the ones we have, and it's starting to work. Accidents have dropped a little bit. We've got a committee formed now. That was one of the recommendations. And I think, just like with the air ambulance, as these committees work, and the recommendations and the ideas come out, peer pressure and the job market will decide who's going to be logging and who's going to be doing other jobs.

That's my point. Thanks.

MR. HARPER (Erickson Aircrane): Since Jan Manwaring found it important to read those regulations into the proceedings I just want to cover one point. It can never be the operator's responsibility to enforce regulations. We're not regulators. That's not what we do.

Lash Larew made some very important points. The minimum standards are just that, absolute minimums. Any logging pilot can do that in their sleep. That's not helicopter logging. That's number 1.

Number 2, the actual training requirements and flight operations, 133, and each of us who operates in heli-logging has a certificate from the FAA to conduct these operations. That certificate can be taken away from us if we break those rules, and we can't do that anymore. We can still fly our helicopters, because they're under a different part. The flight operations themselves are, in fact, under Part 91. Training is covered in 61. In the bigger companies, we have aircraft that require type ratings, we'll have designated check airmen who can actually give type ratings, who are, in effect, the administrator's designee. We can only operate though to those standards, and we can only do those things that are required in the regulation.

In our own training, for our own success we have to go way beyond that. So, it's not a function of should the operators be conducting a complete 133, following that little part of the regulation Mr. Manwaring read, it's whether or not the regulations that are already promulgated and already in effect are being enforced with all operators by the agencies who are delegated to do that. And I think that's an important point.

MR. HERLIHY: We just heard from two eminently qualified helicopter operators who operate big machines, but just one comment about training under 133. Training is not required under 133 as an annual. And when Tim Harper said that 61 covers training, 61 doesn't cover training; 61 covers quals, qualifications. There's nowhere that the FAA is going to enforce your quality of training under 133. So, let's make that clear. Training does not exist as an entity in 133.

MR. MALONEY (Caledonian Insurance Group, Inc): I feel obligated to come to the industry's defense in providing insurance for people who, perhaps, you might think, ought not to get it. I said earlier that the insurance community is not a police force, and there's one overriding influence that I can best characterize "the fragrance of the premium overcomes the stench of the operation".

But, on a more serious note, the insurance underwriters are not out in the field. It's very difficult for an underwriter to be aware of everything all the time. Many insurers do take a lot more time and effort to find out about their clients, and those are the survivors who are around now. Several insurers will not take on an account as a client until they've had a physical inspection of the facilities and met the senior personnel involved in running the operation, and I think that's to be applauded. You can't do that with every Jet Ranger behind a bush, but if you're going to get involved in doing heavy lift machinery and operations, I think that you'll see more and more of that.

MR. KEMP (Silver Bay Aviation): At a meeting in Dallas last week I was elected as the interim chairman of the Helicopter Logging Committee that we're going to form under the auspices of the HAI.

The very first topic that came up was the vested interest of all the operators in ensuring that no further regulation came into this industry. The current regulation in all facets of helicopter logging, there's ground work, air work, FAA, is more than satisfactory if it is enforced.

Now, we come back into some more generic problems of how do you enforce it? If you're an operator in Miami, and you come and log in Alaska, your POI in Miami is the guy you'll address. Miami won't call Juneau and tell them that you're working here. So there are some problems of knowing where people are working in the industry. These are very realistic problems. If you're an Oregon company working in Idaho, no one in Idaho is going to know you're there. There's no requirement to report that. Your local regulatory authority doesn't know what you're doing. But there's no means of addressing that. There's no system in there.

One of the other problems you have in assessing how well regulated you are is, of course, that it's retrospective. How well regulated are we? To avoid any further regulation, how can we, in the United States, gauge ourselves in this particular industry, and I'd ask Paul Mavrinac, from his experience in the States and working in Canada with Transport Canada, and with workers' comp, what are the levels of surveillance in the industry? Do they differ from the U.S.? What are the levels of regulation, and do you think that they contribute to a different philosophy and operation, a different means of operation?

MR. MAVRINAC: I think in Canada we are probably more regulated than you are here, definitely. I know that there's not a logging show that we've got at Canadian Aircrane that, in one or two months, you don't see a workers' compensation or an OSHA representative enforcer to see your operation from the ground up. And they have no jurisdiction above the ground.

On the transport side, it's been excellent in British Columbia. We had an issue on restricted category aircraft about two years ago, we got all the helicopter loggers together, and we had a meeting with the director general of Transport Canada for Transport Canada. He showed up at this meeting, and this is a man from Ottawa that's third or fourth down from the Prime Minister, so it was very impressive.

We have a gentleman by the name of Mr. Pat Carrière, who is from Transport Canada in Ottawa and is here today. Pat is the director of air certification standards and he's on the operations working group for NAFDA. He's the one who gives the foreign operator's certificate to work in Canada.

There's regular inspections by Transport Canada air carrier inspectors. It's a little bit different in Canada because the pilot has to go through a PPC on helicopters every year. Transport Canada is a lot more focused, but they only have to deal with B.C. The Pacific Region looks after British Columbia. Not, like I said, a FSDO in California is looking after somebody that's working in Southeast Alaska. I think that the Canadian regulations are much more comprehensive. Transport Canada has a good presence and the operators have a really good rapport with them.

MR. JOHNSTON (U.S. Forest Service): We found what we call the inner agencies, the Forest Service, Department of Interior, Bureau of Land Management, Indian Affairs, that the thresholds and Part 133 requirements are what we call minimum thresholds. They're what we consider minimum thresholds for getting on board, so to speak, with the external load. They don't particularly address vertical reference long-line type operations. And we found, for our purposes, to meet our needs in resource type work and firefighting, that we had to raise the bar somewhat. We applied our standard, the interagency fire standard, to long-line vertical reference, and through this we see the other areas of the helicopter industry performing better by meeting these standards that we set.

From the heli-logging side of it, they would probably have to tie one hand behind their back in order to meet our standards, because generally, their skill levels are above and beyond even the higher standards we set for the fire community.

As part of the oversight of the heli-logging industry, I think that we haven't talked much today about the other agencies besides the Forest Service that have an overview and oversight over heli-logging. A good majority of logging takes place on government lands. And because of that, and through the way we contract through the timber side of it and through the agency side of it, there is oversight. There's probably 22 inspectors in all of the agencies that visit the heli-logging companies at least annually for firefighting purposes. We look at records, we look at training, we do flight checks, we do whatever it takes to assure ourselves that it meets our needs for the firefighting. So we're talking about additional regulations for these operations.

Again, I think that recognizing all of the oversight that goes into looking at the heli-logging industry, that it's probably adequate if we are actually aware of how much of it is really out there.

DR. CONWAY (NIOSH): First, Roger, I was really impressed by how well and thoroughly everything you presented was thought out. It strikes me that the very thorough treatment of all the different steps involved, and all the different personnel involved, that you all have addressed in your training, is the kind of approach that we're hoping that everybody involved in this industry takes with every facet of what goes on.

MR. MAVRINAC: I think the helicopter logging business is growing quite a bit. I have found, in my capacity, that I'm getting an awful lot of applications and calls from many pilots that have been out of the industry for a long time. The money's getting much better for helicopter logging pilots. I find there's a lot of older pilots who have been out of the industry for a while wanting to get back into it. Now, whether you can say they would be safer or not, I don't know. In Canada you have to get an

endorsement on type for every aircraft you're flying, being a 206, a Jet Ranger, the space shuttle, it doesn't matter. You need a type endorsement on it. I find a fault in that because I hold a couple of aircraft on my license that I haven't flown in 15 years, but I'm licensed legally to go in there and start them up and fly away, and I wouldn't even know how to start them up now. The system in the U.K. would delete that from your license. I would support that myself. I think that was what ended up happening with this individual who wanted to go logging in a 214. He had an endorsement 10 years ago, and there wasn't anybody to check on him. So, again, it was his decision and he lost.

FLIGHT CREW SAFETY TRAINING

By Paul Mavrinac, Chief Pilot, Erickson Aircrane

I've been with Erickson Aircrane for about 17 years. One of the recommendations from last year's symposium here in Ketchikan, was that type and flight-specific training should be provided for aerologging operations, and that flight and ground coordination training should be provided for all aerologging crews. I trust that in the minutes it was that the companies should provide it themselves. I would assume that, as responsible operators, we all do provide these types of training and operations for our personnel. And, if we don't, I hope that Columbia does, because we usually steal half their pilots from them.

At Erickson Aircrane our most important and effective method for transmitting or conveying some of our safety standards and practices and flight standards has been through a mentoring system. Some of our senior training captains will fly with our other pilots, and they assess each pilot on a monthly basis on safety, attitude, airmanship, aircraft systems knowledge, aircraft power management, hook work, long-line ability, and pilot performance. We can make these bids, keep our bids, be productive, be economic, and still train on safety.

One thing from last year, that was not in the recommendations, is about the unscrupulous operator.

The accidents and incidents that happened between '92 and '93 were from, let's face it, unscrupulous operators. These types of operators exist throughout the industry, and they'll breach the rules and the regulations from the FAA and from OSHA. The regulations are there, yet they still break them. Most of the requirements are clearly defined by the FAA in both flight and maintenance, and most of the requirements are minimum at that.

As I understand it right now, in Alaska, there are presently only two State OSHA inspectors, only two, for all the logging camp operations. I would think the FSDO in California which administers the operations of some of the gypos or unscrupulous operators up here, are going to stay in California. They never did come up here. So, my question, of course, is where are the regulators?

We, as legitimate operators, have complied with all the rules and regulations, or we wouldn't be here. We wouldn't have an economically viable operation.

Apart from my duties at Erickson Aircrane, I'm also a director of the Helicopter Association of Canada. In the one year since I stood here last, the association has grown countrywide with 65 operators, representing 600 helicopters. And, within this organization, we've also formed a helicopter logging committee, which is mainly made up of operators from British Columbia, approximately 25 aircraft. I think we logged well over 30,000 hours in British Columbia last year, in 1995 alone, with these 25 aircraft.

The issues that we're focusing on here were in the forefront of all the operators' minds in our helicopter logging committee. They all agree, which is pretty rare to have helicopter loggers all agree on one thing, that we have enough regulations, and that we are very successful at self-regulation. I think, considering the amount of hours that we've flown and the type of missions that we do, we've been very successful at it.

I think most of us know why helicopters crash and why they don't, and how successful we've been just because we agree with the culture of safety in our operations for profitability. Most of us have developed all of these procedures for the perpetuity of our business, and to be the best that we can be out there, and I, for one, think we can do it for ourselves, without a whole lot of extra regulation.

CHAPTER V
HELICOPTER LOGGING FROM MANAGEMENT'S PERSPECTIVE

THE BUSINESS OF HELICOPTER LOGGING

By George Warren, Vice President of Safety, Columbia Helicopters, Inc.

Most of us who have worked in the helicopter logging industry for very long have developed a great deal of admiration and appreciation for the leaders in this industry. Wes Lematta, Jack Erickson, Bud Kaufman and Duane Cross are all examples of people who have had a huge influence on helicopter logging through their hard work, insightful innovation, and tenacity. The problems facing helicopter logging have been unique, requiring unique solutions. The men running these operations have been genuine pioneers, forced to find solutions to problems not encountered before. Their pragmatism has enabled them to follow their vision through to a productive conclusion. Another essential trait shared by the industry leaders is a hard-headed business sense which has enabled them to temper their innovations with prudence. This helps prevent over-extending their operations, most of the time.

The cost of operating large helicopters is enormous and can come as quite a shock to operators of smaller and intermediate-sized aircraft, who try to extrapolate their costs and operating experience with smaller machines up to logging-sized helicopters. Many operators have been overwhelmed by these costs and operational problems when they tried to step up to heavier equipment. The fact that this has happened many times to successful operators of small and intermediate-sized aircraft has demonstrated the enormous difficulties inherent in helicopter logging with big helicopters.

A fundamental characteristic of the helicopter logging industry is its volatility. Wide price fluctuations of log prices on the domestic and foreign markets are normal. Also normal is an increase in logging helicopters coming out of the woodwork whenever there's a significant spike in log prices. Many non-logging operators have succumbed to the temptations to field a large logging helicopter when log prices are high, convinced that it's a sure fire way to make big money. The reality is that helicopter logging is an extremely marginal endeavor with profit margins averaging just a few percent. Many timber sales make no money at all and others lose money. Any operator entering into this activity without sufficient capital to weather the dry spells will find himself in a marginal financial situation in a very short time.

The question that naturally follows is why would anyone be in this business for over 20 years if there's no money in it? The answer is common to any operation involving expensive equipment. As utilization increases, the cost of the operation decreases. Flying logging helicopters as much as possible enables the operator to keep utilization up, which in turn increases the likelihood of realizing profits from other lift projects such as power line construction, roof top sets, or even the occasionally profitable logging job. This strategy, however, requires a long-term commitment of personnel and resources.

One of the essential aspects of efficient helicopter logging is safety. Our firm has long realized that cutting corners is a false economy that can jeopardize equipment and personnel as well as the balance sheet. Strict adherence to regulations and aircraft limits is stressed again and again to all personnel.

In spite of all our best efforts, however, incidents happen. Unfortunately it has long been a fact of life in aviation that many incidents or accidents can be blown way out of proportion by the media and the public. Recent heli-logging accidents in Alaska, while unfortunate, do not reflect the experience of the industry in general. For instance, Columbia Helicopters alone has flown over 100,000 logging hours in the past ten years without a flight crew fatality. Other reputable heli-logging companies can cite similar data.

A further attempt has been made to characterize the hazards to helicopter logging in Alaska as greater than those found in the Lower 48. The fact is that many conditions in Alaska are more favorable for helicopter logging. These include lower ambient temperatures and a lower timberline, which enhance aircraft performance.

During the last twenty-four years the helicopter industry has shown itself to be a safe and effective means of removing timber when conventional methods were not viable. Helicopter logging has adapted successfully to a wide range of terrain and timber types. The crucial ingredients to the success of this industry have been the willingness of an innovative management to commit resources on a long term basis to make heli-logging safe and effective.

QUESTIONS AND ANSWERS

MR. DALE HOKE (Aerial Crane Systems): How much training time do you give your pilots before they're allowed to fly in logging operations?

MR. WARREN: Well, with us, training is a two stage operation. New personnel start out as copilots and then their external load training begins in a light aircraft. We operate a Hiller or a 500, and they usually spend 30 or 40 hours in it until they can demonstrate competency. Then they may move over to a larger helicopter, where they may get up to 100 hours of supervised long-line training before they're turned loose on their own.

MR. HOKE: So, with luck, it may take a season until you feel comfortable turning a new pilot loose?

MR. WARREN: No. I think we can do it in much less time than a season. We can probably do it in four or five months, if everything in our training process runs smoothly.

MR. MARK LINDAMOOD (Carson Helicopters): Of course, you're talking about a pilot who's already got some experience. This would not be a guy who just received his license, correct?

MR. WARREN: I can't speak for other operators, but we don't even hire people to come to work until they've had 1,500 hours pilot-in-command time in helicopters. I think that's probably a general standard for the industry as a whole.

UNIDENTIFIED VOICE: During your upgrade time and your proficiency time, how do you document the training that you give new personnel, each hour? Do the captains who fly with him write up a sheet, or do you have a document that you keep?

MR. WARREN: We have a training form, which screens for all of the various facets of training, and progress is indicated with a numerical grade. There's also room for comments which we encourage. After the form has been filled out, the pilot signs it, goes over it with the trainee, the trainee signs it, sends it in to us, where we keep it in his file.

UNIDENTIFIED VOICE: Apparently, you're using an industry checklist to test for proficiency. So, in fact, you're doing a procedure that goes above and beyond what is present in the 133 FARs.

MR. WARREN: 133 says that you'll train to competence. Mercifully, it doesn't tell you how you're going to do that, unlike a lot of other regulations try to guide your hands. A new pilot is either competent or he isn't.

UNIDENTIFIED VOICE: Is that competent in sling-load, or competent in the type of aircraft?

MR. WARREN: He has to demonstrate proficiency in both.

UNIDENTIFIED VOICE: Under 133, is it required that he be type rated in that aircraft?

MR. WARREN: No, because it's already covered under Part 61. If it's a large aircraft, he has to be type rated to function as a captain, or as a pilot.

UNIDENTIFIED VOICE: What if it's a 9,000 pound gross weight aircraft.

MR. WARREN: If the aircraft doesn't require a type rating, then the answer to your question is yes, he would have to demonstrate competency in the aircraft in normal transition procedures, and he would also have to demonstrate competency in external load operations.

UNIDENTIFIED VOICE: If I understand it right, you can do 133 without being 135; is that correct?

MR. WARREN: Sure.

UNIDENTIFIED VOICE: Does 133 require a pilot to be type rated?

MR. WARREN: No, it doesn't, because the requirement is already covered in other regulations.

UNIDENTIFIED VOICE: I think what the question intends to ask is, if you go out and demonstrate proficiency under Part 133 in a Hughes 500, and you're issued your little card that says you've demonstrated proficiency, might you be able to jump into a 206? With loopholes, you don't have to take another check ride or demonstrate proficiency to anybody in that 206, according to Part 133.

MR. WARREN: Was that your question?

UNIDENTIFIED VOICE: That's my question. I wanted to learn more about your documentation process with new pilots. 133 does not clearly describe how operators should document the training of new personnel. Obviously your outfit is documenting. You're working to a syllabus. Unfortunately, that doesn't necessarily mean that the next guy who comes along with a helicopter will follow the same process.

MR. WARREN: What you're saying is correct, and again I don't want to trivialize it. But can you cite me some accidents that were directly attributed to the fact that an operator didn't document the training process adequately?

UNIDENTIFIED VOICE: I am aware of a case where a pilot's training wasn't documented. The company had no paperwork, and we couldn't find where he had practiced these maneuvers.

MR. WARREN: Then he didn't demonstrate competence.

UNIDENTIFIED VOICE: He might have. I don't know. We couldn't find any record. Now, obviously you have a record, so that solves the problem.

MR. LINDAMOOD: Based on your experience in the business of helicopter logging, how much would you estimate it costs to train a pilot with 1,500 hours, to be a production pilot in a 107? How much money do you think the company spends on training, as he's learning until he finally gets up to where he can go out on a logging job, and do a very safe job?

MR. WARREN: You know, I'm reminded of some people from a government agency who were asking for what we felt was proprietary information. They assured us that nobody would ever find out because all they were doing was gathering information for various makes of aircraft to show in general what the operating costs, et cetera, were. All that their findings were going to show were averages for the type of aircraft or the make of aircraft. However, since my company is the only one that operates 107s and Chinooks, the data for the 107 and the 234 are obviously going to apply only to us. So, your question may involve information that applies only to our company.

MR. LINDAMOOD: I was asking the question because, as you mentioned earlier, when the log market becomes more profitable, the "gypo" loggers pick up people whom they've trained in 25 hours, and it doesn't cost them very much. But our company may decide not to train, but to hire people who already have a 5,000 hour minimum requirement to come to work. Last year we trained somebody new, and it cost us a few hundred thousand dollars. When I tell people that, they don't believe that training could cost that much. However, when you look at what it costs in production, it does cost that much. Your company has an excellent, wonderful, safety record, but you spend a lot of money doing that. However, you get the dividends back in the end.

MR. WARREN: That's exactly right. I think one of the things that we've discovered over the years is that a safe operation is an economically viable operation. When you start cutting corners on safety, be it maintenance, pilot training, or anything else, it turns out to be based on a false economy, and it comes back to bite you in the end. Anybody who is cutting corners on any sort of safety regulation, whether it pertains to flight safety, or ground safety, or any other area, will cause the loss of industry-wide respect for the quality of that company's management. They will also be operating under the general perception that they're not going to be in business for much longer.

A previous speaker said that a lot of the solutions to the problems that we're facing lie with everyone from the industry right here. It's a point that we should take very seriously. If we, as operators, try to stand apart from one another or constantly be concerned about somebody getting a competitive edge on the other over every little thing that comes down the pike, and if we don't work together on a lot of these issues, we're going to all fall separately. This call to action may be one of the best things that

ever happened to this industry. It may serve as a wake up call because, if we act on it, we can progress and go forward and continue to be a growing, viable industry.

UNIDENTIFIED VOICE: George, do you think that the restricted category in the states has any effect on the heli-logging? Since you're involved with operations in Canada, do you feel that it would also affect that country, having a restricted category?

MR. WARREN: Do you mean if we continue to have the restricted categories as they currently stand? It's hard for me to say too much against restrictions. We operated under those guidelines for years. I don't know that I agree with one of the previous suggestions that operators need to purchase only new equipment, because of concerns about the safety of used equipment.

MR. ROY FOX (Bell Helicopters): It's the salvage parts, the military surplus that I was talking about.

MR. WARREN: I don't have an argument with that. But there are constraints. The provisions allowing restricted category aircraft to be operated under 133 came about as the result of a pretty shaky deal. The way that was finessed through the FAA isn't anything I'm very proud of. But I think it still goes back to the integrity of the operation, the integrity of the operator. If the restricted category aircraft is operated safely and in accordance with the regulations that are in place, which are perfectly capable of ensuring a safe and efficient operation, I don't really see that much of a problem. I'm not a big supporter of restricted category aircraft, but we have operated them ourselves.

RISK MANAGEMENT

By Tim Harper, Risk Manager, Erickson Aircrane

I spent 15 years as a professional pilot, and although I do have a background in insurance and safety, I have an educational background in the law, and in today's environment, for a risk manager, that seems to be fairly important.

What we deal with in really any aviation activity, but specifically in helicopter logging, is that safety, apart from the human consideration, is something that has to be integral to our business for a lot of reasons. There's an old saying in aviation that it's really easy to make a small fortune in aviation. One simply starts with a big one. And anyone who's been in the industry for any length of time recognizes that this is in fact the case.

So, for the helicopter logger, safety equals productivity. Because without being safe, the helicopter logger can't be productive. And unless one is productive, one doesn't make any money. Safety in helicopter logging equals productivity, which equals dollars, a profit. It's axiomatic in the safety community that accidents cost approximately six to seven times more than their surface cost; moreover, in a highly intensive industry, cost ranges up to as much as 10 times. By that I mean the cost over and above the medical costs, the workers' comp costs, and all of that. In fact, the majority of the costs for the helicopter logger is on the ground side in daily workers' comp accidents.

What's the difference between a logger slipping down a hill and wrenching his knee, and a helicopter banging into a hillside, even if no one's hurt? When the logger falls down the slope and wrenches his knee, it doesn't make front page news. You put an aircraft into the ground, or into a cumulo granite, or whatever you put an aircraft into, and it's big news from a lot of different perspectives. It's big news from the insurance perspective. It's big news from the human perspective. It's big news from the company perspective. One of the things that we deal with in helicopter logging is that in many ways we can be a schizophrenic industry. I was having a conversation last night with a member of our group who runs another helicopter company, and he was talking about the fact that probably the easiest thing to acquire in this whole operation, and probably the least expensive thing, is the aircraft itself. One can get a lot of aircraft out there for fairly low sums of money. What costs money is all the things that make it a safe, and productive, and viable operation -- the spares base, the support base, the trained people to do everything from overhauls to field maintenance. The crews that have to go out and be productive underneath that helicopter.

So, we're faced with this kind of conundrum in our industry. There are traditionally aviation operators who decide to log but who don't know a lot about logging. There are loggers that decide that helicopter logging is the wave of the future. They think, "I'm going to get these environmental weenies off my back, and I'm going to go out and be a helicopter logger". But they don't know a lot about what it takes to operate, maintain, and safely utilize an aircraft, especially within this environment.

I tend to be one of those who disagrees that helicopter logging is an unsafe or risky business. I think it's no more risky than any other kind of business. I think that, in fact, it can be done safely and efficiently.

Last year I asked the question: If one makes the inference from the data that during 1992 and 1993 there were these helicopter accidents in Southeast Alaska, thereby making it the most dangerous occupation in Southeast Alaska, may one also infer now that since, for the last three years, there hasn't been anything going on, is it now the safest? The industry has to take a look at itself and has to realize that there are standards and cultures which we must develop within the industry, amongst ourselves, that will allow us to have a productive, viable, and real business that will carry us on through the millennium.

A lot of people in this room know how to do that. Consider, for example, Columbia Helicopters; they're our biggest competitor, and nobody at Erickson can say anything other than they're a class act, because they are. They have excellent safety programs. They have excellent maintenance. They know their aircraft. They know what they're doing. Their training programs are outstanding. These are good operators. They operate safely and efficiently, and they do it hour, after hour, after day, after day, after week, after week. Now, why do they do that? Because they've made a commitment, just like Erickson has.

We joke often about the various syndromes that hit people. There's what I call PMS and there's TMS, and TMS is something that most of us guys are affected with. It's called terminal macho syndrome: "I can do it. I've done it this way before. I can get away with it." The next thing you know, you've bent an aircraft.

We do incident reviews in our company. If something breaks when it shouldn't have, we get together and we find out why, and we find out how to prevent it. We find out what the root causes are.

When one is not willing to do that, when one just puts another part on it so it goes out and flies, one is breaking some very basic rules that the aviation side has.

There's been lots of talk about regulation, and what regulation needs to be in place, and what regulation can be put in place, and how we can look at the components in helicopter logging, and how we can look at operations in helicopter logging. The fact of the matter is, the regulations are in place. They've been in place for a long time. They're good regulations. They work. Especially when it comes to a lot of the aviation regulations.

But let's talk about the procedures that are involved on the maintenance side, talk about the flight standardization procedures. I can speak for Erickson and Columbia in saying we have good relations with FAA inspectors. We consider them professionals who come down and do a job, and help us to constantly improve our program. They come out and they check our pilots. Our pilots get ramp checks.

There are also OSHA people who come out and look at our ground side all the time. We have consultants from our worker's comp carrier that come out. We call them in and ask, "Are the hearing levels too high? What's going on out here on the choker setters?"

On, and on, and on, we work with the regulators, and they come out and they see us. Why? Because they know us. Why? Because half the time we call them up. We practice self-reporting, as I'm sure a lot of other operators do. If we see something, if we make a mistake, and we fly something, in one case, an hour over what it was supposed to be flown, we send them a letter, and say, we did this, this is

what we put in place to make sure it doesn't happen again, and we work with the regulators on constantly improving our programs. Then why do logging accidents occur in Southeast Alaska?

The operators that don't work with regulations, it seems to me, from what I've heard in these conferences last year and again this year, tend to be ignored. They're left alone. They come out to Southeast, or they come out to someplace else, and they go operate, and nobody really checks on them.

So, I'm making a pitch here, not for more regulation, but for better use of the regulations that are in place. I think we have to take a look at what makes safety work, and why safety works in a company. Number 1, it's a cultural thing. Culture change is always hard. It's a long, involved, road. It takes commitment from upper management, it takes commitment by middle management, and it takes commitment from every member of the organization. I know a lot of companies in here that have made the commitment to do that. They say, "I'm responsible for safety."

Now, in our company one of the ways that we're rated, from the very top management all the way down, is what's called CSF, or critical success factors. One has certain critical success factors, with minimums and maximums, and there's a management and a feedback report that comes out so that one can rate oneself and one's supervisor can rate one.

Nowhere in my CSF does the term "safety" appear. Nowhere. I don't have a critical success factor for safety. Our operations manager does. Our director of maintenance does. Our chief pilot does. Now, that may seem a bit strange, but it's the only way it can work, because safety is not a function of office pukes like me. Safety is not a function of staff and support people. Safety is, was, and always shall be an operational function, always. Because I can go out in the woods all I want, and I can tell the guy on the landing, "Wear your face screen, wear the hard hat we gave you with the earmuffs, wear your Kevlar chaps". He'll say, "Yeah, right, right, right." But he'll go cutting logs until I leave and then he's going to take them off. Now, if his project manager says, "Sucker, if you don't do it this time, you're going to walk down the road," he's going to keep that stuff on.

The other thing that we've done is we've tied our productivity bonuses into the safety record. Now again, I'm talking about the ground side, and I'm going to talk back and forth about aviation and ground because I don't see any difference. Of course, we have aircraft and there are certain rules and regulations. Yes. We have people on the ground and there are certain rules and regulations. But safety is safety is safety. Either one has a safety culture or one doesn't. Either one has a safe operation or one doesn't. And I think you'll find, if you look at the people who operate their aircraft correctly, who put the money into the spares, who put the money into the R and D, who put the money, and the time, and the effort into training pilots, and working with crews, and giving command pilots authority to put the airplane down, when they don't feel it's safe, on the ground, or put the airplane down when something isn't right, without any question, I think you'll also find that those companies put that same effort into safety on the ground.

The reason that the helicopter loggers are going to be really self-policing and self-enforcing on safety is something that's called the iceberg theory. An accident, be it ground or aviation, has a direct cost, medical and compensation. Whatever it costs to get the person well, whatever it costs in compensation to take care of them, and then whatever it costs to retrain them in another occupation or whatever. But there's an indirect or hidden cost, and this is what I was talking about being more than five to seven percent in normal industries, and in high production industries like ours, upwards of 10 percent.

Everything from time lost from work by the injured worker, loss of earning power, economic loss to injured's family, lost time by fellow workers, loss of efficiency due to breakup of crew, lost time by supervision. And it goes on, and on, and on. Usually in advanced safety management workshops, the group will conduct an exercise and often go ahead and calculate what a small injury costs the company. People are always amazed the first time they go through the exercise to see the enormous cost that lies underneath an accident or an injury.

Now, that's just a personal injury. That's not even considering any equipment. That's just a personal injury. If you have a $50,000 injury, and you've got a 10 percent profit margin, it takes you $500,000 of profit to make up for that accident, for that injury. Now, you take that and put an aircraft that costs whatever your aircraft tend to cost, and one ends up with a cost ratio that's enormous, because you also have the lost productivity of the machine, you also have the repair costs, you also have a rise in insurance costs.

Larry was talking about burn rates, and trust me, underwriters look at your own personal burn rate. How much have you cost me over the last five years, or, if you're lucky, 10, 13, 14, 15 years, as some of us have, because we've got that record with underwriters. So, all this adds up. Again, exclusive of the human factor, misery and suffering, hurting your workers, it adds up to a lot of money. And for the helicopter operator it's a basically make or break proposition in safety.

We also deal a lot, in helicopter logging, with misunderstanding by some of the people who are supposedly out there to help us work safely. We deal with the FAA, we deal with OSHA, we deal with EPA, we deal with DOT, we deal with state OSHAs, we deal with state department of natural resources, DEQs, we deal with the U.S. Forest Service, we deal with the state fire departments when we're fighting fires, we deal with 29 CFR, 14 CFR, 40 CFR, 49 CFR, we deal with Part 133, Part 91, Part 61. We deal with a lot of regulations in our industry. We deal with a lot of conflicting things at times.

Suppose, for example, you go to a client and find a small landing; you think it's too small to be safe, and are concerned about it. You go to the client who says "Well, if you don't log it, somebody else will log it." You say, okay. Maybe you negotiate with them to make it a little bigger, but then you've got some danger trees. The forest Service will come in and say, "The owls need that tree." Then OSHA comes in and says, "Oh, that tree's dangerous, we're going to cite you," but if you cut down the tree, then they're going to cite you. But the FAA might say something else; and the helicopter logger sits there and he asks, "How do I work safely?" They can't even agree on what's safe or what's right, or what's more important.

The bottom line is, we, as an industry, have to make a stand, and we have to start saying to the regulators, "Look guys, let's get together and let's talk about what works and what doesn't. What's the priority? What's more important?"

But, as long as we have the terminal macho syndrome, that "Oh, heck, it doesn't matter; we can do this, and it's really safe, and those guys don't know what they're talking about," we'll never see our industry emerge and get the respect that it deserves, nor will we see profits where they should be. It's that simple. And again, and I'm talking exclusive of the human cost. It's bottom dollar. Safety saves money and it keeps operators whole, and it keeps the operation going. If you have an accident and

you shut down, and you lose production time, you lose dollars you can't get back most of the time. You lose veracity with your clients.

So safety, from the helicopter logger's perspective, is a very important issue. It's an issue that, in our company, as in other companies I know about, is key to our operation, is integral to the operation, and is something that we're willing to really invest a lot of money in because it's a good return on investment. This is not an industry of cowboys. The pilots that we have flying are highly professional pilots flying complex machines.

We were talking this morning about the CRN, and we've certainly looked in the CRN for our people. You know, talking about systems and all that goes along with the aircraft, formalized training programs. We have standardization pilots that go out and fly with people, as does Columbia and a lot of the other operators. We have training programs. All of this stuff is in place.

I think what we need to do in our industry is take a look at how we can help, and I know it's hard to talk about helping the competition, but, if we come up with a good idea, we let it out. There's an area where there's no closed mindedness. That's not a good way to put it, but there's no holding onto ideas about safety to make it better for all of us, because, in the end, we all pay for those operators who are out there and not operating effectively.

I don't know that I have any answers. What I do know is that I have some knowledge of how safety can work to our benefit, and I think that it's important that some of the people here understand that, and by that I don't mean the operators, but some of the other folks, understand that helicopter logging operators are enormously concerned and committed about safety, and committed to it.

SETTING UP THE JOB

By Jim Neal, Safety Manager, Aerial Forest Management Foundation

I was born and raised in a logging camp, in the Cascade Mountains in Oregon and as a kid I worked behind Cats and under yarders. Since 1971 most of my time has been spent in helicopter logging as woods boss, timber faller, and working on rigging crews.

I am now with Aerial Forest Management Foundation. In the last year I've had a chance to get back into helicopter logging. I ran a float camp for Columbia last summer, bull bucked a couple jobs for them, and cut a job this winter.

As I ran this job for Columbia last summer and fall, other than being a little more remote than most areas, I'd say that everything else was pretty much the same, as far as setting up and running a safe helicopter logging operation. There are some basic principles that apply, whether you're in Alaska, Brazil, or central Oregon.

I'm glad to see that Tim Harper (Erickson Aircrane) talked about safety and economics, because that's absolutely true. For the purpose of my talk, I'm going to assume that the operator I'm talking about has experienced men as fallers, as woods crews, as pilots, as mechanics. I'm going to assume that they're all aware of all the safety regulations, wearing all the proper safety equipment, chaps, goggles, et cetera. I'm going to talk about how you set up and work a helicopter logging operation safely. And then finally how that ties into economics before you have an accident.

When I set up a helicopter job, by the time the cutter cuts the first tree, I should have a pretty good idea of where I'm going to finish yarding. For the purpose of this talk I'd like to divide up a helicopter logging crew into about four categories: the cutters, the woods crew, the landing crew, and the aircraft and pilots. And I'd like to look at safety issues in three ways in each of those categories. I'd like to look at safety issues for each individual, how the individuals in each category work together safely, and finally how to put the different phases together, working safely as a whole unit.

For example, in the cutting, there are some pretty obvious safety considerations for each individual cutter. What is it about this particular sale that is going to endanger the individuals? Is it bluffy ground, is it a partial cut that has limbs hanging up in the trees? Is it bears? Is it remote so that you have to be very concerned about if somebody does get hurt how you get people to him? And then, how do the cutters work with each other? How closely can they work to each other and be safe? Or how far away can you put them and still enable them to check on each other?

Finally, how does the cutting crew, as a whole, work in relation to the yarding operation? You don't want the cutters above the rigging crew, for example. Something could roll down the hill, in certain situations, at the rigging crew. Then, as you're planning the sale and funding the sale, you go through the same line of thought for each category. What is it about this particular sale that would be hazardous to the individual rigging crew? Is it snags? Again, is it bluffy ground? How do you put your rigging crew together? How do you start yarding so that when one person hooks on a turn he's not flying over his buddy, or some cutter someplace? How can the rigging crew take care of the pilots? You need to wear something very visible so you can be seen, so the pilot knows when you're out of the way.

A gentleman earlier this morning talked about a ship that was over-grossing. Well, the rigging crew has a lot to do with that. On really steep ground, sometimes a pilot can take off and not realize how much he has until it's, in fact, a little too late. The rigging crew has to control that. They're load cells on the helicopter. You know how much weight you're putting on there. You have to do that. You can't put on a tree length. You can't hook somebody onto something that's too big for him to lift. That's just not good business.

Same thing for the landing crew. What is it about a particular job that each individual choker or coiler has to do to take care of himself? Where can they stand? How do they work with each other and stay out of each other's way? The knot bumpers, how do they work together, and with the choker coilers? How big do you build the landing to facilitate these guys working safely? You need to know what the piece size is, how many turns per hour, how many pieces per turn, how limby is it, and how many sorts there are.

You need to have a safe place for the helicopter pilots to land the logs. You need to have a safe place planned for them to land in case of an emergency with the ship. You've got to have proper approaches to the log landing, and to the service landing. You've got to enable everybody to have constant communication with them.

A gentleman brought up an interesting point this morning, and that's the issue of overworking. It's fun to watch a safe helicopter logging operation. There's a rhythm you establish. You design the operation so if you've got one section with one-log turns, and another section with 20-log turns, you want to combine them so you're not overworking everybody in the crew when you're within 500 feet of the landing, and so you don't have people sitting around going to sleep when you're out there a mile and a half. So, you want to combine long and short sides. This is as much to keep a rhythm as anything else.

I would like to expand on the concept that overwork tends to cause accidents. I believe you can make a case that underwork tends to, also. So, there's a rhythm you establish that really tends to affect the safety.

People on a helicopter crew tend to travel together. They tend to know each other pretty well. So what happens if I, as a project manager, don't have a good enough logging plan to keep the cutters out of the way of the pilots? Does the pilot fly over the fallers or the rigging crew? No, he flies around them, resulting in longer turn times. If I don't build a good approach to the landing, what happens? Does he try to crash into the trees and kill the guys coiling the chokers? No, he takes longer to land. If the rigging crew isn't wearing the proper visible clothing, it takes longer to find them. For anybody in this room that happens to be a new operator, it doesn't take nuclear science or advanced math to figure out what 15 seconds a turn costs you in a year's time. So, as Tim Harper (Erickson Aircrane) said, safety and economics run hand-in-hand.

Occasionally somebody does get hurt, so part of the task in starting up a job is to ensure that everybody is qualified in first aid. How do you get a victim out of the woods? Where's the closest medical facility? These are all things you need to consider.

INSURANCE COMPANIES' PERSPECTIVES

By Larry Maloney, Broker, Caladonian Insurance Group
and Don Milani, Assistant Vice President, Sedgwick Incorporated

MR. MALONEY: Just by way of background, I've been active as an insurance broker since I moved to the Northwest in 1968. I immigrated from England after a short and inconspicuous career at Lloyd's of London, and I went to work for an aviation and marine insurance broker in Vancouver, B.C., where I worked for 10 years before moving to Seattle in 1978. And throughout that period of time, I've been actively involved in the placing of helicopter insurances.

In the time that I worked both in Canada and in the United States, I've been involved with accounts and operators who have flown very large equipment, both on shore and off shore, and who have been involved in helicopter logging. One of the main things that I've observed is that aviation insurance is a very cyclical commodity.

There have been wide swings in the availability and cost of insurance during the time I have been involved in the industry. An analogy is that the rates that have been charged for helicopter operations are a bit like a watch that has stopped. It's correct twice a day, but you never know when that is. I have seen rate cycles where rates have been well below the price level which are sufficient to keep insurers in business. They may well keep operators in business, but they won't keep the insurers in business over a period of time. I've also seen rates swing violently upwards to a point where they've become a very severe burden on the operators. And I regret to say that we are in one of those high end parts of the cycle. Insurance rates for helicopter operators have risen dramatically, from all time lows in the late '80s and early '90s, to a point now where they're reaching their highest level in the last ten years.

When I lived in Vancouver the helicopters we were insuring were the early light turbine equipment. The Hiller 1100s, a few Hughes 500s, and the Bell Jet Rangers were just coming out. The insured values were an awful lot lower, obviously. Only about $80,000 or $90,000 to buy a Jet Ranger A Model. In western Canada the rates being charged were well into double digits, 12, 14, 15 percent hull rates. Because of accident problems associated with developing the new technology, it got to a point where, in the London marketplace -- which was pretty much the exclusive market -- there was such a bad accident rate in the Jet Rangers that the underwriters said, "It's going to be a 25 percent rate and a 25 percent deductible." That was in the early '70s.

It's a lot better now. I'm not going to talk about specific rates available now, and I'm not going to talk about specific insurers or underwriters. I will, however, give you an overview of where I see the marketplace. Heli-logging has been around a long time, 30 plus years to my knowledge, and the industry was, in the early days and currently, dominated by a small number of high-valued large helicopters. I don't know if it's another 80-20 rule, but 80 percent of the board feet are probably pulled out by 20 percent of the operators. I'm guessing about that. I have no statistics to support that statement.

The availability of insurers to provide coverages for helicopter logging is very small. There's probably only two or three realistic choices for insurances on these high-valued units. So, the underwriters are in the driver's seat. That's just a fact of life at the moment.

One thing you should remember about insurance is that it's a very retroactively looking industry. The only thing insurers have to go on is what's happened in the past. They make conclusions, judgments, and projections about the future, but it's all really basically a big guess.

Another analogy about the insurance industry is that it's like a car going down the road. You've got a marketing guy who wants to sell insurance, and he's got his foot firmly on the gas pedal. The other guy in the front seat of the car is the underwriting manager (he's the one assessing all the risks), and his foot is firmly on the brake, and the guy giving directions is the actuary, and he's looking out the back window.

There's no doubt that many of the insurers who are out there have no interest whatsoever in insuring external load operations. It doesn't matter what you're picking up or what you're doing with it at all; they just say, "Thanks, we're not in that game." Obviously, there is regard by the insurance industry that helicopter logging is a high-risk exercise because of the frequency of turns, close proximity to the terrain, and maximum torque events on a consistent basis. It's hard work on everybody. So, the insurance underwriters generally are looking for a proven track record.

The current state of the market is such that the people who are left on the underwriting side, the people who are making the decisions on rates and on which operators to provide coverage for, are the survivors. In the late '80s, early '90s, there were a lot of people in the insurance business who were offering quotations and offering coverage, and they were largely responsible for driving rates down, but now they're gone. They drove rates down to a point, as I said before, where they were unsustainable from a business perspective. The few people who are left are the survivors and they can perhaps be forgiven for saying, "I told you so." Some are saying, "You went to another guy because he was cheap, but we all told you it was too cheap, and now you're back." Then they say, "This is the new price if you want coverage from us."

Well, the people who are still providing coverage are those who are the more professional, well-established, discerning, and savvy underwriters. And I'm happy to say that a number of them are still willing and prepared to look at helicopter logging activities. But, as they review helicopter logging operators they are looking for the most sophisticated, professional and well run. They are very selective about who they are insuring.

Now, there's been some hard lessons. Some bad events have taught them some hard lessons. These bad insurance claims have predominately involved people who have, as previous speakers have said, been unprepared, probably in many ways, to provide the required degree of professionalism and commitment to safe operations. I think that the insurance community is now aware of that. Like I say, they can only look backwards. They can't look forwards. But if you aren't an optimist you could never be an underwriter, because you'd never write anything for fear of the worst.

So there is an element of optimism. But, once they've been proven to have made a mistake, most of them, at least those who survive, don't repeat it. So I've seen pretty strong reactions now by the insurance community to single-engine, single ship, military surplus helicopter logging operations. These helicopters are extremely difficult to insure. It's extremely expensive if you can get it, and it's a tough sell to the insurance community. Some insurers have stated they will not insure any military surplus helicopters. Whether that's right or wrong, I don't know, but that's the way some insurers have decided to keep their money in their own pockets.

The insurance industry is often asked why it doesn't do something about bad operations. The same charge, I guess, is levied at the FAA or other regulatory authorities. The insurance industry is not a policeman. But, in the long-term, I can see the evidence that the ineffective, inefficient, and hazardous operations do become penalized to the point of extinction by the insurance community. It's not anything that somebody sets out to accomplish -- there's no black list. One insurer might talk to another insurer, but track records eventually catch up with the individuals who have problems. So, don't look to the insurance community to provide any kind of a screening process on an overall basis, but over time it will happen.

A year ago there was a great deal of discussion about twin- versus single-engine operations. While I make no statements about which is better or which is worse, I will share with you what I perceive to be the reactions by the insurers when they are offered insurances of both types of machines. One of the things you have to remember about insurance from a hull insurance perspective (and that is really all that we are talking about for helicopter logging as there is no real element of liability exposure to underwriters on helicopter logging -- it's all "will the helicopter get damaged or won't it"?) is that insurance rates are just a method of arriving at a premium income. You could charge a premium based on the size of your hat, or the size of your hangar, or gross sales, or whatever. For the purposes of hull insurance, a premium is expressed as a percentage of the insurance value. So, if you've got a very high insured value, you can generate, with a given rate, a comparatively large amount of premium dollars. All the insurers are looking for is an inflow of enough money to meet projected outflows in claims. So, high valued-units, the twin- engine helicopters, which traditionally carry the high values, just tend to carry lower rates than single-engine helicopters which have substantially lower insured values. So, just because of the way things are, insurance rates for single-engine helicopters are generally higher than multi engine machines.

I can't give you a formula that would explain this differential. It's not a science. It's more of an art form in providing helicopter hull rates. Statistically I have no analysis either about which helicopters have -- well, I take that back -- everybody knows single-engine helicopters have more total accidents than twin-engine helicopters -- but I do not know if it is more as a percentage of the total fleet out there. I suspect you would find more single-engine helicopter accidents, if you just did a statistical analysis of all helicopters out here.

But, the problem with a multi-engine helicopter accident is, if it happens, it's a big dollar item. You might think because of lower loss frequency perhaps underwriters would give lower rates for multi-engine than they do. But, in practice they do not and this is because, if and when the terrible event does occur, they've got to pay out a lot more money. So, I don't see any satisfaction by the multi-engine operator that his rate is as low as he thinks it should be simply because he's performing operations with multi-engine helicopters.

I said earlier that the insurance industry for helicopters, currently, is dominated by individuals who are survivors. They are the ones who have stayed around, and they are thorough and professional, and I see the same thing in the helicopter logging industry. This is preaching to the choir, because the people here are the most professional and are survivors in a rugged industry. But as a general statement, the better and more safely that you operate your equipment, the lower you'll see your insurance costs. It's still going to fluctuate due to events outside your control, but, if you continue to provide good, safe operations, insurance rates will come down.

Thank you.

MR. MILANI: I am a safety professional, but I haven't been one all of my life. When I got out of the Army, I decided I wanted to be a forester. I went to college, got a two-year degree in forestry, graduated the same year President Nixon laid off most of the Forest Service, so, as a result, never got a job as a forester. I went to work for a logging outfit in Klamath Falls, Oregon.

I've been with Sedgwick, Incorporated for the past nine years. Sedgwick is the second largest insurance broker in the world, and has a lot of leverage when it comes to insurance matters. I work in the Sacramento office where we specialize in writing association and program insurance. Instead of going out and writing that individual policy, we like to put together programs. In California, we have two programs for the timber industry, the Associated California Loggers and the Timber Operators' Council.

When it comes to workers' comp insurance for helicopter logging, there is a perception that needs to be changed. If I were to say "Helicopter Logging" to a room full of workers' comp insurance underwriters, they would all cower under their desks. If I were to ask them, "Why are you afraid of helicopter logging? What's the big deal here?" They would answer, "Well, it's a treaty exclusion." In insurance talk that just means that insurance companies have insurance companies who insure them and many of the reinsurance companies do not like anything that leaves the ground.

So your workers' comp carrier may pick up the first level of insurance, some take the first $300,000 of a claim, some $500,000 , some maybe even $1,000,000. Once that claim reaches a certain level, however, another insurance company, a reinsurance company, comes in and takes that over, and there's usually an exclusion for any kind of aircraft operations. So, it makes it hard for a workers' comp carrier to say, "Okay, we'll do this."

In talking to them about it, I asked, "Is the fear a perception, or is it based on fact?" Most of it's a perception. Now, down where we live, around the Bay Area, a couple of years ago there was a helicopter operation that was lifting an air conditioner up on a building and the helicopter crashed. There was one fatality and the other person walked away from it. Later that same week another helicopter crashed. All the underwriters remember those dramatic crashes, and in their mind, that's helicopter operations -- two or three crashes a week. So it's a perception versus fact.

Then the other problem the underwriters have is that there is so little payroll generated when we're talking about helicopter pilots. It is hard to fund for a catastrophe, but we know we're going to have them periodically. So, how do we collect enough money so that when the big hit comes, we can pay for it and still stay profitable? So, that's just some of the problems from a workers' comp standpoint. Most of the individual underwriters don't understand the industry, and most of them don't want to take a chance.

A similar story involved crop dusters. A company that we work with has a crop duster program for workers' comp. The single biggest claim wasn't even one of the pilots; it was one of the field workers who was driving from the field back to the hanger. He had an epileptic seizure and stepped out of his pickup at 55 miles an hour. But again, the underwriting manager came back to the underwriter and said, "See, I told you this is a hazardous industry, and we cannot insure these kinds of risks anymore. "

So again, it comes back to the perception versus fact. So it's one of those things that we really need to work on.

Another problem that we have, from a workers' comp stand point, is many of you are multi-state, and, in some cases, international. It's really hard to find an underwriter who's willing to go through all the steps to write policies for each individual state and then figure out how to keep up with the bookkeeping, so that you pay the appropriate premium for the appropriate state.

One of the creative solutions that we came up with for one of our insurers is a composite rate. This company pays the same rate in all states except Washington because Washington doesn't allow individual workers' comp carriers. Instead, you have to be in the State fund in Washington. All the other states, pay one rate, and it all goes into the pot. At the end of the year, if the losses were higher than what the rate we charged, the company makes up the difference. If the losses were lower, they get some of their money back. It's a very effective program, and it's a very easy program for the helicopter logging company.

So, there are some ways in which we can, with larger operations, fill that need for your workers' comp, and make it relatively painless. But, one of the solutions to the problems with insurance, and it's not just workers' comp, is to educate the insurance industry about helicopters and helicopter logging. Helicopters don't fall out of the sky on their own; overall helicopter logging is relatively safe, and becoming safer all the time.

Another thing that I think we need to do is educate our employees, and especially our pilots, on how to talk to the general public and other people. There's this romanticism about putting your life on the line every day, and some of the stories we hear are just incredible. Now I didn't know that you could get a long-line wrapped around a 10-foot redwood tree and jerk it out of the ground, but, you know, we hear these kinds of stories. And, as those stories get back to the insurance underwriters, it's, "Oh, my God, we're not going to touch this stuff. It's really hazardous." So, there again is that perception.

We need to promote the helicopter logging industry. One of the things I'd hoped to have up here with me today, is a t-shirt I'm designing that says "Just say 'Yes' to helicopter logging", and then I will be mailing them off to insurance underwriters to get them to think positively about our industry.

The other thing I think we need to do, and I think it's maybe being done somewhat, but needs to be done more on a formal basis, is that the industry leaders, who are the people in this room, need to start policing the industry. Police yourselves before the regulators have a chance to come in and do it for you. This can be done through an association, a strong association, and through insurance programs. We've policed the logging industry in California through the association by giving special rates to companies who will agree to follow certain safety procedures in their logging operations. It's really cleaned up the industry. In fact, logging is still the most hazardous industry in California, but roofing is catching us rather rapidly. It's not because roofing's safety record is getting worse, it's because ours is getting better. So we're moving in the right direction, and that can be done in all kinds of industries, through the associations, and using good insurance rates as a hammer to get people to comply. It is bottom line dollars that gets peoples' attention. People will comply with that a lot faster than they will comply with the regulations.

Now, we're entering a brave new world. I know a lot of you have been in business for a long time and are saying, "Gee, you know, things just don't work the way they used to." And you've got to, as we go into the new world of business in the 21st century, really think things through, look forward to how things are going to be done in the future, and get that actuary in the back seat of the car to turn around and look forward too, because they truly do look back all the time.

But, as we enter this new world, we don't want to be like the very, very rich person who was dying and he just could not face eternity without part of his wealth, so he made a deal with God. God allowed him to bring some of his wealth to heaven with him. The guy was trying to figure what to bring. It dawned on him that he could bring one bag full of gold bullion. That's the most prized possession he had. So, he's got a bag of bullion laying in bed next to him, and when he dies, as his spirit leaves, he grabs the bullion and he heads to the Pearly Gates, and St. Peter says, "Boy, we've really been expecting you. We want to see what you've brought. What kind of wealth did you bring here?" He says, "I've got the most precious material I have." And St. Peter looks in the bag and says, " Why did you bring pavement?"

We've got to think about where we're going and be sure we are not bringing pavement to the future. We've really got to know what we're doing, be creative in the way we think, and a lot of that can be done through a good strong association and a good strong insurance program.

THE USE OF LOGGING HELICOPTERS FROM A FOREST SERVICE PERSPECTIVE

By J.P. Johnston, National Helicopter Program Officer, U.S. Forest Service

I'd like to thank NIOSH for providing me with the opportunity to give an overview of the relationship between helicopter logging and the use of helicopter logging machines from a Forest Service perspective.

My name is J.P. Johnston, and I'm the national helicopter program officer for the U.S. Forest Service. I work at the National Interagency Fire Center out of Boise, Idaho. We're a detached unit of the Washington office of the Forest Service. And, using the typical government application of acronyms, we're known as the Washington Office West. We're "WOW". We report to the Washington Office East, affectionately as "WOE". So, we say, "Hey, I've got a good idea", and they say, "W(H)OE".

My job, as national helicopter program officer, is to assist in providing to the wild-land firefighting and resource management community, safe, economical, and efficient helicopter resources for wild-land fire protection. This assistance entails establishing standards, policy, procedures, the inspection of aircraft for compliance to national interagency contract standards, and sometimes, in rare cases, enforcement of these standards.

I'd like to talk about the relationship that has developed, at least from a firefighting perspective, between the Type I helicopters, heli-loggers (I'll use the terms interchangeably) and the Forest Service. Since about 1987, the agency started to appreciate that the Type I helicopter was indeed a viable and economical tool for wildfire protection.

Let me elaborate -- during 1994 and 1995 we flew over 60,000 hours and made payments of over $100,000,000 for the Type I and II helicopters, firefighting helicopters. During that period we had over 140,000 fires, and burn over 6,000,000 acres, and we contracted, as part of the national program, for over 52 Type I helicopters, or heli-logging helicopters. To the credit of the heli-logging community, these hours were accident free.

I believe that one of the reasons that the Type I helicopter has become such an important firefighting tool is the fact that, by the nature of the heli-logging business, the fleet is strategically placed throughout the national forest system. When a fire occurs, generally a heli-logging operation is nearby. This de facto deployment allows the government to maximize its use of the Type I helicopter without incurring the availability costs associated with exclusive use contracts.

Conversely, this "call when needed" contracting system allows the heli-logging operator the opportunity of additional revenue sources, and better utilization of excess equipment. In this "call when needed" environment, Type I operators have shown the willingness to invest the capital to develop innovative techniques and equipment for wild-land fire protection. Examples of this are the computer controlled gating systems for large water buckets and the invention or creation of large helicopter dip tanks. And, as an offshoot of this, the development of the Type I helitanker which I believe is pioneering a new frontier in wild-land firefighting and creating, what may be, a new industry for the helicopter community.

What the taxpayers get for their dollar is an efficient firefighting tool that has the capability of delivering vast quantities of material in a short period of time. That can make the difference between a fire that's being controlled and one that's going to go over the hill. For example, one Type I heli-logging machine was reported to have delivered, using a 2,000-gallon water bucket, 178,000 gallons in 6.3 hours. That's over 28,000 gallons of material per hour.

There are two reasons we see this kind of production. First, the crews have the mountain flying experience necessary to be safe and efficient in the rugged, mountainous terrain of the western United States, and secondly, the crews we get from the heli-logging industry are the premier vertical reference pilots in the industry, and possess extraordinary long-line skills. In fact, one of our helicopter managers asked me the other day, "Hey, what's the difference between God and a long-line pilot?" I said, "I don't know". He said, "Well, God doesn't think He's a long-line pilot".

Anyway, we expect and receive trained and competent crews accustomed to working under adverse conditions, and oftentimes these crews are familiar with our system, and seem to welcome the change in pace from the logging routine. Logging aircraft are well supported logistically, and capable of being maintained under field conditions. Consequently, we experience little down time in the field.

However, a weakness exists in the area of CRM, or crew resource management. I've noticed that the Type I pilots oftentimes come from a single-pilot background, and tend to be of an independent nature. Therefore, we would like to see additional work in the areas of CRM.

I think that there is a correlation between the currency and proficiency produced by the heli-logging industry, and that is an economical, efficient operation that has an amazingly safe record from a Forest Service perspective. The skills and dexterity gained in the logging woods, the efficiency of motion, and the maintenance standards learned from the rigors of logging, combined with the unique flexibility of the "call when needed" contracting process, produce a benefit to the taxpayer that is worth the dollars spent.

I've been thinking about successful helicopter operations that I've seen, and what their secrets for success might be. And it comes to mind, perhaps, the Dallas Cowboys or any winning team, and what it takes to be a champion, or to have gone to the Super Bowl, and I thought maybe this could be expressed as a formula. That formula might be stated as follows: number one, hire talented people; number two, train these people to the highest standard; and, number three, then practice, practice, practice.

Thank you.

CHAPTER VI
OVERSIGHT OF HELICOPTER LOGGING

NATIONAL TRANSPORTATION SAFETY BOARD

By John Hammerschmidt, Member, National Transportation Safety Board

The NTSB is an independent federal investigative agency. We are not connected to the Federal Aviation Administration, and in many respects are considered to be a watchdog of the FAA and the federal Department of Transportation.

The NTSB investigates all types of transportation accidents: aviation, railroad, pipeline, highway, hazardous material, and marine. In fact, we've done some marine accidents right here in the Narrows near Ketchikan. We did the major part of the space shuttle Challenger accident investigation since I've been with the Safety Board. And so our work is pretty wide-ranging.

Listening to Mike Klatt and George Conway lay out the charge this morning, as we began the important work of this meeting, I was struck by the opportunity that this group has to make real progress, sustained progress, in helicopter logging safety. I'd like to take just a few minutes this morning to give you some of my perspectives about the challenges you deal with in helicopter logging, the realities of your work, and the opportunities for this workshop.

In the 11 years I have been at the Safety Board, I have learned that every transportation accident leaves behind it a harsh trail of disrupted lives and livelihoods. That's why we work so hard, in the government and in your own operations, to prevent these accidents, and to make sure that when they do happen once that they do not happen again. And it's with this background that the Safety Board viewed with such concern the pattern of helicopter logging accidents that occurred in Alaska between January 1992 and June 1993. There were six accidents that took nine persons' lives. All involved helicopter logging operations.

I would like to go into one of these accidents in a little detail. Not to single out the pilot who lost his life, or the company, or anyone else, but rather to show how many threads of important safety issues were tied together in a single accident. Now, I might mention that looking through the Proceedings this morning of last year's conference, that Dr. George Conway has a very good synopsis of this accident in his paper, the "Epidemiology of Alaska Helicopter Logging Deaths" on page 7 of the Proceedings. I'll be describing the accident in more detail.

On May 2nd, 1993, a Bell 204B helicopter was destroyed when it collided with the ground at Copper Harbor, Alaska. The helicopter had been engaged in helicopter logging operations for about five hours. Investigators from the Safety Board found that the particular logging operation underway at the time required a very steep descent path from the log pickup site at a 1,200 foot elevation to the drop site near sea level. The descent was estimated to take about 11 to 12 seconds, and was described by witnesses as "straight down in autorotation and dropping the logs." The pilot, who was fatally injured, had previously expressed doubts about being able to accomplish it. Following one of these descents, while in a hover, the tail rotor and 90 degree gear box separated.

The Safety Board metallurgists found that there were signatures of metal fatigue. The gear box had a military origin. Also, the evidence indicated that the helicopter had been operated in excess of the gross weight hook-limit. Let me turn now to some additional information on that important point.

The weights of the logs recorded on individual flights indicated the aircraft to have been operating in excess of the 8,500 pound gross weight limit and the 4,000 pound hook-limit before the accident. The certificated weight and balance of the helicopter limited the weight of the external loads, depending on the fuel on board the helicopter, to between 3,418 and 4,018 pounds. Investigators found that 20 percent of the turns (a turn is a single lift of a log or logs) exceeded the weight and balance limit, and the heaviest recorded turn was 4,500 pounds. Finally, there was no record of surveillance by the FAA office holding the operator's certificate.

The Safety Board determined that the probable causes of this accident were fatigue failure of the tail rotor gear box, and improper repetitive operations at greater than maximum loads. We also determined that inadequate maintenance quality control by the operator and inadequate FAA surveillance contributed to this accident.

But of course the Safety Board does not exist to investigate accidents and stop at that point. Our main purpose is to prevent accidents. Our way of accomplishing this is by issuing what we call safety recommendations, which strongly suggest changes to improve safety that we direct to whomever we think can best bring about the change. We've issued safety recommendations on a number of issues in helicopter logging based on what we've learned from our investigations of these accidents. You should have before you those very recommendations we have issued.

One of the main threads we've identified and issued safety recommendations on in this area is inadequate FAA surveillance. We recommended that the FAA work out problems in accomplishing the surveillance of helicopter logging operations by ensuring that the appropriate FAA office was made responsible. On that point I would like to turn back to the factual report on this investigation and describe, in a little more detail than you probably have in the report before you, aspects of the FAA surveillance.

Regarding the Copper Harbor accident, the FAA-approved Helicopter 204B Flight Manual, indicated that the minimum flight crew should consist of one pilot, who shall operate the helicopter from the right crew seat.

The manual states that "The left crew seat may be used for an additional pilot when the approved dual controls and copilot instrument kits are installed." The accident airplane was found to have left seat controls and instrumentation installed according to an FAA Form 337. This form (Major Repair and Alteration) describes the work accomplished, but did not include FAA authorization to operate the aircraft with a single pilot in the left seat. In this accident the helicopter operator was in the left seat. No FAA approval of left seat operation was found.

The operator had conducted aerologging operations with multiple helicopters in Alaska from facilities in Ketchikan since April 1991. The operator's certificates to conduct operations under 14 CFR Parts 133 and 135, as well as to operate an FAA approved maintenance facility, are held by the Flight Standards District Office (FSDO) in Riverside, California.

Investigators reviewed the records of FAA surveillance of the operator in Alaska. They found no record of FAA surveillance by the principal operations inspector or the principal maintenance inspector from the Riverside FSDO of the operator's facilities in Alaska. The FAA was conducting remote surveillance out of the Juneau FSDO of the overall operations in this region. Yet no record of surveillance was found to have taken place at sites where actual external load activities or field maintenance had taken place, nor on helicopters engaged in 14 CFR Part 133 External Load Operations.

An analogous situation occurred in the December 1, 1993, commuter airline accident at Hibbing, Minnesota. I was the Safety Board member on scene, and we noted that the airline's principal inspectors were based in Des Moines, Iowa. The airline, however, did not fly to Des Moines. The principal inspectors were not able to travel to the airline's operational base in Minneapolis to perform any surveillance. The principal operations inspector had talked to the airline's director of operations over the telephone, but the two had never met. And these facts were significant in that investigation, because the Safety Board determined that inadequate FAA surveillance contributed to the cause of the accident which took the lives of 18 people.

As has been mentioned already, last fall the Safety Board completed a comprehensive study of all aspects of aviation in Alaska, including special operations like helicopter logging. During the public forum held in Juneau last year, as part of this study, we received some compelling information from the helicopter logging community. We heard from you about the potential for the current service life limits on aircraft and components to be inappropriate for the specialized conditions in which you use your equipment. As already mentioned, this issue has come up in fatal helicopter logging accidents.

Because of the concerns that surfaced in both our accident investigations and in your industry's comments at the public forum, the NTSB study of aviation safety in Alaska included a recommendation to the FAA for it to review the maintenance programs of helicopters used in aerologging and to develop prescribed service life limits and overhaul times on engines, airframe parts, and components as necessary to provide an adequate margin for safety.

The Board issued this safety recommendation a little less than three months ago, and we are just now evaluating the FAA's response to it, which we received last Thursday, February 22nd. For reference, I'll just read you the FAA's response. It's very concise, as they often tend to be, and it is from FAA Administrator Hinson: "The FAA will review the aircraft certification and maintenance programs of helicopters used in aerologging to ensure service life limits and overhaul times are appropriate. I will keep the Board apprised of the FAA's progress on this safety recommendation." So, as you can see, it's quite general in nature, and we'll be evaluating that right away.

The 1993 helicopter accident at Copper Harbor illustrates that the safety issues of your industry obviously are not simple. In a way this may be beneficial because it gives all of us a lot of different ways in which, together, we can attack the problem. And I believe that Dr. Conway has already mentioned that aspect.

This accident also showed something else very important. We all need to recognize, and to some degree accept, the hazards that are inherent in your business. The job of picking up logs from a mountainside is just never going to be as safe as picking up a pencil from your desk! By its nature, helicopter logging will contain a certain element of risk. But even if all of the risk cannot realistically be eliminated, I think that NIOSH's conclusion, that helicopter logging has a higher occupational death

rate than any other job, has got to be a wake-up call for all of us. We need to develop effective measures to control risk wherever possible. I am very pleased that the safety record for helicopter logging here in Alaska has been much, much better in recent times.

I hope that the string of accidents that happened in 1992 and 1993 is a thing of the past. I think that the attention to safety in your industry may have a lot to do with the improved safety record we're seeing right now. The workshop we're participating in, I'm quite sure, is an example of how attention to safety can, indeed, make a difference. You are building on a solid foundation of work that you have done last year and before.

The output from last year's workshop is very impressive, especially the recommendations of the subgroups on equipment, maintenance, human factors, training, and management. A few weeks ago Jan Manwaring sent me the information that had been developed thus far. I read through it, and in discussions with staff members at our headquarters in Washington D.C., I said, "These people are really on the ball."

This part of the world is famous for gold, in addition to the quality of the lumber that's available for logging. And I think that there's a lot of solid gold in the subgroup recommendations on which today's and tomorrow's discussions will be built. You have an excellent program ahead of you in this workshop that brings together a wealth of practical hands-on experience in flying and managing helicopter logging operations, and a wealth of expertise in human factors, safety, and rotary wing flight. I'm very pleased to be here to lend my wholehearted support to all of your efforts. I congratulate you for the time and energy you have already committed to safer helicopter logging, and I wish you much progress in this workshop, and safe flying and logging here in Alaska.

I thank you for your attention.

NTSB UPDATE

By John Hammerschmidt, Member, National Transportation Safety Board

For the record, I am a Board Member of the National Transportation Safety Board. I have been working at the NTSB for 12 years now. I was on the staff of the Safety Board for six years before becoming a Board Member. Prior to entering government service, I was in the private sector. I was the fourth generation of management of a family lumber business that was founded in 1911. I have purchased a lot of lumber that originated up here in the Pacific Northwest, and have been around the lumber industry, really, for all my life. And so, it's great to be back in this absolutely beautiful environment.

Let me touch on just a few items that I would like to relate to from previous presenters. First of all, Phil Kemp had an absolutely outstanding presentation, I thought, and I couldn't agree with his thoughts more on practically every point, especially the bottom line, where he got to the conclusion he put up on the slide. Safety is a conscious state of mind, and that when a company wants to implement a safety program it really needs to come from the top down to be truly effective. In that regard, let me announce that the NTSB is holding a symposium on corporate culture and transportation safety. The reason I mention it is because I was asked about this yesterday afternoon by a couple of you who showed some interest in that. And, for the record, this will be a symposium on the relationship between corporate culture or management philosophy and safety in the transportation environment. It will be held in Crystal City, Virginia, that's a suburb of Washington, D.C., on April 24-25, 1997.

Very briefly let me say that internationally recognized experts will discuss how corporate actions and attitudes can affect safety. Safety Board accident investigation reports will be used to illustrate this relationship. And, if you should have any interest in attending this symposium, I believe that the stated registration deadline is April 2. But like I say, that follows up exactly on what I thought Phil Kemp was trying to get across this morning.

Also, want to make sure and thank Mike Klatt and all organizers of this meeting, HAI, of course, Dr. George Conway, Jan Manwaring, and whomever is responsible for putting this on again, for inviting me to be a small part of it and providing some input from the NTSB.

I hope that there's no misconception about the NTSB and what the NTSB is, because we are an independent government agency, we are not connected to the Department of Transportation. The mission is safety through accident investigation. Our entire focus and mission is safety. So I just hope there's no misconception about that.

Since a year ago, when many of us here were gathering to exchange information and ideas on improving heli-logging safety, the NTSB has been a very busy agency. Many of the activities that our agency has been involved in have had a national and an international following.

And let me, briefly, if I could, recap a few of those activities before focusing on heli-logging activities. I just thought you might find it interesting to appreciate the latitude of our activities which, in a sense, key into what Mr. Herlihy was saying about our strained resources and the fact that, at times, very often, we are required to delegate accidents in the aviation mode to the FAA. Some of these activities, since we last met, have been the Value Jet DC9 accident on May 11 in the Florida Everglades involv-

ing an in-flight fire. There were 110 fatalities in that accident. The TWA, Flight 800, Boeing 747 accident on July 17 of last year off the coast of Long Island, New York, 230 fatalities. The car air bag issue that has reached greater public prominence as more front seat child passengers have been tragically killed by these safety devices. The issue of Boeing 737 rudder system safety in terms of engineering design. Add to that just four accidents that I personally responded to as part of our go-team launch process.

In July of last year, just north of here, the laundry room fire with heavy smoke propagation on the cruise ship Universe Explorer, cruising in the Lynn Canal near Juneau, with 1,006 people on board. There were five crew fatal. In fact, Jan Manwaring came down to Juneau to observe our shoreside investigative activities.

The second accident that I responded to with the go-team was the September '96 emergency landing in Newburg, New York, of a Federal Express DC10 due to an in-flight fire in the cargo area. The airplane was destroyed by fire from where it came to rest on the high speed taxiway, just off the runway.

Another accident was the December collision of the Liberian bulk carrier BRIGHTFIELD with the Port of New Orleans River Walk Shopping Mall on the lower Mississippi River. Miraculously there were no fatalities in that. It could have been a very, very bad accident from a human injury and fatality standpoint, but we were lucky on that one.

And earlier this year the crash of an Embraer 120 Brazilia on approach to Detroit Metropolitan Airport. All 29 on board were fatal.

Beyond these activities, just very briefly, there was the November 19 runway collision in Quincy, Illinois, of a United Express Beech 1900C, 14 fatalities in that accident. Two days later there was the gas pipeline explosion in San Juan, Puerto Rico, 33 fatalities and more than 100 injuries, and I'm slated to chair a public hearing on that later on this year in San Juan, Puerto Rico. And I could go on and on. The Delta Airlines MD-80 uncontained engine failure in Pensacola, Florida, fatal accident. We do international accidents. The Boeing 757 accident out of Lima, Peru. It lost it's instruments and flew into the ocean. All fatal. The 707 taking off from Manta, Ecuador, on the coast of Ecuador with multiple fatalities.

But, the reason I mentioned this workload that has strained our resources is because, against this backdrop of high profile, highly publicized accidents, the issue of heli-logging safety remains an area of continued interest at the Safety Board. And I also mention it in terms of what was said in the last presentation in reference to the fact that the Safety Board needs to delegate certain accidents to the FAA to do the field work because we just do not have the manpower to investigate those. The prime example being our investigation of the commuter accident, the Com Air accident in Michigan in January of this year. When we send a go team out we have many specialities. We have about 10 specialities that we divide up into working groups. Our structures group, which is one of the very most basic of our working groups, which has to do with ascertaining the structural integrity of the aircraft, that is the fuselage, the vertical stabilizers, et cetera. For that group we had to draw upon an investigator from our Anchorage field office to fill in that slot. So, we are strained from a people standpoint as well.

And, at last year's heli-logging workshop we made note of the much improved safety record of heli-logging operations in Alaska since the string of accidents in 1992 and 1993, and Dr. Conway's epidemiology accident chart presented this morning again reminds us of that trend. And I liked it when Dr. Conway used the phrase "looking at data with a cool head". I thought that showed some insight.

I wish I could report that the NTSB has not investigated a single heli-logging accident in the year that has elapsed since we were last here to discuss solutions to the inherent risk of heli-logging safety, but I'm afraid that during the past year the Board has investigated at least four such accidents in the Pacific Northwest, three of which occurred in an 18-day period of July of last year, and two of which occurred in Alaska. Although each of these accidents is still under investigation, and the probable causes have yet to be determined, I thought you might have an interest in some of their details. And I realize that many of you have a direct knowledge and/or a direct interest in the circumstances of some of these accidents. And the details that I will relate represent preliminary, factual, information collected by our regional investigators.

The first is a fairly straightforward, no injury accident, where the pilot hooked a skid on a stump during takeoff. However, it illustrates one of the more common type of logging accidents. On July 7, 1996, at 1930 Alaska Daylight Time, a skid equipped Bell 206B helicopter, registered to and operated by Coastal Helicopters of Juneau, Alaska, struck a skid on a tree stump and rolled over during an attempted hover/takeoff from a field site near the Kensington Mine area, Juneau. The positioning flight, operating under 14 CFR Part 91, was departing the field site for another field site located in the area. The helicopter was transporting surveyors and their equipment. A visual flight rules flight plan was in effect, and visual meteorological conditions prevailed. The certificated commercial pilot, the sole occupant, was not injured and the helicopter received substantial damage.

During a telephone interview with the pilot the next day he stated when he landed the helicopter he straddled a stump with the skids. The landing area was covered with stumps and cut logs. During the takeoff attempt he raised the helicopter to a hover and it drifted to the right. The inside of the left skid struck a tree stump. The helicopter started to roll to the right. The pilot stated that his passenger was standing in the tree line directly in front of the helicopter. He did not want to strike his passenger, so he pulled the cyclic back and further to the right. The helicopter rolled onto its right side.

The second accident, which involved a mechanical failure during the lifting of logs, and as part of that investigation, the hanger bearing from the tail rotor drive shaft is currently in the Safety Board's lab in Washington awaiting analysis. It occurred on July 13, 1996, about 1325 Alaska Daylight Time, when a Sikorsky CH-54A helicopter crashed during aerologging operations about 16 miles north, northeast of Ketchikan. The helicopter was being operated as a visual flight rules, local area flight, under 14 CFR Part 91, when the accident occurred. The helicopter, registered to and operated by, Silver Bay Logging Company, Juneau, Alaska, was destroyed. The certificated commercial pilot received serious injuries. The copilot, holder of a commercial helicopter certificate, received fatal injuries. Visual meteorological conditions prevailed. The flight originated at a logging camp about 17 minutes before accident.

The operator reported that logging operations were being conducted near Shelter Cove, located in the Tongass National Forest. The helicopter, a surplus military aircraft, certificated in the restricted category, was involved in the removal of logs with a 200-foot long external cable. The accident site, located about 1,400 feet mean sea level, was in a narrow canyon. Ground personnel reported that the

helicopter had just lifted two logs while hovering. A popping sound was heard coming from the helicopter, and the pilot released the load of logs from the end of the cable. The helicopter began spinning and the tail rotor was observed to slow down. The helicopter descended to the ground and collided with steeply sloped terrain.

The third accident occurred when departing a landing zone constructed by loggers. This is the accident that occurred in Warren, Idaho, and Mr. Herlihy has gone into many of the details. More than I had even in my prepared remarks. So, let me just say, for the record, that on it July 24, 1996, about 1430 Mountain Daylight Time, a Bell 206B helicopter, operated by Helicopter Support Services, Incorporated, Cascade, Idaho, rolled over during liftoff and was destroyed near Warren, Idaho. The commercial pilot and a passenger received minor injuries. As has been mentioned, the other passenger was fatally injured. Visual meteorological conditions prevailed, and no flight plan had been filed. The flight, as was mentioned, was conducted under 14 CFR 135.

The fourth accident illustrates the need to make pilots and mechanics aware of what is happening structurally to some helicopters engaged in high cycle, heavy load, operations. And I might mention, in respect to this investigation, that the investigator-in-charge is out of our Seattle regional office. He was also the investigator-in-charge of the Jessica Dubrough fatal accident out of Cheyenne, Wyoming, on which the Board met on Tuesday of this week and adopted the final report.

On November 5, 1996, approximately 1400 Pacific Standard Time, a Garlick TH-1L rotorcraft being operated by the pilot operator of an external load company was destroyed during a collision with terrain following the loss of the tail rotor system and subsequent loss of control while in a hover. The accident occurred at Leavenworth, Washington. The commercial pilot, who was the chief executive officer and president, was fatally injured. No flight plan had been filed and meteorological conditions at site were unknown. The flight, which was engaged in logging, was to have been operated under 14 CFR 133. Witnesses reported that the helicopter was in a hover preparing to lift a load of logs when the tail rotor assembly, including the vertical stabilizer, separated from the airframe. The helicopter was observed spinning around its vertical axis as it descended into terrain. Although this tail boom is currently at the NTSB lab for detailed examination, the investigator-in-charge of this investigation believes that this accident is very similar to a no-injury accident that occurred on March 21 of last year in Alabama which involved a local fertilizer application flight by a Bell 205A1.

The internal working theory on these two accidents is that the conditions that have led to past failures of the 42-degree gearbox during heavy lift operations are now being addressed by increased inspections and by not exceeding torque limits on the engines. Consequently, the working theory is that the structural weak point may have now moved to the tail boom area, and pilots and mechanics need to be aware that this is happening, rather than just taking for granted that these machines will perform the repetitive heavy lifting as planned.

To summarize, in the past few years the safety record of heli-logging has improved considerably. But, as illustrated by the circumstances of these four accidents, three of which occurred in a 2-1/2 week period last July, there is still plenty of room for improvement.

Let me close by congratulating everyone in the room today for your commitment to heli-logging safety, which is evidenced by your being here. As you probably know, most of the heli-logging accidents that the Safety Board investigates in the Pacific Northwest are handled as regional or field

investigations by NTSB investigators from our Seattle or Anchorage offices. And, of course, we welcome your thoughts, your input, and you assistance as we strive to make heli-logging safety improvements through accident investigation.

I want to make one final personal comment that I enjoy coming to these heli-logging workshops because I view myself more as a listener than a talker, and I learn a great deal at these gatherings. Not only the workshop itself, but having meals around the table with many of you, and I think it's a good learning experience, and I would like to compliment everyone that had presentations this morning. I thought the presentations have been very well done. Thank you. And I'd be glad to field any questions.

MR. HERLIHY: Thank you for your comments, John. I would like you to consider formalizing an expert support group from the industry that could assist us much in the way it assists the Board, in much the way ALPA has done, or other organizations, so that when a fatal accident goes down, just as Bell Helicopter is notified, just as the engine manufacturer is notified, that the HAI expert aerologging group is notified and give them the opportunity for "party status" to assist the NTSB.

MR. HAMMERSCHMIDT: Thank you for that comment, Mr. Herlihy, and we will consider that.

MR. MONSCHKE: John, I've responded to several of your safety recommendations from the working area back up to the NTSB, so it's good to see you. I've seen your signature, but I've never got to meet you, so glad you are here.

I'd like to respond to a couple of comments. On the tail rotor hanger bearings, I believe the civil version, the S-64, Erickson Aircrane, already has ADs out, or at least service bulletins out to address that issue. ADs are in the works at this point to take care of the military version, CH-54A and B. Our people are working with the Seattle ACO office, who is in turn working with some of the operators, and we're not trying to impose something here that the people can't live with. So we're trying to get the operators involved to be part of the solution.

The vertical fin on the Bells has been a problem, and we now have got Bell on board to provide a solution service bulletin which will become an AD for the vertical fin, which includes a redesign of the vertical fin. Basically it will be a beef up of the lefthand spar which is where most of the problems and the cracks are coming from. It's a difficult area to inspect, so it looks like a redesign rather than an inspection is going to have to be the solution.

Several of the restricted category operators from the military surplus birds are proposing their own solutions, which basically include a beef up of that spar. Not everyone has responded yet, so we've got to work on more of the people with the restricted category military surplus on that particular issue.

I wanted to make a remark to you that we have a helicopter accident safety school in the FAA that is a follow on to our basic accident school. So, again, going back to what John admitted to as far as workload and personnel, you should really be getting knowledgeable personnel out there, but with the turnover in personnel that we do have, and new people coming on board, training takes a while. We do have trained helicopter investigators within the FAA.

MR. HAMMERSCHMIDT: Okay. Thank you for that follow-up.

MR. LINDAMOOD: I read a long time ago, that the Russians started heli-logging in 1956 with a large helicopter, and if anybody knows anything about it, and we have our Russian friends here, I'd like to find out. I've read that in two different publications. Do you guys know anything about this?

MR. LOGINOV: We can clarify the questions on the logging operation in Russia or in the Soviet Union, formerly. But, first of all we'd like to represent ourselves. His name is Vitali Chentosov. He's the president of Aerinn Air Company. And my name is Mike Loginov. I'm the original manager of this company. And our company includes, among others, branches of the company which perform the heli-logging. And the first experience in Russia in this area, was in '62. But it was quite different from selective logging which we are using now. It was clear area logging, we call it, clear cut method. And by using this method all the area was cleaned. All the trees were cut first, and then our operators hauled these logs. The work was performed by using the short link within a 30-meter trench. And our company performs selective logging and this logging as well.

And if somebody is interested about our experience, we can provide you some information about our experience in this area, especially in the safety area because this is a key point of our activity. Safety is very important from our point of view.

FAA AIRCRAFT CERTIFICATION

By Rick Barnett, Certification Engineer, Federal Aviation Administration

I'm an FAA certification engineer working out of the Seattle Aircraft Certification Office. I would like to talk to you about the helicopters and equipment being used in logging and FAA oversight of this equipment.

I work with modifiers and operators to adapt their rotorcraft for logging type operations. To give you a flavor as to what we have been doing to improve logging equipment capabilities, I made a list of the approvals issued by our officer over the last several years. These approvals consisted of both Supplements to the Type Certificates (STCs) issued to the original equipment manufacturers (OEMs) like Bell or Sikorsky, and Restricted Category Type Certificates (RCTC) issued to approve military surplused rotorcraft for civilian usage under the provisions of FAR 21.25(a)(2).

STCs the Seattle Certification Office has issued over the past nine years to better adapt the existing helicopter fleet to meet the logging operational environment include:

a. Erickson Aircrane/S-64E -- Nine STCs including one for a six-foot long cargo hook pendant system to damp-out/protect rotorcraft from vibration and shock loads transmitted to it through the long-line/external load; and engine mount improvements intended to cure chronic cracking problems in Sikorsky design.

b. On-Board Weighing Systems/assortment of light helicopters -- Twenty STCs approving cargo hook load-cell installations to monitor the weight of the external load; and a new 6,000 pound cargo hook that is releasable electrically during emergencies while carrying maximum weight external loads to 2.5 gs maneuvers. We are currently working on the approval of a 3,000 pound cargo hook with 2.5 gs electrical release capabilities.

c. Croman Corporation/S-61N -- One STC for a 10,000 pound cargo hook and sling system.

d. Columbia Helicopters/CH-54A -- Four STCs including one for the relocation of the transmission oil cooler system from the back of the transmission to the top deck of the fuselage to solve chronic cracking problems with the original cooler mounting; and the installation of a heavy-duty cargo hook support beam system to facilitate external load operations.

e. Idaho Helicopters/UH-1H -- One STC to re-engine the rotorcraft with a Lycoming model T53-L-703 engine, flat rated to provide power for high altitude/hot day logging.

f. Helipro Corporation International -- Two STCs including one for equipping UH-1H helicopters with a Bell Model 212 vertical tail fin and tail rotor system, the replacement of the troubled 42 degree and 90 degree gear boxes with upgraded 212 parts, and the installation of 212 push/pull rod control systems; and the shortening of the S-61N and S-61L forward fuselages by removing a 50 inch section, thereby yielding better main rotor wash effectiveness over the fuselage and superior external load lifting capabilities.

g. Requests for STC approvals related to logging are accelerating. Numerous STC modification programs are in process in the Seattle office.

Secondly, the Restricted Category TC Projects for military surplused rotorcraft that have been processed by the Seattle officer over the past four years include the following:

a. Lenair/Columbia Helicopters/H40NM -- for six CH-54A helicopters, backed by all DOD modification work orders, safety of flight releases, maintenance alert bulletins, service bulletins, etc.; approximately 230 Sikorsky maintenance, parts, overhaul, and operational manuals, and over 20,000 Sikorsky manufacturing drawings.

b. Bluebird Helicopters's CH-54B program.

c. We have three other military surplus programs pending for UH-1Hs, S-61Rs, and S-61As.

When we talk about safety, it has to be recognized that the logging environment is harsh. Also, it must be recognized that none of today's helicopters (except the Kaman 1200) were designed by the manufacturers for use in logging operations. They were all designed for basic utility operational environments.

Logging operations subject the helicopter to as many as 30 high cycle/heavy lift operations per hour. Recognizing this, large helicopter operators like Columbia (for their 107s and 234s) and Erickson Aircrane (for their S-64Es and S-64Fs) have worked with the helicopter manufacturers to conduct complete flight strain surveys or analyses in the logging environment to investigate appropriate life limits for their heavy lift/high cycle operations. In the case of the 107s, some of the life-limited parts have had their life limits reduced to one-sixth of their previous utility life limits.

In addition, numerous ADs have been issued to correct service problems related to high cycle/heavy lift operations, e.g., the BIM inspections for the S-64E/Fs and S-61 main rotor blades, and the major AD for 107s establishing new limits. Also, numerous ADs have been issued against Bell products related to high-cycle operations. The latest ADs were issued against the S-58 transmission main gear box ring gears and main rotor shafts.

It is apparent from these AD and STC activities that the existing rotorcraft fleets are slowly being improved for use in logging operations. Accordingly, we may soon meet NTSB safety recommendations for non-military surplused logging helicopters and equipment.

I believe that helicopter logging can be done safely. All one has to do is look at the two logging operators who have achieved 100,000 hours each of accident-free service. To achieve this kind of safety, we need professional adherence to certification excellence, proper maintenance, flight crew training, enlightened operator management, and FAA leadership.

Like all agencies, the FAA is a political organization which tries to meet its two congressional mandates of promoting aviation safety and aviation commerce. These mandates sometimes appear to be in conflict. The rule should be to foster aviation through aircraft safety.

The FAA is continuously being pulled in separate directions by self-interest groups, like those represented here. In order for us to meet the combined needs of the rotorcraft manufacturers, modifiers, operators, and insurance carriers, those engaged in logging should first work out their differences among themselves and then present a uniform position to the FAA. This would make our task much simpler and allow us to be more effective and efficient in meeting this industry's combined needs, at all levels from the Washington office, to the Rotorcraft Directorate, to our field offices.

Accordingly, I support your efforts to develop a logging committee within HAI, but like all of you, I have my pet programs to which I wish to raise your awareness. The first problem deals with the DOD plan to sell or transfer some 2,500 military surplused aircraft to the private or public sectors. In doing so, it has become apparent that the DOD is not planning to release all of the supporting data (modification work orders, safety of flight releases, maintenance alert bulletins, service bulletins, and maintenance, parts, overhaul and operations manuals) when it releases these rotorcraft for civil use.

Thus, line engineers like myself are being challenged to issue Type Certificates for Restricted Category operations which are not fully supported with a complete database from the military for their products. In other words, these TCs may be of limited worth, because many do not specify complete, accurate and current information for use in defining the rotorcraft configuration and in continuing air worthiness. I believe this constitutes a penny wise, dollar dumb situation that isn't in the best interest of anyone.

Accordingly, I ask your assistance in encouraging the DOD to supply a complete set of its documents for each surplused rotorcraft model to the FAA Rotorcraft Directorate for use as a database and public resource. A complete and current copy of these documents would then be available to anyone from the FAA for a simple copying fee.

Our failure to collect this information during the TC certification process is probably the reason behind the recent issuance of FAA NOTICE 8110.61, which sets standards for establishing the quality of the maintenance programs associated with these Restricted Category TCs, after the fact. This process is backward. Good continuing airworthiness programs should have been established up-front during the certification process for these surplused rotorcraft in accordance with the requirements of FAR 21.25(a)(2).

In addition, we have received reports that many of the cargo hook systems currently used on smaller aircraft do not have 2.5 gs electrical release capabilities. Current Rotorcraft Directorate policy for FAR 27.865 certification require 2.5 gs emergency release capability for both the electrical and mechanical release systems.

We understand that some OEMs are currently writing contracts specifying less than 2.5 gs electrical release capabilities for their new rotorcraft designs. NTSB accident records indicate that some accidents may have been avoided if these rotorcraft had been equipped with cargo hooks having a 2.5 gs electrical release system capabilities.

I also have comments related to two points made by Mr. John Hammerschmidt (NTSB) in his presentation earlier today. Helicopter overload operations of as little as 10 percent can reduce critical helicopter life and wear limits by 50 percent or more. That is, established life limits for part replacement or overhaul could become compromised by continued overloading, as the part wears out twice as fast as

we had expected. Thus, do not overload your aircraft! This practice does not work and it is terribly hazardous to safety.

Our office routinely approves Left Hand seat pilot operations under the STC process. Such modifications require some changes to the hand controls and switches, some instrument relocations, flight test evaluation and a Rotorcraft Flight Manual Supplement. If anyone would like to pursue Left Hand seat pilot operation approval, please contact our office.

QUESTIONS AND ANSWERS

MR. HERLIHY: We have found that the moving of the controls to the left side is fine and complied with STC-wise, for engineering. But that's not enough. You must go through an operational approval cycle also, once the controls are moved over. An STC requires a supplement to the flight manual.

This has not been done in some cases that we've found. The STC was done, but the supplement to the flight manual was not done. That's just to illuminate a little of what John Hammerschmidt was saying this morning. We found that there was an STC in the accidents we have investigated, but there was no performance requirement followed through the POI.

MR. BARNETT: In the STCs we've issued, we've had flight test support. They went out and flew the airplane from the lefthand seat and in each case an appropriate RFM supplement was issued.

FAA AVIATION SAFETY INSPECTIONS

By Matt Thomas, Aviation Safety Inspector, FAA

I'm with the Juneau Flight Standards Division Office (FSDO) as an ops inspector. Quick background, I know at least half the people in the room. Flew a mixed bag, rotorcraft and airplanes for the Coast Guard. Have flown in Southeast, worked for the Safety Board and am now working for the Juneau FSDO.

What I want to go over is very brief. What the FAA's intentions are in Southeast.

From a surveillance or an oversight standpoint, what we out of the Juneau FSDO and also the other FSDOs in the state intend to do, is increase the number of site visits that we're able to make throughout this particular season. And to make those both notice and no notice, to the different sites, different companies. One of the things that we will look at, and are interested in, is the rotor load combination manual and checking that from a paperwork standpoint for being in line with what's really going on.

Things that we're looking at, simply to observe operations, both the heavy lift, increasing interest in the support ship operations, ground ops, facilities, fueling, and taking a look at the various records, maintenance and load cell. If you have tapes that are being run out, we will want to have those available as well. And just checking fuel loads. Standard stuff that anybody as an operator is going to do anyway.

And, as far as maintenance, both day and night. If you're doing day turns and your night crew's working aircraft, we'll periodically want to try to set up to stay overnight onsite and see what's going on off-hours. It may be a radical departure from a set perspective to work after four in the afternoon. That is certainly what I would like to do. We'll see what other folks do on an individual basis. But some of the folks who have interacted with me, from a certificate standpoint, have found me popping up at some of the camps and some of the other places where normally people aren't showing up.

From a support standpoint, lack of access to technical problem information and components failure information across a wide fleet is common. Restricted category aircraft, these military surplus aircraft that are popping up, multiple type certificates that are in existence, are also a concern. There's certainly a concern from the Fed standpoint, and I would suspect from a support standpoint, people who are running aircraft, that with multiple type certificates, who's performing fleet support? Historically, when there was one OEM and one type certificate, you had a single database where you could find out where failures were taking place. Now we may have one problem at one operator, the same problem somewhere else, the same problem five or six other locations, each operator who's got a small fleet of two or three that have a single anomaly, whereas, in reality, we've got a fleet problem that nobody recognizes.

This may be a good forum to try to figure out how to share data from a logistic standpoint. The electronic communications abilities that we have now, putting up web sites, bulletin boards, whatever, may be a viable forum for what appears to be significant failure issues, and a place to share data.

At Anaheim the question was raised about military surplus aircraft, will Sikorsky provide any kind of data or support for those aircraft? What came out then was unequivocally no.

MR. WEAVER: Sikorsky's stance has not changed.

MR. THOMAS: Okay. Is there, from the rotorcraft directorate, any OEM or type certificate support comments to be made?

MR. MONSCHKE: Yes and no.

MR. WEAVER: Is this an inappropriate forum to ask that question?

MR. MONSCHKE: The OEMs, in general, don't recognize military surplus aircraft, if they have any responsibility once the military's done with that aircraft, for various reasons. Some people within the OEMs are beginning to have a 180 degree turnaround on the issue because they see a market for spare parts. And that's one of the biggest problems we have with these surplus aircraft is non-availability of spare parts, parts that are not FAA approved. So, that's where you get the yes and no. I think the final answer is going to be no, but I think it's still out.

We are having an FAA only meeting within the next month to discuss life limited parts on military surplus restricted category aircraft. After we get everybody that's from the aircraft certification offices on board on the issue, then we want to try to work through the HAI logging committee, in conjunction with the OEMs, to see what we can do about this problem. That's about all I can say about it at this time.

MR. THOMAS: Another item that had come up, that type certificate holders will be expected to be on the hook for supporting their aircraft. Valid statement?

MR. MONSCHKE: Valid statement. That's FAR 2199 if anybody cares to look in there. Any time the administrator finds there is a safety problem with an aircraft, that TC holder, at the request of the administrator, has an obligation to make an investigation and report on that problem, and also as to what a proper fix would be for that problem. Over and above that, Part 21.3 says if you have a problem you must report it within 24 hours. I suspect that's not always being done, which gets back to the issue of sharing data. If we get the reports, we can get the data out. We'll probably be making an effort from AIR, which is the certification service, to the flight standards service on these issues in the next coming year. So, yeah. It is a TC holder's responsibility to support his TC'd aircraft. And he need's to get the word out to all the people that are operating his aircraft.

MR. THOMAS: There has been some comment made about NTSB recommendations to the FAA on Part 133. Member Hammerschmidt made those comments. FAA response is still pending back to the Safety Board on that. Glenn, HAI is still putting together its comments to go to FAA, is that correct?

MR. RIZNER: The date is actually closed. So FAA is now internally sending their comments to NTSB.

MR. THOMAS: This is a follow-up to comments on things that had come up earlier in the day. Discussion about an accident plan, pre-accident plan, and this is simply my perspective, not necessarily an organizational perspective, but having an accident plan versus not having one, from a company standpoint. When there is an accident, what you end up with is a huge amount of chaos, and it's a traumatic experience for that organization that's experienced that event.

What I've found, I think every time I've gone to an accident site, is that everybody is pretty well unfrozen, everybody wants to do something, everybody wants to make something better, and what they need is direction. There will be 100 people standing around wanting to do something good, and, if there is a plan in place, it will allow the company to direct it's people to do something good, or to at least do something in a positive direction without having to think. Because, once the accident has taken place, people simply become reactive. And it's the same as having a checklist in your aircraft. It gives you, the company, the ability to yank out a checklist and go down the steps to do the things, the bold faced items that need to be accomplished to maintain control of the situation and to let your people focus back on a common goal. If you don't have a plan, things will not come together, they will not be smooth. People will come in from the outside, provide you direction, which may or may not be exactly what you guys need at that time.

As far as accident investigations go, comments again on the way the Board prioritizes field versus limited, it is a manpower driven decision by the Board dependent upon the number of people available in Anchorage. Right now there's three bodies up there that cover the State of Alaska, and occasionally have to cover things down south as well. If there's a fatal accident that always goes to the top of the list. Sometimes there aren't bodies available to respond, and things are delegated or a limited investigation is performed, and trust is placed in the local FSDO to conduct the "on-site" investigation for the accident investigator who works for the Board. But, bigger numbers of paying passengers always end up going to the top of the list. People who are strictly crew members tend to migrate toward the bottom. The Board's perspective is that its primary customer is the paying passenger, and everything else tends to go downhill from there. It's, I think, a manpower allocation way in which things are done.

The Board has the ability to grant "party status" to folks who have the ability to bring a technical expertise to the investigation. Very often that is the company. If that's not extended, it can always be requested. It doesn't have to be granted. It's completely up to the Board investigator-in-charge who to grant "party status" to. The only body that actually has a legal right to be there in addition to the Safety Board is the FAA. Everyone else is by invitation, and it's based on what can you bring to the table. This particular forum could create a source of expertise for this particular industry which would be beneficial, A, to the industry; and B, to Board or FAA folks who are conducting an investigation that need your expertise because they're not familiar with the operations.

There are the FAA individuals who you will interact with on an accident site and who may or may not have a large amount of accident investigation background. They will have some. They will have some training, and the amount of that is as widely varied as the number of people there are in an organization.

As far as who is going to actually be selected to go to an accident site, if a FSDO has 20 people who work there, it may not be the most qualified person in category, class, make, model of aircraft. It may be the person, more than likely, who happened to be in the rotation that week. You may have a heavy lift rotorcraft accident and find out that you have an avionics specialist who happened to have the beeper that week, and that's what you get. If the Board or if the other parties are concerned, you can always bring that up to the IIC, the investigator-in-charge, of that accident and recommend that other expertise be brought in if that's appropriate. And that again falls to the NTSB person to determine whether or not it meets their needs for an investigation.

The FAA folks again who you will interact with have a different mandate than the Board folks. The Board's responsibility is very well-defined. Whether it's in surface, aviation, or marine, their job is to investigate accidents in transportation, determine a probable cause of that accident, and create recommendations hopefully to prevent a recurrence. Very focused, and that's what all of their people do. Accident investigation is a very small portion of what the FAA folks do. Much more time is spent in certificate management, and that may be widely varied. Again, you could be a rotorcraft company, and you may find your POI or PMI has never worked on helicopters before. It's the way the manpower allocation ends up falling out.

You do need to be aware that the Board's responsibility and the Board's authority is to run an investigation, and their purpose is very focused. Probable cause, safety, prevent recurrence. If I show up now, on site, as an investigator for the FAA, whether or not I'm working with a Board investigator or separately, doing a limited investigation for the Board, I'm wearing two hats. One is to gather data for that safety investigation, and the other is enforcement. That's the mandate of the Agency, and I'm obligated to look at a problem from both of those sides. When you're dealing with the FAA and the Safety Board in an accident situation, you have to be aware that the FAA person, if you give them information from a safety mind set, that it is indeed going to go back to that office and into two different reports. One for enforcement, if that's appropriate, and the other for what's forwarded to the Board.

FAA has an enforcement role. FAA also does has a safety role, which is another reason why the FAA folks have a legal right to be at the accident site. And also the manufacturers have the ability, when they're granted "party status", to go to an accident site, because they may bring technical expertise to the accident investigations. The other side of that coin is, if they find a problem with their product, they get real time information. They don't have to wait six months for a Board report to come out to be able to go back and fix that problem, to put out a service bulletin or a letter, to make changes in manufacturing.

From the FAA standpoint, we have the ability to address safety in an immediate fashion. If an emergency AD is appropriate, we can get with the manufacturer, we can get with the appropriate directorate and get that on the street in an immediate fashion. Or, if certificate action is appropriate because of what comes out of that, again we're onsite, real time information, and we can address the regulatory issues that come up in a very rapid fashion. As far as long-term safety issues, what tends to happen is if there's not an immediate action item that needs to be taken, most of the FAA investigations tend to lean then toward certificate action enforcement. The information is passed to the Safety Board, which then comes out in recommendation form for long-term modifications.

As far as the standard practices manual that we're working on goes, beware of what goes into it, because it can come back to haunt you. You will read about it and see it again, so it's a two-edged sword. It provides boundaries, guidelines for your own industry, for the new entrants, but that also, by becoming a standard, it will show up in all the FSDOs and will be looked at, even though it's not regulatory, as at least a guideline for how business ought to be conducted. And when you're dealing with people, again, you don't know who you will interact with on site. It could be an avionics, an airworthiness, an ops person who knows nothing about your operation. That will be the only guidelines that they have to operate from. So you're speaking to several audiences at once when that gets published.

MR. HERLIHY: Matt, perhaps you could respond and get the helicopter directorate involved here. In the investigative process we have an issue that comes up occasionally and we don't know how to handle it. It's happened in the past with the FSDO here at Juneau. We have a situation where parts are being overhauled and components of parts are being overhauled somewhere by third parties in the United States. Let's take, for instance, a 90-degree gearbox being overhauled in a facility, and the investigators both from the NTSB and the FAA look at this thing and have a question because it failed. We have a question when we go back to its records and it says it was overhauled in a repair shop in the western region. We go to the manufacturer, and the director at the same time, and ask if this overhaul process is proper? The manufacturer says that overhaul facility is not one of their approved facilities. So we get a reading from the directorate and he says, you know, you're right. It has to be done according to the process set out by the manufacturer. And this gives rise to a question. When we then go to that FAA region, and say that this may not be done according to the helicopter directorate and according to the manufacturer, and their response has been, "Well, we provide the certificate for the overhaul facility, not the directorate". And so, could you get that either answered or entered into your secret meeting? Ask how to get us all marching to the same drum and who runs the quality of the overhauls on the components. Especially as we're seeing a lot of these components in military machines.

MR. MONSCHKE: Well, the scenario that you just pointed out, Doug, is correct. The aircraft certification service has no input on the flight standards repair station activity. If the flight standard inspector in charge of that repair facility has made a decision that they're capable of doing a particular overhaul or repair, and it gets on their certificate, they are perfectly legal. However, oftentimes the FSDO inspector will come to either the directorate or to an aircraft certification office and ask for help, and we'll give them all the help they can stand. And sometimes we find in favor of the repair station, and sometimes not. A lot of things that the manufacturers say you can only do this one way, is not always true. There's many ways you can overhaul or repair parts. A lot of it has to do with proprietary information. If the repair station substitutes their own process, or a mill spec, or something that is equivalent, and provides equivalent level of safety, we usually don't have any problem with that. If they're doing something totally outside the bounds of engineering judgment or reason, then we'll probably say no. If we're involved, but it's not our call to make. It's the flight standards inspector in charge of that repair station that makes that call.

MR. THOMAS: The certification is done by the local FSDO for the 145, and the directorate is a resource to which to go for technical information or advice, but they don't sign the tickets. The notices are signed out of the local office. It is, therefore, incumbent upon the local inspector to do his or her homework.

MR. HERLIHY: The point I wanted to make maybe wasn't clear, is that the investigations often happening in one region and your inspectors from this region, say Alaska, are working hard with the NTSB investigators to sort out whether the component has been overhauled right. We have the scenario where the repair station is in yet a second region that offers the certificate. They are not in the investigative loop. They're not offering help on scene, of course, because they don't have inspectors and investigators on scene. And when we go for a technical question on whether, for instance, the repair of a gearbox is correct by putting in O-rings, new grease and paint, we would say to the manufacturer, and the directorate, is this the way to do it? The manufacturer and often the directorate say, no. This is not the way to do it. I stand with the manufacturer. But, we seem to have an unresolved

situation because it's a third and independent region that certificates the repair facility. That's what I wanted to get into the internal FAA meeting.

MR. GAYTON: I'm with the heli-logging committee and I'd like to ask you what the current philosophy in particularly the Juneau office, but also throughout the FAA, is with oversight and surveillance. The operators that you mentioned early on in your briefing, which are chasing the contracts in areas that are beyond the geographical range of the supervising FSDO. I was the broker on three of the six accidents that we had in Alaska in '93. In retrospect, my feeling was that if the local FSDO had taken the initiative to look into it, that some of those accidents would have been imminently preventable, because the operator was inexperienced geographically, and ill-prepared for the operations undertaken. Not badmouthing the operator, very successful, good safety record in things in the Lower-48 not associated with heli-logging, but with similar equipment, and we have this problem, it's not restricted to heli-logging. I mean it's industry-wide. I have EMS operators in California, that are also operating in Texas, that are also operating in Florida, and what is FAA's position about assuming oversight and surveillance for basically a foreign carrier to your region?

MR. THOMAS: I can speak to Juneau very well and, to a lesser degree, for FAA. As a result of the series of accidents that took place in this particular district in the early 90s, the Board put out several recommendations. One of them said, FAA you need to do more surveillance on these operators. It was recognized that the certificates are geographically held somewhere else. The FAA has said, FSDOs in general will perform geographic surveillance on operators that are transient to your area.

Last year there was an influx of some extra funding specifically earmarked for helicopter logging surveillance in this district, and in the other districts by our region. That is a uniform policy. As the camps are starting, we intend to ramp up, do spot checks, notice and no notice, and try to increase that surveillance. It becomes a man-hour limitation at that point, but we did do more last year than had been done the year prior, and certainly during the time of those accidents there was very little until a problem rose up and made itself apparent. The policy is, yes, do more geographic surveillance.

MR. GAYTON: Particularly of the non-domestic operators?

MR. THOMAS: Well, not just that. I would not say specifically the non-domestic. I wouldn't say that the folks who are based in Juneau, other than what took place in town, would be visited any more than anybody else out in the camps, just because of the remoteness of the sites.

How may times does George Warren see a Fed show up on a site that you can't drive to?

MR. WARREN: Well, we've seen more in Southeastern Alaska in the last year than we've seen anywhere else in all the preceding 20 years.

MR. THOMAS: You know, the logistics of getting there are such that we either hitch a ride with the operator or rent a floatplane, or we go and grab a helicopter. It creates some logistic problems, but that's our problem, not yours, and as long as we can come up with the hours and the money to get the people to go, the intent is to do so.

MR. KEMP: What happened here in Alaska, as far as oversight, really wasn't any different from what I'd experienced in the Lower-48. The only time we'd ever get ramped was passing through an airport,

and that was very unusual, or if you go to a lift job, where you have a lift plan filed, they'll come and ramp you. But the interest in part, comparable to the accidents that occurred in Southeast Alaska, was what went on in South Carolina when we all worked there after Hurricane Hugo, and there was just a spate of accidents in that area involved in logging. I mean it was very similar to what was going on here, and in that whole time there I never, ever saw anyone from the FAA. And we were working within a 10-mile radius. Drive down Highway 17 and we were all there. And I don't know that what happened in Alaska was that unique. They responded to the accidents. That was where the demand was. And as far as oversight to everyone else, you couldn't find them.

MR. THOMAS: And, in response, I think that's probably a typical experience that most people have had, regardless of your piece of the aviation industry. Until a problem becomes apparent, there's not a problem. The FAA is a fairly large organization, it does not necessarily move real fast. I think that's the nature of the business. There has been headway made in this particular industry. We've gotten, thanks to the sound beating that the Safety Board placed upon the FAA several years ago in this particular topic, money specifically earmarked at least to try to address some of the issues that go on with helicopter logging.

Given that you're going to probably see us onsite here and there, if there were line items that were more beneficial for you as a manager to get some feedback on for what we see at your operation at some job site, what you would want to have spot checked? Because that's what it is, it's a spot check. For you guys it's a free audit, maybe a free audit, depending on what we find. But, it has the potential to be a free audit and you're not paying some high priced hired gun like Doug Herlihy to come in and do it for you. You're getting us on the dole. Give us some task direction. I, certainly out of Juneau, would rather be as productive as possible, and help you as well as myself. If you've got something you want us to ask for, or to look at, tell us.

MR. FORTY: . You said earlier, somebody that may come out may only have avionics experience to investigate the accident?

MR. THOMAS: Yes, sir.

MR. FORTY: They have no power train or frame expertise?

MR. THOMAS: May or may not.

MR. FORTY: It just paints a bad picture for me, for the guy that's going to do the investigation of an accident if his only expertise is in say, radios, avionics. Is there anything the FAA is working on to get somebody in the field that possesses the appropriate expertise?

MR. THOMAS: It is purely local management driven. You have a pool of bodies, and a manager can assign them however he or she sees fit. I heard of a relatively bad experience with the Jet Ranger story, as far as maybe not having the appropriate expertise looking at a problem.

MR. FORTY: It just paints a real bad picture for me. Any of us that have an accident want to see it dealt with properly. We want to see, if there is a problem, that we'll all want to fix it safety-wise, but if we're relying on somebody that's only with avionics experience, I mean it's painting a bad picture for me.

MR. THOMAS: You may get somebody without the appropriate expertise, and it may or may not be intentional. It may be an oversight. If you see an expertise problem, there is nothing that prevents you from bringing that up to the IIC, the investigator-in-charge. There's nothing that prevents you from calling the manager of that local FSDO and saying, "Hey, this is a constructive recommendation. We've got a problem. We might not have the best personnel match. Can you help?"

MR. FORTY: I see it happening.

MR. THOMAS: It has happened before; it will happen again; it will happen forever. When we're dead and gone, that kind of a mismatch will take place. Hopefully not always, hopefully not very often at all, but it's a reality.

MR. FORTY: But you're going to be more reluctant to give information if you know this fellow has only got an expertise in one field. I mean, I'm just not comfortable with it. I don't know, it'll probably never happen. It's government. If the person that comes out could know the whole scenario. Can you get a pool of them? Or maybe this isn't the way it operates. I'm not sure how the FAA operates.

MR. THOMAS: Your comments are very on target. I don't have a good answer for you. I will take your comments back, at least to my office internally.

MR. FORTY: It's just such a gray area to me, if the fellow that shows up doesn't have the expertise.

MR. THOMAS: And you guys, as business owners and operators, you have a stake in it, and if you don't think what's going to happen is going to be appropriate...

MR. FORTY: Then we'll have to speak up.

MR. THOMAS: ...you've got to speak up. If you have a red flag, raise it. The worst thing that will happen is the person you're dealing with will say, thanks for your input, but I choose to disregard it.

MR. FORTY: And then I just don't want to get into upsetting the fellow that's there if you don't feel he's proper, but I guess that's all in professionalism. You'd have to deal with that in the field.

MR. THOMAS: It's personality driven. You've got the full spectrum. But we're walking into a group of people who this is the single most emotionally shattering event, probably of their whole life. And they are going to be timid. People immediately aren't sure what to make of who walks into their house. You never make points by upsetting your local FSDO.

MR. FORTY: I guess that's what I'm saying. That shouldn't be the feeling.

MR. THOMAS: It isn't, but it's a natural one that you would experience if you were there. And the best thing I can say is, professionally bring up your concerns. I mean, if you look at the spectrum of people who are at a FSDO, and most of those offices run a strict rotation. And the next guy in line is the one that gets the beeper for the week, and it could be any specialty, you just don't know.

MR. MONSCHKE: For you, Doug Herlihy, that question you just asked, it's going to have to be a separate issue because the FAA only meeting we're having in the next couple of months is going to be on life limited parts only. I would suggest that you could get John Hammerschmidt, or somebody in the NTSB to make that a safety recommendation, or maybe get Matt, or a FSDO inspector, to write it up as a safety recommendation. But please define the problem in detail, because it's a cross between flight standards and the certification service, most likely, and it'll be a difficult issue. That'd probably be the best way to handle that.

I'm up here to make a plea to restricted category military surplus TC holders and people who operate those aircraft. Getting back to that problem of gearboxes, please be aware that the military had a lot of breakout parts on their aircraft. A breakout part is when the military buys an aircraft from a manufacturer, all the data that goes with that aircraft, all the drawings, engineering reports, flight test data, everything. After a few years, when they get comfortable with working on the aircraft themselves, when they start needing spare parts, instead of buying those spare parts from that original equipment manufacturer, or one of their qualified FAA vendors, they will take the drawings out to the public and ask for bids. Normally you get the low bidder. We have found people out there making parts that don't even know what "heat treat" means. They're making a life limited part that's got a tolerance of .001 and they make it to .01. Guess what? You just cut the life of that part probably by 90 percent. So, we have failures out there. So, if you're replacing parts on your CH-54s, your S-61s, any ex-military surplus aircraft, please be cognizant of where you're getting parts from. I know it's a problem, because a lot of the OEMs don't support spares anymore. But, if you're getting breakout parts, I would definitely give those things a very good incoming inspection before I used them. If it was up to me, and I was one of you guys flying those things, I wouldn't fly in a helicopter that had a breakout part on it. I want original equipment.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

By Ron Tsunehara, Compliance Officer, Occupational Safety and Health Administration

Let me give you an overview about OSHA in Region 10, the Pacific Northwest. Region 10 covers the states of Alaska, Washington, Oregon, and Idaho. OSHA maintains an office in each one of those states, and has jurisdiction over federal employers that have employees where other federal agencies do not have jurisdiction. For example, if the FAA has jurisdiction over a certain area, and has standards and enforces safety in those areas, then OSHA does not have any jurisdiction. That's true with any federal agency.

OSHA also has an agreement with three states in the Northwest -- Alaska, Washington, and Oregon. These states enforce the safety and health regulations over certain workers. Federal jurisdiction exists in all three states; however it's very minimal. In the State of Alaska, the federal jurisdiction extends mainly to navigable waters. It has jurisdiction over shipyards, long-shoring operations, and fish processing that takes place on the waters. I believe the only place where OSHA has jurisdiction over logging operations is on the Island of Metlakatla. OSHA has jurisdiction over the Native American operations. The State of Alaska has the majority of the jurisdiction for the logging industry within the state.

The State of Idaho is the only state in the Northwest where the federal agency has jurisdiction over all employer logging operations. There is no state operation in the State of Idaho. The States of Washington and Oregon are very similar to Alaska. So basically, the State of Alaska has the majority of the jurisdiction over our logging operations.

In the area of standards, the states must adopt standards that are at least as stringent as federal standards. The federal government did not have logging standards until October of 1994. Oregon, Washington, and Alaska had their own logging standards, which they effectively enforced prior to the adoption of the federal logging standards. In October of '94, OSHA issued logging standards which did not cover the use of cable-yarding systems. The national office, which adopted the standards, decided that the states had standards that would cover cable-logging and, therefore, did not add them to national standards. The States of Alaska, Washington and Oregon all have cable-yarding standards.

There are no specific standards for helicopter logging; however, there are two federal standards that would apply. First is the helicopter standard under 1910.183. This standard covers the use of helicopters in general and has been in effect since 1971. The second standard is the new logging operations standard, 1910.266. This standard was adopted in October 1994.

Standard 1910.183 says that you shall comply with the regulations of the Federal Aviation Administration. It requires that you have a briefing on your operations daily. In other words, all those involved in the helicopter-logging operations need to discuss what's happening on a daily basis. There's a requirement for the testing of electrically operated cargo hooks daily by a competent person to ensure that the release should be able to release mechanically also. There's a requirement for eye protection and hard hats for the people on the ground. There's a requirement for housekeeping at the landing area and for keeping loose articles within 100 feet of the wash secured or removed. I know that's awfully hard in some instances. There's the requirement that the load be safely slung, and that the weight limitations of the airplane be enforced. There's a requirement for communications of everybody involved.

The standards are really very basic requirements. They're pretty much common sense items that I'm sure most of you have been using all along.

The logging requirements contained in 1910.266 are those that would apply to helicopter-logging operations. This standard identifies certain personal protective equipment that the employer has to provide. The personal protective equipment required, includes gloves, head protection and eye and face protection. OSHA also has a standard for first aid kits and fire extinguishers. (The OSHA standard itself lists those components of a first aid kit that are required.)

OSHA has some requirements for environmental conditions such as high winds and heavy rain or snow. If conditions are such that you can't do the operation safely, then you are required to stop operations. OSHA also has requirements for the storage and use of flammable and combustible liquids, a requirement that the deck area have enough room so that the employees can move around safely and do their work, and a requirement for the training of employees. (OSHA has a separate requirement for first aid training and CPR training.) So again, these are really basic requirements for the logging operations.

I'm glad someone mentioned the fact that these are really minimal standards. You have to understand the standard promulgation process to understand how much OSHA gets into its standards. Whenever it issues a standard, it puts out a notice of proposed rule making and asks for comments. In order to have a standard, OSHA must show there's a risk and that the cost of abiding by the standards is not going to be extreme. So in the development of the standards, there's a lot of tradeoffs before the final standard is issued. There are some things that OSHA would like to get in it standards that it is unable to, because of political situations and because of the costs involved. So again, these are really minimal standards, and we at OSHA would encourage everybody to go way beyond OSHA requirements.

For enforcing these standards, OSHA has a compliance directive. It's called CPL 2-1.19, and it gives instructions for the inspectors on what to look for when they do inspections of logging sites. There is nothing in there about helicopter logging. It's mainly about the logging operations and the typical logging side.

OSHA sometimes writes its standards in general terms to give you leeway in meeting them. If you write OSHA regarding a standard, we respond with a letter of interpretation. If you ever have any question regarding a standard or compliance with a standard, write us for our interpretation. If you write OSHA, we will always write a letter back explaining OSHA's position.

REGULATIONS AND STANDARDS IN EXTERNAL LOAD OPERATIONS

By Don Study, Former Director, Labor Standards and Safety, AKDOL

Regulations provide a level playing field for all the actors. Everyone has to abide by the same requirements within the industry. We find, in construction and other fields as well, that there's always some new player out there trying to cut corners, trying to come in with a low-ball bid just to get the contract, by not complying with safety standards. They may go out of business, but their losses hurt the industry in the long run because the industry takes the blame. That death or that property loss is attributed to the industry as a whole. Also, the insurance rates apply to the industry as a whole, and everybody's insurance rates go up because of it.

I don't know exactly how the FAA comes up with some of its standards and regulations, but the majority of the OSHA standards came from industry. When OSHA was first formed back in 1970 with the Occupational Safety and Health Act, most of the standards and regulations it enforced were initiated by industry. For instance, one industry had been demanding a confined space entry standard, because there were too many people dying in confined spaces in the United States. But how long do you think it took federal OSHA to develop a confined space standard? Fourteen years! Fourteen years after the industry asked, the agency finally came out with a standard.

If an industry could self-regulate, I'd say that's great. But if that's not possible, government regulation may be the only way to accomplish the control that you need. I say again, the losses hurt the whole industry, not just one operator. We all are affected by insurance rates, reputation, and so forth.

The Alaska Safety Standards are covered in the logging code, 07.175, paragraph (a) through (d)(2) (Appendix, page 115). Unfortunately, the code requirements do not always reflect the realities of the field. For instance, the code reads, "Helicopters must comply with any applicable regulations of the FAA. Every practical precaution must be taken for protection of employees from flying objects in the rotor downwash. All loose material within 100 feet must be secured."

How do these regulations fit the reality? Because the Forest Service doesn't want certain trees removed, the sales are getting smaller and the landing sites are getting smaller. Now we see rotor wash with 70-80 mile an hour winds in a smaller and smaller landing zone with people down there next to danger trees. You're supposed to secure everything?

The code also states that, "Whenever approaching helicopters while running, individuals shall remain in full view of the pilot" and requires that, "Employees shall avoid cockpit rearward unless authorized by the operator to work there." The reference is to maintenance people. We just had, late last year, a situation where an individual asked a helicopter pilot for a ride. The pilot, who was refueling, said "Yeah, I'm going to be leaving in just a second, so hurry up." The passenger appropriately went to the rear of the aircraft but walked right into the tail rotor and sustained immediate, fatal injuries.

Again the code states, "Air crew and ground personnel shall receive instruction in proper communication, either hand or radio." This regulation ignores the fact that the logging company and the aerologging company are two separate entities. One company seldom employs all field workers at a logging site, so there needs to be an interface between those two companies to ensure that all of the employees do have adequate training.

Another section of the code states that, "Flight path shall not be above employees. Weight of load must not exceed manufacturer's rating. Helicopter operator is responsible for size, weight, and manner in which loads are connected. If, for any reason, lift is unsafe, lift shall not be made. Landing zone must be 125 feet from loading area." The FAA may not agree that the State of Alaska has authority to enforce these standards, particularly ones related to operation of the aircraft. It's my understanding that anytime the operation of the aircraft is involved, FAA regulations preempt federal or state OSHA. As far as ground personnel and operations are concerned, federal and state OSHA have control, but not in the actual air operations.

Another part of the code requires that, "Certificates issued by, and governed by, the district office in the pilot's residence area have jurisdiction." Jurisdiction of remote locations, routinely, are not handed over to the local office. If your certificate was issued in Salt Lake City, jurisdiction remains with Salt Lake City.

In my previous experience, I judged that what was happening at remote locations was never looked at by the FAA. In fact there was one situation in which the location of a camp was unknown. We had to relay the appropriate information to the people involved so they knew where their operations were and could go check them.

Many accidents occurring in Alaska can be linked to a violation of one or more of the following regulations:

> "Operator must be or have services of a commercial or Airline Transport Pilot (ATP) available. Chief and assistant chief pilots must be commercial or ATP."
>
> "Chief or applicant must demonstrate proficiency to FAA. Compliance not required of previous experience, and safety records show knowledge and skill are adequate."
>
> "Only if one is a crew member, is a trainee, or performs essential functions, is one allowed on the helicopter." I didn't see any provision for carrying passengers.
>
> "Demonstration may be made to the chief pilot, assistant chief pilot, or in a logbook entry indicating flight check or a letter of competency."
>
> "It must not exceed the total weight approved for the rotorcraft."

These regulations illustrate the maxim that what regulations do not say is just as important as what they do say. What minimum hours are required for pilots, other than chief pilot or assistant pilot, to qualify for commercial or ATP standing? There are no limitations on flight crew hours. However, we know from research on human factors that too many hours in the cockpit puts the body and mind on autopilot. The individuals are there physically, but not mentally. Notice, too, that regulations do not require any inspection by the FAA office where the logging occurs. In fact, regulations do not even require the chief pilot to be at a remote location.

There's no requirement for increased maintenance to meet the increased cycles and wear on the aircraft.

There's no commercial or ATP requirements for the pilots in general, other than those for the chief and the assistant chief.

No requirement seems to exist for adequate maintenance facilities. In Alaska especially, we are affected by harsh operating conditions and bad weather. Around Southeast you get a lot of saltwater, a lot of salt spray. If you don't think that goes very far from the beach, live in one of these communities up on the hill. You'll be washing salt spray off your windows 300, 400 feet up from the water. It travels a long distance, and will affect logging operations.

Quality of pilots, as far as I can find in the standard, is totally dependent on the company's ethics and standards. Some of the insurance standards may require specific hours and specific training, but it isn't discussed in Part 133.

In the demonstration of a typical operation to the FAA for external load operations, there's no requirement other than what was given to the FAA at the home office. If the conditions change in a remote site or if there are different operational parameters, the FAA will not take that into consideration with the certification process with the companies.

One final concern about FAA policy is that when we first started dealing with this issue we questioned why there wasn't more involvement, more regulations. And the individual I was talking with referred to the pilots, saying"They know it's hazardous when they get into helicopter logging." I hope that was just that individual's thoughts and not the attitude of the agency as a whole.

In my opinion, helicopter logging can be accomplished safely, but only with sound safety practices. I've heard some of those sound safety practices already voiced in this room. The extraordinary hazards associated with this type of flying demand the highest standards in pilots and equipment.

QUESTIONS AND ANSWERS

MR. RANDY ERWIN (Erickson Aircrane): Earlier I asked a question of someone else in here about the first accident we discussed this morning. So many things about that accident were gross. The question was, how is it that the FAA allowed that operation to continue? But the State of Alaska has the same regulations. Although it's unclear whether or not they can regulate an operator while he's in the air, they could certainly take away his business license, or impound his equipment to make him cease and desist if he's violating the state regulations.

MR. STUDY: The problem is with the state regulations. If we don't have jurisdiction they're not enforceable.

MR. ERWIN: So, basically, this section of the Alaska Logging Standards that has to deal with helicopter logging that we're talking about, is unenforceable even though it's part of the standards?

MR. STUDY: I would question its enforceability as far as actual flight operations go. Anything on the ground is another story.

UNIDENTIFIED VOICE: And the question I would have is, why can't a state enforce it? As I understand it, as a matter of law, a state can promulgate and enforce a regulation that is equal to or more stringent than a federal regulation.

MR. STUDY: We can have standards that are equal to or greater than federal OSHA and enforce those standards. But, if we are preempted by another federal agency, that federal agency takes primacy over enforcement.

MR. MARK LINDAMOOD (Carson Helicopters): In Oregon if you break regulations, hard hat regulations or high visibility clothing, the first time you're fined a certain amount. One way of controlling operators who are violating safety acts, is to fine them. Fine them again, and then take it to court if they don't want to pay it.

MR. STUDY: Yes. That's based on ground operations.

MR. LINDAMOOD: It has nothing to do with flying?

MR. STUDY: Flying is FAA's jurisdiction.

MR. LINDAMOOD: But your regulations are speaking to flight and ground operations. That's where I'm confused. The regulations you're saying are enforceable are speaking to ground operations. In fact, we have many of those same regulations in Oregon, and they are enforceable; in fact they *are* enforced.

MR. STUDY: The regulations I was referring to were concerned with weight of the load. It may not exceed manufacturer's specifications. That's an FAA rule.

MR. LINDAMOOD: That's taken from 133?

MR. STUDY: Yes. Helicopters must comply with any applicable FAA regulations. That's enforced by the FAA, not state OSHA. If it pertains to ground operations, state OSHA will enforce it, and has enforced it.

UNIDENTIFIED VOICE: It seemed to me that you were possibly advocating a little more regulation to clean up our act. My point is, the regulations are there now. If people are held to task to follow those regulations, a lot of these problems may not have occurred.

Now, if a gear box is going to fall off a helicopter, I don't know if that's because the pilot was continually over-grossing it or not, but the regulations are there, and a lot of these things wouldn't have happened if people had been following the regulations, or if the agencies responsible for enforcing the regulations had done their job.

Maybe we need to change the enforcement structure, rather than adding more regulations.

MR. STUDY: When we first got involved with this, the FAA didn't even know where you were located. They didn't have a clue where you were.

MR. LINDAMOOD: But we're not talking about the FAA, we're talking about your state agencies. And it says in one of your regulations, that you can't exceed the helicopter's manufacturer weight ceiling. If that's in your regulations the state should be able to enforce it. If a state inspector walked out to one of these sites and picked up a bunch of cycle sheets and saw that they were overloading the aircraft 14 times a cycle, why doesn't he fine somebody before a bunch of people are killed?

MR. STUDY: The main reason was jurisdictional. Our folks, at the time I was there, did not investigate helicopter accidents. The National Transportation Safety Board has the responsibility for investigating those accidents, and the FAA has the responsibility for the enforcement of their regulations.

MR. WARD WINTER (Canadian Helicopter Logging): I think most of the pilots who have been around a while have all been in those operations before. In some of them I've wondered how the guy I was working for kept operating. I was doing it because I needed a paycheck, but I was waiting for the FAA to come along and slap his hands. I don't think we need more regulations; we need to enforce the ones that are in place. Whether it's a state agency, a federal agency, or anybody else, somebody has to have jurisdiction. I know a pilot who had his license jerked after he killed about 40 people. The next day his wife had the certificate and he was back in operation. It's criminal sometimes.

MR. STUDY: I'd like to ask one more question of everyone. Who would you suppose would have the best answer for solving all the problems we've talked about, as far as losses that have been experienced within this industry? Who is best suited to come up with those answers? It's not the FAA, folks. It's the people sitting right here in this room.

UNIDENTIFIED VOICE: It's a panel of operators who have been operating for 20 years with a decent safety record.

MR. STUDY: It's the people sitting right here in this room. I looked over the list of everyone attending this meeting. The solution to this whole problem is sitting right here in this room.

UNIDENTIFIED VOICE: That's today. But the next time you have a good log market, every "gypo" who can buy a UH-1B will be in there logging. We don't have any control over them except to say, "I'm not going to fly his aircraft."

MR. RON SMITH (Erickson Aircrane): And we go one step further. You can't pin this on the FAA. We're talking about operators going over long distances with no regulation. But, within this system is another huge anomaly. Surplus aircraft that are restricted category do not require an operator's certificate.

MR. STUDY: I feel this is the industry right here, and the members that need to find the solution to that problem. If there's no other way to do it, there's always the option of the industry itself asking for a regulation, written as the industry wishes.

ALASKA DEPARTMENT OF LABOR

By Cliff Hustead, Safety Consultant, Alaska Department of Labor

I represent the State of Alaska Occupational Safety and Health (AKOSH) which is part of the Alaska Department of Labor. I worked in the wood products industry for approximately eight years before I went to work for the Alaska Loggers' Association for approximately seven years. I've worked for the State for approximately eight years as both an enforcement officer and as a safety consultant. I was a safety specialist in logging for the Department for approximately five years. Currently I'm a safety consultant, but I have all industries from Cordova to Ketchikan. As part of my duties, I've traveled throughout the State looking at different operations, both helicopter and high-lead operations.

I heard somebody ask earlier, "How often are these companies being looked at?" Well, AKOSH inspects companies about every three years, but only two safety consultants look at logging -- one for the northern region and me in Southeast Alaska. There are approximately 60,000 employers in the State of Alaska, so AKOSH is spread pretty thin. We've got one enforcement officer to cover all Southeast Alaska. Last year I think he did three general scheduled inspections of logging, and there were no helicopter operations inspected that I'm aware of. So, you're asking how much enforcement? Very little!

With so little enforcement, you might ask, "Well, how come there weren't any fatalities in logging last year?" I think a lot of companies came to the conclusion that it takes a safe and productive operation to stay in business. I think a lot of the companies are also hiring their own safety professionals. They're bringing in private consultants to work in their operations and they're cleaning up their own acts.

Also, we are seeing a lot of companies, especially helicopter operations in the last couple years, that are very professional. They're bringing in safety personnel and training their people. They're doing a lot of things that helicopter logging companies initially weren't doing. They're doing maintenance, training, and conducting on-site inspections.

Before this change in policy occurred, one of our biggest complaints had always been that many companies had some of their most highly trained individuals delivering parts to the logging sites instead of out there training employees like they should.

We all know from experience that supervisors should be setting up the safe landings, working with the Forest Service and private industry in setting up sites in a safe manner, and doing the engineering that's necessary to make it safe before they arrive on site. We know that sometimes the ridges are too steep for the fallers to even fall the trees, that occasionally the helicopters aren't able to pick up the logs because they are too heavy, and that there are many logistical things that need to be done from an engineering standpoint and from a planning standpoint before operations begin.

AKOSH tries to work with many agencies -- OSHA, the U.S. Forest Service, Department of Natural Resources, the U.S. Coast Guard, and NIOSH -- in developing materials. Roger Lansden (Columbia Helicopters) mentioned earlier that when it comes to safety, you should exchange information with everybody. There are no trade secrets when it comes to safety information, at this forum, at a safety

conference, or a company's safety program. We all have to work together as a safety team, to make everybody aware of not only the regulations, but also the industry practices.

Ron Tsunehara (OSHA) was up here talking about the new federal regulations. We have state regulations also. In fact, this last year we cleaned up our state regulations and finally eliminated the wood spar sections. We cleaned it up to coincide with the federal requirements, because as of December 6, 1995, we're using the CFRs or federal regulations to go by in the State of Alaska. We use the federal CFRs and addendums for state-specific codes.

I was very impressed by what Roger Lansden (Columbia Helicopters) said about Columbia's training program. Some companies don't have a training program. You ask what criteria does the state or the federal government have to monitor this? To be honest with you, there's very little. The codes state that employees have to recognize the hazards of their particular job. They have to be trained in the specific state and federal codes. But other than that it doesn't say much. It's like one individual said earlier, you could probably train employees in one day in all the elements the codes require, and you would probably meet the minimum requirements. But, you have to remember, most of the codes that are set up today are performance based. If you perform, and you have a good, safe operation, OSHA's probably not going to question the training too much. But if you get employees hurt and killed, you're going to get looked at more by OSHA. They're going to come in and look at your operation with a fine tooth comb.

I recommend you regulate yourselves, inspecting daily, monitoring safety programs, and using proper safety procedures. Some companies out there won't regulate themselves, and OSHA will need to regulate them until they go out of business. AKOSH has approximately 20 inspectors in the state covering 60,000 employers. Recently we were cut back 15 percent and had to let five inspectors go. If the State legislature decides to only fund at the level that it did before, we will cut back another five inspectors, so there will be only 12 to 15 inspectors throughout the whole state, covering all the employers.

When I started to work in the safety field 16 years ago, I told myself that I was going to continue to do this job until we had no fatalities in logging and the number of all other work-related deaths were reduced significantly. Well, we did go a year without a logging-related fatality, and I was very pleased. I think a lot of people should be patted on the back because they did do an excellent job this year in their safety programs.

I wanted to talk about the Alaska Department of Natural Resources and private industry working together to come up with a guideline for reserve trees, dead trees, and snags. The guideline is established for high-lead yarding and helicopter logging. A lot of helicopter logging is select cut, which means only a select amount of trees is taken out of a forest. When that is done, it's not just cutting down the harvestable tree, but maybe cutting three, five, or more, just to get that one tree down safely. This is one area where we worked together.

I have copies of this guideline. If you have danger trees, snags, or whatever in an employee's work area, you can look at the guideline and follow it. The agencies and the industry have all agreed to go by the guideline.

I'm not going to say helicopter logging is more dangerous or less dangerous than high-lead logging, because I think there's inherent dangers in both of them. One thing that the federal and state codes require is training of employees. Employees need to be trained in the general safety considerations of their jobs, and safety codes relating to their work. The training has to be documented. Whenever you do training for employees on hazards of their job, codes, or whatever, it must be documented in their file. Let's say that an individual violates a safety code -- doesn't wear his hard hat, doesn't wear his fluorescent vest or whatever at a landing area. The company is supposed to retrain that individual and document that he's received that training.

Sometimes, rather then provide training, it's better to have certain skills be a condition of employment so that employees have to have it before they come to work. For instance, all employees in logging need to have current first aid and CPR training. Logistically that's a pretty hard thing to do when you've got a camp 50 miles from town.

We also require a stretcher, blankets, splints, and first aid kit. The federal code says within a half mile, while ours says within a quarter mile. In helicopter logging it's at a landing area. That's all fine and good if the weather conditions are good, and if the helicopter's running well. But what if, whether for maintenance problems or weather problems, the helicopter can't fly to the workers, and all of a sudden there's an injury. Canada has a law that says the first aid equipment has to be within 20 minutes walking distance. The helicopter companies need to have emergency equipment right out on-site with the employees.

The new federal logging code says you have to wear heavy-duty logging boots that are chain-saw resistant. What does that mean? I've asked the federal inspectors what chain-saw resistant is. According to the Federal Register, steel-toed boots won't work because they only protect the toe. It says ballistic nylon or equivalent. An interpretation by the Washington Contract Loggers' Association is that heavy-duty logging boots would suffice. Employees don't need steel toes, and they don't need Kevlar. Single layer, high top, heavy duty logging boots are sufficient with calks in them.

Most federal codes are performance based. If you found in your operation that you were having injuries to the feet from chain saws, then you might be required to have ballistic nylon in your boots. If you have employees with quick reactions, you won't need Kevlar boots.

In helicopter logging and high-lead logging, the ground is getting steeper. The other day I went and looked at a slope that was approximately 58 percent. How are cutters going to buck those trees on a 58 percent slope safely, especially when you don't have a lot of stumps in the area to keep the trees from rolling down on the workers below? This is something in the planning stage that we need to think about when we're setting up a logging area.

Before a tree is felled, somebody that is competent needs to check the slope and other safety factors. A lot of companies hire someone who has never cut timber in his life, and send him out there to evaluate the slope of the ground so a timber faller can cut that tree. Just because a helicopter can get in there to log it, doesn't mean it will be easy for the ground people to cut those trees safely, unless they can be hauled out tree length. You might have to just fall the tree individually, fall it down the hill, let it land, and then have someone go down and buck it safely.

We've had a couple fatalities in helicopter logging on the ground with people working too close to machines. Not having good communications, and having several different contractors working in one area can cause safety concerns.

If you're going to set up a logging operation, you need to plan, from one step to the next, to have a successful, efficient and safe operation.

QUESTIONS AND ANSWERS

MR. KLATT (NIOSH): I have a question for Cliff and Ron. If you were out doing an inspection, and you see an FAA infraction, what can you do and what do you do, seeing how you don't go above the ground level in your job responsibilities?

MR. HUSTEAD: Well, in my specific job right now, as a consultant, what I'd probably do is inform the company of the infraction, and if it went ahead and fixed the problem on site, that's as far as it'd go. I'd probably put that in my recommendations in my report, and as long as they corrected it, there'd be no further action.

MR. TSUNEHARA (OSHA): Yeah. We would bring it up with the employer, but then we would probably make a referral to the FAA and tell them what we saw.

MR. MANWARING (NIOSH): Jan Manwaring. Just a question to OSHA, AKOSH, and FAA. And also, I guess part of the question also goes to the operators and the companies as well. Would it be a help or a hindrance to team up an AKOSH or OSHA inspection with FAA?

MR. HUSTEAD: Well, I think it'd be helpful. I'm not real familiar with their regulations, so it'd probably help to go out on an inspection with them, just to see what they look for. Then if I did see a problem like that out in the field, at least I could make the employer aware of it and try to have the situation corrected. So, I think, in that sense, it would be a real benefit.

MR. TSUNEHARA: I think it would be very beneficial, especially in those gray areas possibly where the jurisdiction might overlap. We could straighten out the jurisdiction right there, and those things that FAA covered would be covered by them, and those things that would be covered by OSHA would be covered by us.

The only problem I might see with that is the OSHA inspections have to be unannounced inspections. It would take some coordination with the FAA, and so that everybody understands how we'd go about doing it. In a fatality, of course, it's a different situation. We probably would make contact with the employer, make sure that everybody was there that we wanted to see, and then go on site. It would be really helpful to have the FAA along if it involved a helicopter.

MR. WALLACE (FAA): As part of the Vice President's initiative to reduce regulation, there's been a number of programs within each agency to reduce regulation. And also we've been working with OSHA headquarters to reduce overlap, and 1910.183 was one of those points. I think you're going to find, that on the next revision of the OSHA regs, I think the whole thing's going to be deleted.

Also, as far as the FAR regulation of Part 133, what we've referred to as the aviation review advisory committee process, we've already looked at Parts 27 and 29 that deal with aircraft certification and external load certification. Those portions have been completed and we're getting ready to go into the operational side, which is Part 133. We are very concerned about the FAA's budget. I don't know how many of you folks who were at HAI last week were at a meeting with the administrator. The FAA administrator came out and said that as of December 31st four taxes that helped fund the FAA disappeared. And right now the FAA is competing with every other federal agency to try to get a piece of the pie that's referred to as the discretionary fund, which is the operating fund. And right now, out of the entire federal budget, you're looking at 5 cents per dollar for operating funds. So everybody's looking for a piece of the action out of that. The operators have been told FAA has reorganization bills before Congress right now, and one of the things that the entire industry has to be aware of, is that you might have to pay for the pleasure of FAA oversight in the near future.

DR. CONWAY (NIOSH): I have a couple questions. Is there currently any reporting or courtesy sharing of ramp site locations between you all and FAA?

MR. HUSTEAD: To be honest with you, there hasn't been much AKOSH involvement out there lately.

As we keep getting fewer and fewer inspectors, there's nobody out there to report where these people are working. When we do see somebody out there that is doing that type of work, we pass it on to the appropriate people.

DR. CONWAY: The second question, it really has two parts. The first, the green sheet, the NTSB safety recommendations from June 17, '93, A-93-80, which has the last paragraph having to do with the maintenance oversight responsibilities basically being transferred to the FSDOs in the geographic locale, I was curious, what is the status of the response?

The reason I'm asking the question is that this is one of the kernels of the concern that's being voiced about oversight and follow-up, and certainly the notification process within the locale versus the certification site is one of the critical, potentially critical events in working this out.

MR. HAMMERSCHMIDT (FAA): I just wanted to say for the record that I'm not sure what the official status on that recommendation is. We will find that out for you for in the morning.

One very important point I wanted to express to this entire group, is how rewarding it is for someone from the National Transportation Safety Board to see such importance attached to our work, as reflected in the analyses that have been done by NIOSH these past few years of our accident reports; to see the wide dissemination of these recommendations with their full description in all of your packets today, and also just the importance attached to it here in this workshop. It's just very heartwarming to those of us that do put a lot of our efforts into these work products to see them actually being utilized.

I know that, generally speaking, at the Safety Board, a lot of our investigators out in our nine regional offices, which stretch from Anchorage to Miami, from New York to Los Angeles, expend a lot of time in their lives investigating all of these more or less general aviation type accidents. And oftentimes one hears them making comments, "Well, I wonder if what we're doing does any good, has a final positive result"? Because sometimes the accident investigations are repetitive. If our regional investigators in

particular could be here at this workshop and see the interest in these safety recommendations and these investigations, I think they would be very, very pleased.

DR. CONWAY: Does the Forest Service routinely notify the FAA FSDO of sale results for logging sales that are going to have helicopter yarding operations?

MR. JOHNSTON (U.S. Forest Service): I doubt it.

DR. CONWAY: Because it certainly seems like one efficient way of getting the information from point A to point B. I don't know if it's ever been discussed.

I want to pose a question to Mr. Wallace. Is it possible to just work out some transfer of information so that the local FSDOs at least have the knowledge of where the sale sites are so that at least there is the opportunity to follow up locally?

MR. WALLACE: We have been involved in a number of the interagency committees. For example, the ICAP. There's a lot of communication between agencies, especially where there's some kind of an overlap like this; therefore, this is completely doable, yes.

MR. MANWARING (NIOSH): The earlier question I had about the team approach of an inspection, how does the industry feel about it? I'm assuming FAA would be favorable to that approach.

MR. HARPER (Erickson Aircrane): I don't think the team approach is a good idea.

What we're talking about is apples and oranges, I believe. OSHA has it's place, it has a job, it has a purpose, and they investigate and regulate certain things. The FAA has its place as well. You wouldn't even be dealing with the same people, quite frankly. An OSHA investigator would come out and would deal with the logging superintendents, and project managers, and woods bosses, and people on the logging site. The FAA would be dealing with the maintenance people and with the pilots.

You know, I heard one of the comments made that if OSHA spots an FAA violation, or an operational violation with an aircraft, should they report it to the FAA? If they can recognize it, I would suggest that they do so. However, one assumes a great deal of training, A, and regulatory knowledge, B, for which the OSHA inspectors are not designed, nor would an FAA inspector be appropriately trained to recognize certain OSHA violations. They're two entirely different fields, and they're apples and oranges.

We have this melding in the industry of these two separate functions, and there is overlapping in the sense of common sense, but I'll illustrate very quickly one point. My company just received an OSHA violation for the way we were fueling an aircraft. There's an Oregon regulation that says that the fuel nozzle must be electrically bonded to the aircraft. They took umbrage at the way we were bonding the fueling equipment to the aircraft. In fact, we use a single point, closed fueling system which, by its very nature, electrically bonds to the aircraft. The other point was, they said the aircraft wasn't grounded. Well, an S-64E and F Sky Crane, both have a grounding wire that is a functional part of the aircraft that comes from the main landing gear, but, of course, the OSHA inspector doesn't know that, because he doesn't know anything about aircraft.

So, we're going to win the appeal, but nonetheless here we have people regulating something about which they know nothing. I hate writing appeals. I didn't like doing appellate work when I was at a law firm, and I don't like doing appellate work now. But it points up that an inspector for any regulatory agency is, in effect, a specialist, and they have areas in which they've specialized and they've trained, in which they're knowledgeable. They have sets of regulations with which they work, parameters for what they do. And within those parameters they're experts, really, and they help us interpret the regulations. They also enforce those regulations. And I think it's important that we keep in mind that we're dealing with two very different fields.

SETTING THE STANDARD, HELI-LOGGING IN THE '90s

By Patrick Davie, Occupational Safety Officer,
Workers' Compensation Board of British Columbia

I am here today to speak to you about helicopter logging in the '90s, about workplace problems, about solutions and about setting a standard.

Before I tell you about the Workers' Compensation Board's involvement in this industry, I'll tell you a little bit about my background as it relates to logging. Before I became a safety officer for the Board I worked in the forest industry for over 16 years. I worked in the rigging on conventional shows, I worked road building, and I worked falling timber. For over 13 years I felled timber, and for five of those years I fell timber for helicopter shows.

In the last seven years at the WCB I've helped put together our standard practice manual for heli-logging, I've helped develop specific regulations for heli-logging, and I've been involved with the making of our latest heli-log film "Setting the Standard"

As a safety officer, every year I'll inspect over 20 heli-logging operations, I'll be called out to investigate numerous accidents and incidents, and I'll attend the site of at least three fatals. Over the past five years we've witnessed an enormous increase in heli-logging, and heli-logging-related accidents.

As public and environmental pressures remove more area from traditional methods of logging, the contractor is forced to develop and accept new ways of extracting timber. Enter heli-logging. Transport Canada statistics indicate that over the last ten years in British Columbia there has been approximately 26 heli-logging aircraft accidents. Traditionally, they say we've had two heli-logging aircraft accidents every other year until 1995, then we had 11.

Injuries amongst ground workers have also increased dramatically, from approximately 22 hillside workers, that's chokermen and hookers, injured in 1991 to over 130 in 1995. And from approximately 17 landing workers, that's chasers, buckers and loader operators, in 1991 to over 70 in 1995. From 1991 to 1995 we had more than 650 job-related heli-logging accidents. We know what kind of injuries are happening, and we know where they are happening.

Over 30 percent of hillside accidents are what we refer to as "struck by" accidents. To me, that means we're not "clearing" turns. We're logging unfinished tree lines, and we're not ensuring hazards, such as broken limbs and tops, are identified and removed before logs are being hooked up beside them.

On the log landings, over 36 percent of accidents are "struck bys". This means we're not arranging our landings to support the volume and size of timber being landed. Yes, the Forest Service does want minimal landing sizes, but lets plan our sites for worker safety, then work that plan. Too often log landing sites have been picked by company engineers interested in percent of land use and distance from logging blocks. Unfortunately this limited planning does not always account for adequate layout for ground worker safety.

Landing layout must ensure workers can work in the clear of incoming log turns and machinery. It must take into account a separate loading area and the extent of log sorting done at the site. It is also

extremely important to remove landing perimeter hazards, such as snag and danger trees. Adequate flight paths must be planned to ensure tree tops are not dragged into the landings.

As a safety officer, I'll visit a site and make an assessment on what I see happening at that moment. I realize that problems such as landing size, availability of logging trucks and weather conditions can influence and quickly change working conditions. That means employers and workers must also be able to adapt to a changing workplace.

In 1996 we reviewed heli-logging-related accidents and we initiated further steps to address this industry. Along with employer and worker groups, we developed specific draft regulations for helicopter logging. We began giving or own officers specific training and direction in safe heli-logging practices, and we developed and produced our first helicopter logging safety video called "Setting the Standard". This initial video addresses most of the main causes relating to hillside and landing heli-logging accidents.

This industry in British Columbia as in other countries has enormous potential. It can tap resources previously out of reach. It can create employment. It can stimulate local as well as regional economies. But it can exact an enormous price in human suffering. The incidents I hear about, and the accidents I go to, whether at conventional logging sites or at heli-logging sites, are generally similar. Fallers are still being killed by snags and poor falling practices; rigging crews are still being hit by turns or upending logs, when they don't get clear; and landing crews are still looking over their shoulders to avoid machinery and incoming timber. Now throw in terrain that is usually anything but kind, timber size and quality that seems to be deteriorating by the year, helicopter flight time that's so expensive it makes project managers lose hair on foggy days, and a crew that may change significantly on every project. This can make an all too common recipe for disaster.

As I mentioned earlier, there are similarities to both types of logging. As a safety officer investigating incidents and fatalities, I find there are also similar root causes, and these can be generally categorized under three headings: pre-job planning, supervision, and training.

In developing draft regulations specific to heli-logging we have attempted to address these causes. We started by forming a committee of employer and labor representatives, along with key individuals from the Workers' Compensation Board. We reviewed accident statistics, coroner's inquest recommendations, existing regulations, and other known standards. We ended up with approximately 45 new regulations that were acceptable to all groups.

Number one was the pre-job planning and training of workers. Out of the over 35 fatal investigations I've been involved with over the last seven years, many of these can be attributed to poor planning of work sites and workers who have not been trained to recognize and avoid work site hazards. To this end, Regulation 29.2 was developed. Pre-job planning and training. A, the employer must provide written safe work procedures for workers exposed to a potential hazard from aircraft operations. B, the employer must ensure that workers are provided with pre-job instruction and that the instruction is documented. And C, the employer must ensure that workers can demonstrate the ability to safely perform their tasks as required.

In fatal investigations, the prime questions in my mind are: was that worker properly trained; did he or she know the hazards and safe work procedures to be followed? More times than not the employer

cannot prove due diligence, that he had taken all reasonable steps to adequately train his workers. The next most frequent root cause of accidents was a lack of site supervision. This ranged from supervisors that were not effective in their job (some of them had been promoted to supervisor just because they were the most productive worker on site and not because they could effectively supervise or coordinate working activities) right down to work sites that just didn't have anyone on site designated to supervise and coordinate activities. To this end Regulation 29.17 was developed. Site supervision. The employer must ensure that a person on site is assigned the responsibility of supervising and coordinating airlift operations.

We have to have someone on site running the ship. We have to have responsible people able to adapt to a changing workplace. And, most importantly, we have to have senior management committed to reducing injuries. Only then can we truly excel in this industry and be proud of setting the standard.

CHAPTER VII
PREVENTING, SURVIVING AND INVESTIGATING CRASHES

PUBLIC HEALTH APPROACH TO PREVENTING HELICOPTER LOGGING INJURIES

By Gary Bledsoe, Manager, Alaska Occupational Injury Prevention Program, AKDHSS

I'm going to talk about the public health approach to crash investigation so that you can see how it might be similar to traditional approaches, and also some of the differences that we've incorporated from the science of public health. I would like to begin with the definition of several terms. We have used the term epidemiology quite a bit so far, yet I'm not sure everyone here fully understands that term, so I'd like to read a couple of definitions to you.

When we talk about public health, what we mean is the art and science of dealing with the protection and improvement of the community's health. This is a very general definition, so that it includes the control of infectious disease, which is generally considered to be the role of public health . But it also includes prevention of injury and the control of physical, biological, and chemical agents in the environment.

Epidemiology is a sub-specialty of public health that studies the distribution and determinants of health-related events in specific populations. This information is used to control health problems, an activity referred to as applied epidemiology.

Traditionally, factors that enable us to control disease are: the host, the person infected; the infectious agent, the virus or bacterium; and the general environment. Epidemiologists found that if they could control one or all of these factors, they could actually control disease. A famous example from history of this approach is the work of John Snow in 1854 in London. He was able to control an epidemic of cholera without any knowledge of the germ theory of disease or the availability of antibiotics. He did so by using common sense and looking at the available data using the epidemiologic model. Snow plotted cases on a city map as they occurred in relation to city water pumps. He found a particular pump that was implicated. By removing the handle from the pump and preventing its use, Snow was successful in controlling a major epidemic.

Public health researchers have applied this same methodology in the research of injury prevention. The disease triad has been modified into an injury triad with the host as the worker, the agent as an external energy source or an engineering factor, and the environment as the workplace . The first reference I can find related to the public health approach is an article by Hugh DeHaven, of Cornell University. He was a Royal Air Force pilot in World War I who survived an airplane crash. He didn't attribute luck or supernatural causes to his own survival. Rather, he began to look in a scientific way, in terms of engineering and physics, at why he survived this airplane crash, and he also used the principles of epidemiology.

In World War II DeHaven authored a landmark article, *Mechanical Analysis of Survival in Falls of 50 to 150 Feet.* He collected data (and analyzed it epidemiologically) about injuries involving civilians who had fallen from various distances, many of them in attempts to commit suicide. DeHaven then

applied this information to the design of aircraft, particularly with regard to ergonomic factors (e.g., the placement of controls). DeHaven's use of epidemiology was very important in the evolution of a public health approach to injury control.

Currently we use the Time-Phase Matrix, first described by William Haddon, who, in the 1960s, developed this tool to analyze automobile crashes. Haddon divided the events of an injury incident into the pre-event, event, and post-event phases, and then looked at each of the injury triad components in light of what was occurring at a specific point in time: before, during and after the incident.

I would like to show you how this methodology might be applied to a helicopter incident, using the Hobart Bay crash as an example. I have entered a few of the salient features of the incident into a Haddon's Matrix (Figure 1).

Phases	Worker	Energy Source	Environment
Pre-Event	1. Policies/enforcement regarding flying with attached cables 2. Training policies and requirements	1. Inability to land to pick up passengers 2. Attachment of choker cable for electrical ground 3. Lack of safely engineered external grounding system	1. Stumps and uneven terrain at pick up 2. Potential of static electricity
Event	1. Pilot/copilot emergency procedures 2. Lack of seatbelts for all passengers	1. Attached 30' choker cable 2. Lack of seatbelts for all passengers	1. Rugged terrain 2. Limited landing site 3. Presence of tall trees
Post-Event			1. Isolated rescue site 2. Poor accessibility

Figure 1. *HADDON'S MATRIX*
Factors

In this case a helicopter was returning loggers to a camp. There was a problem with one of the passengers receiving electrical shocks, apparently due to static electricity being transferred to the helicopter from the main rotor. A 30-foot choker cable was attached to the helicopter to act as an electrical ground. However, the cable was not removed during the flight and the cable became entangled with the tail rotor. The pilot heard a loud bang and attempted autorotation. He overflew the intended landing site and crashed in rough terrain, killing the copilot and five passengers, and seriously injuring himself and four other passengers.

Now, if we can apply Haddon's Matrix to this particular case, causative factors begin to emerge. You may disagree with where I've placed some of these factors, or you may have ones of your own that you're more knowledgeable about, but our motive at this point is simply to analyze this incident using this analytical model.

In the pre-event phase, looking at worker factors, the question of policies and enforcement regarding flying with attached cables is certainly relevant. Did those policies exist? Were they enforced? What were the training policies and requirements for pilots? Why were the passengers not restrained? Did they know the requirement regarding seat belts? When using this matrix you may not know all of the answers, and you may find that some of your ideas are not necessarily valid. Remember that as your research progresses, this table can be refined; it's a tool to help you gain understanding of the incident.

As we examine the pre-event phase, we can also evaluate the energy source and engineering factors. One circumstance that led to the Hobart Bay incident was the inability of the helicopter to land on the ground and pick up the passengers, thereby requiring an electrical ground due to electrostatic charge buildup. The matrix provides information regarding the lack of a safely engineered external grounding system. Perhaps these systems exist, but in an initial analysis, this is a factor to be considered. If there is an actual need, and helicopters commonly experience the problem of static electricity, why isn't an external grounding system used in those situations where the aircraft cannot land and must hover to pick up a load?

As we evaluate the data concerning the pre-event phase, one can find a number of contributing factors. Stumps and uneven terrain at the pickup site made landing impossible. As we have just seen, static electricity can also be considered as an environmental factor.

In evaluating the event phase, certainly you'd want to look at pilot and copilot emergency procedures, unrestrained passengers, and, in terms of the energy source, the attached 30-foot choker cable which is obviously a critical factor. The lack of seat belts for all of the passengers is an environmental factor that was crucial in this incident. The environment at the site event crash was also a contributing factor: rugged terrain, limited landing sites, and the presence of tall trees. Many other factors may be associated with the event phase and can be identified by experienced aerologging workers.

In the post-event phase, the environment is a major factor in Alaska because of isolated rescue sites and poor accessibility to these rescue sites. Thus, severely injured people are more difficult to retrieve and transport to adequate medical facilities.

Haddon's Matrix can be applied as an analytic framework by any crash investigation team. The advantage of this model is that it prevents the tendency to look for a single cause theory for injuries and incidents. This method requires you to look at a broad range of factors that may not always be considered. The matrix helps us to develop a multi-factorial analysis of what caused a particular incident.

WEATHER AND TERRAIN HAZARDS IN HELICOPTER LOGGING

By Phil Kemp, Maintenance Director, Silver Bay Aviation

Combining weather and terrain into a single subject matter is an appropriate means to address two seemingly separate issues, which in reality are inextricably combined. As we separate the two subjects, we will see these two natural features remain connected at all times, both driving and limiting helicopter logging operations; terrain providing the impetus for the business, while weather is one of the principal constraints on operation.

All helicopter logging operations challenge the capabilities of both personnel and the machinery being operated. Most aspects of helicopter logging remain constant throughout North America. While sales may be selected due to rugged or inaccessible terrain, the helicopter provides harvesting methods in areas that could not otherwise be accessed, and a means of moving logs to existing roads, landings or water drops for transportation to market.

While most helicopter logging takes place in steep, rugged terrain, helicopters have played an important part in harvesting timber in swampland and other areas which would not permit the operation of heavy ground equipment. It also allows select cuts in sensitive areas such as watersheds, or salvage sales for windblown or fire damaged timber.

Helicopter operations may place both personnel and equipment in areas of extreme exposure -- on cliffs, steep mountain sides, confined gullies, or simply along the edges of standing timber. This is not to say that helicopter logging is intrinsically dangerous, but a consciousness of hazards, good communications between ground and air crew, and sound safety practices will minimize risk to both crews and equipment.

Exposure exists for helicopters logging steep slopes or confined areas with standing timber, since terrain angles may bring the aircraft into close proximity to both ground and trees. These same areas pose a risk to ground crews from falling limbs or snags dislodged by the helicopter rotorwash.

Main or tail rotor strikes (i.e., rotor contact with any object) will cause an immediate reduction of lift or control of the helicopter. In severe cases it may cause drive train, engine or structural failure, resulting in an immediate forced landing. It could result in uncontrolled descent and impact. Tree coverage and steep terrain may exacerbate this problem further, with possible further impact damage to the helicopter and occupants.

In the event of an accident, the only practical, expedient means of access may be by another helicopter. Most large helicopter operations utilize a support helicopter for choker and crew transportation, with a combination of the two providing for evacuation in the event of an incident occurring to the other.

Many helicopter logging operations are carried out in remote or inaccessible areas. This requires that every person on a crew must know what resources are available locally and how to rapidly mobilize them. This may mean other operators, helicopter and fixed wing medivac organizations, or military and Coast Guard operations. As in all emergency situations, response time and training are the keys to a positive outcome.

Water, more of an Alaskan issue than the Lower 48, is the final consideration of terrain. Incidents involving water are more likely to occur while ferrying the aircraft than during logging operations. However, water drop operations are not uncommon in coastal Alaska and British Columbia. Consideration for ground crews involved in water drop operations include adequate flotation and survival equipment on the worksite. It is important, when ferrying an aircraft, to ensure that adequate flotation, survival, and emergency equipment is carried at all times and that it is appropriate for the time of year and number of personnel on board. Modern Emergency Locator Transmitters (ELTs), with current satellite tracking systems, will bring a rapid on-location reaction by the Coast Guard or other emergency service to the most remote, inaccessible location, irrespective of weather or time of day.

Every aspect of weather affects the operation and production of both the helicopter and personnel involved in the logging operation. The altitude and air temperature of operations affect the performance of the helicopter, both in engine power output and rotor efficiency.

Density altitude is the combined effect of ambient air pressure and temperature by which all helicopter performance is calculated. Essentially, the higher the air temperature or altitude, the less the performance of the helicopter. The lower temperatures and elevations of Southeast Alaska provide for good performance year-round. It should be noted that most of the medium lift helicopters are commercial variants of aircraft designed for maritime operations and as such, provide their best performance in this environment.

Weather is generated by the movement of air at differing pressures, containing moisture, which comes into contact with changes of temperature or terrain and generates the familiar weather patterns we experience. Wind, precipitation, fog and clouds are the everyday weather we must work in, and Southeast Alaska has its fair share of each.

Rain has documented but unconsidered effects on both rotor and engine blade airfoil sections, and can cause deterioration in performance. Current research being conducted by NASA is attempting to quantify these effects. The principal consideration for operators are the effects of water erosion on main and tail rotor blades, causing increased maintenance and repair costs. Blades are equipped with replaceable bonded nickel steel strips, stainless steel or plastic tape to protect the exposed leading edges. Extreme erosion may result in premature component rejection.

Perhaps the most significant danger from rain, or any other form of water, is the contamination of fuel both in bulk storage and within the aircraft fuel system. The gas turbine engine depends upon constant combustion to operate. Interruption of the fuel supply, even by small amounts of water, can cause a flame-out, resulting in total power loss. Daily sampling of aircraft and storage tanks prior to any fueling operation, correct handling of fuel transfers, the use of water separators, and suitable NO-GO filtration units should eliminate virtually all danger of water.

Snow affects operations, in both air and ground operations. The initial problems occur in traveling to and from job sites and in preparing the aircraft for flight. On the ground, snow may be so deep as to not permit safe or efficient operation of the woods crew. It may also bury cut timber to the point it may be impossible to operate.

Icing can occur at virtually any time visible moisture exists. It can be predictably forecasted any time low temperatures (below 40 degrees F) with visible moisture occur. Ice accretion affects engines and

rotor systems, degrading performance of both. The cycle of ice formation and shedding is a function of design and ambient conditions. Most damage occurs in the path of shed ice; turbine engine compressors are particularly intolerant of ice ingestion which causes power loss or engine failure.

Rotor system icing is limited on blades, the flexibility of which allows shedding of ice at regular intervals. Again, the shed ice trail is where the most danger lies. Engines are provided with anti-icing systems, with inlets and intakes being heated electrically with engine bleed air or by engine oil to prevent the build up ice in these particularly prone areas. The fact that ice can form anywhere water is present highlights the necessity to keep water out of the fuel system. Icing in airframe fuel systems is a very real hazard, resulting in power loss.

All helicopter logging operations are conducted under Visual Flight Conditions. Avoidance of terrain requires that all aspects of the helicopter operation be conducted either above, below, or around weather. Weather curtails operations more than any other operating factor. The visibility restrictions of all types of weather range from deteriorating visibility caused by rain or snow, allowing operations to continue, to having cloud and fog shut operations down completely.

Logging operations carry on around these localized weather patterns. Care must always be taken to ensure that suitable alternative landings remain open during operations around fog. Maritime and mountain areas are both prone to fog. Certain locations exist where aircraft have been unable to operate successfully due to the extremes of localized weather. Since the predominance of these weather patterns occur during fall, winter, and spring, they combine with short daylight hours to pose serious constraints in running profitable and productive operations.

Although very uncommon, lightening strikes have occurred during helicopter logging operations. Damage to electrical systems is generally minimal; however, damage to the aircraft and its systems may be massive and require replacement of all components in the helicopter. Damage is caused by the massive charge of electricity passing through the aircraft. At every point of contact without minimal resistance, arcing can occur across gears, bolts, or whatever is in its path. The resulting damage may destroy the integrity of any affected component or part. As they attempt to pass to ground, most lightening strikes will enter and exit the helicopter through the main or tail rotor blades. Consideration of the charge passing through the long-line and striking the ground crew should be assumed to be potentially very real.

Wind affects operations both positively and negatively. The effect of wind on a hovering helicopter, nose into the wind, is to increase the amount of lift generated by a given power setting by virtue of increased airflow over the rotor system. Conversely, wind from inappropriate directions or downhill winds will degrade performance as well as extend flight paths as the helicopter maintains its head into the wind to maximize available power and controllability. Excessive winds cause problems both with controllability of the helicopter and of the hook. Additionally, wind adversely affects crew comfort and performance in the aircraft, coupled to unwanted structural loading of the aircraft. Turbulence and gusty conditions further affect them. Every helicopter type and individual crew will have some limitation.

Many of these conditions can affect a parked helicopter. Strong winds or extreme snow falls can snap or bend rotor blades, blow the aircraft and its equipment around landings, or even blow the aircraft

over. Ice storms can result in aircraft becoming temporarily unflyable as ice builds (even within assemblies such as blades) and the helicopter cannot feasibly be de-iced until a thaw commences.

When planning helicopter logging operations, consideration must be given to the landings and the affect their location has on the overall operation. Are landings of suitable size, with appropriate flight paths for prevailing or anticipated winds? Are flight lengths long or short enough for efficient operations? Is the flying uphill or downhill? Will the helicopter type being operated work efficiently within all these limitations?

Similar considerations need to be given to service landings. Is the surface satisfactory or will the landing require watering to minimize dust and consequent erosion? Is it suitably drained? Does the landing provide adequate protection from prevailing weather or wind? Does the morning sun shine on it to assist in winter de-icing operations? Can you get fuel in all weather conditions? Failing to consider all options in the planning stage of an operation may result in serious problems later.

A final consideration of the combined effects of weather and terrain in a logging environment concerns emergency situations. The recovery from many emergency situations in helicopters depends on the pilot's taking immediate action. This may be acceleration of the helicopter to provide increased rotor lift to counter reduced power. It might require diving the helicopter to produce speed to recover altitude and control, or in the event of a total power loss, to maintain adequate rotor RPMs to facilitate an autorotative landing.

Alternately, should a loss of flight control be experienced, establishing a high airspeed may be essential in order to maintain control of the helicopter to perform a run-on landing or an autorotative landing in a confined area. In either of these circumstances, constraints of weather or terrain may seriously limit available options, which in turn significantly reduce the success rate of recovery from emergency situations.

These circumstances are very real. The worst accident that occurred in Southeast Alaska involved a loss of control in deteriorating weather and daylight, resulting in an attempted autorotative landing within the confines of a rock pit when weather and terrain eliminated all other escape routes. Take any of the circumstances that are contained in this paper and combine them in any sequence and find the limitations or areas of risk for your particular operation.

Finally, no consideration of hazards of terrain and weather could be complete without the most contentious issue in helicopter logging -- twin-engine versus single-engine logging. Many of the scenarios we have considered involve the course of action following power loss. Many individual causes may result in this outcome. The course of action to be taken must consider the available power, altitude, air temperature, weather and terrain to effect the most appropriate recovery. This consideration is, of course, academic. If you had only one source of power to start with, the immediate requirement is to find a suitable forced landing site within autorotative distance.

Some of the statements made at this workshop regarding the performance of twin-engine helicopters are totally uninformed. Helicopters configured for logging operations are stripped of all extraneous equipment and are operating at an empty weight that provides for all maneuvers to be performed on one engine. History has proven this point. The safety record for twin-engine helicopters involved in

logging operations stands comparison with any other twin-engine helicopter operation. The same, sadly, cannot be claimed for single-engine helicopters involved in logging operations.

It must be added, however, that many of the accidents involving single-engine helicopters are not due to failures of engines or related systems, but to failures of drive train or structure that have historically consistent failure rates, or failure to comply with operating limitations. The combined activities of operators, regulatory agencies and manufacturers have resulted in positive action to address the issues. If we meet in 1996 we will be able to assess their impact on the industry. Safety is not achieved by good fortune; it is achieved by hard work, planning and determination. The same or greater effort is required to maintain the standard that has been achieved.

Awareness of emergency procedures, localized weather systems and terrain, forced landing sites and the preparation of plans for the evacuation of injured personnel are the required steps taken by operators to minimize the risk to personnel. Who to contact, how to contact them, and what local emergency resources are at your disposal are the keys to rapid reaction and the keys to enhancing the survivability of any life-threatening situation.

DEVELOPING A PRE-ACCIDENT PLAN: DAMAGE CONTROL, NTSB, FAA, LAWYERS AND THE PRESS

By Doug Herlihy, President, The Herlihy Group

As the agenda indicates, my discussion involves planning for an event that no manager, employee or witness wants to even think about. An accident involving the loss of a machine, with injuries, or worse, along with the loss of other property, and certainly an absolute shutdown in production, is not a popular topic for planning. Unfortunately, that planning is quite necessary, and as managers, all of you, I'm certain, have taken the time to plan, to some extent, the steps you will take when the unfortunate telephone or radio call comes in to your office. I can tell you with a reasonable certainty, that you will never be completely prepared for what will follow that bad news. So my short presentation today will try to outline for you a pathway to follow, to get you all through the first hours and days that follow a major loss.

Publish a plan

Many of the steps, are of course, common sense reactions to emergencies. Most experienced operations bosses, managers, or chief pilots will act appropriately, and do a good job when the time comes. Unfortunately, accidents have a way of happening when the most experienced people are off for the day, out-of-touch with their office for a few hours, or are themselves in the accident. Too often, many critical "decisions" fall on temporary switchboard operators, night maintenance people or others who may not have the experience or the knowledge of the steps you want them to take in the first hours after an accident has occurred. All of us hope that our best managers are on hand to make the right calls when the time comes. Unfortunately, there's a likelihood that key people won't be there when it happens.

First of all, a published outline of "Pre-Accident Planning" has to be available to all hands. It makes good sense to have this sort of plan available on the shop floor or at the remote site for ground accidents as well. What I'm about to suggest in the following sequence of events may, to some of you, be a bit non-standard, but represents the typical way the dominoes are aligned when the accident happens. Some safety courses suggest developing decision and action matrices that follow a scheme of notifying the most important first, and handling the "official responsibilities" first. Unfortunately, critical errors can be made, such as it affects the preservation of information, both in the interests of a clear and unbiased investigation, and in the interests of the company's proprietary information and litigious exposure. One issue we will all agree upon is however, what comes very first in the event of an accident.

Initial Notification - - Get Help On The Way!

The actual plan, and how it's presented, certainly can vary from company to company, even sale to sale or site to site. Who gets called, who does what, only you in your organization can determine that. There are however, a few things that *must be done, regardless of who's* taking the first call in your company. When a call comes in to an operations location reporting an accident, whether by radio call or telephone, the first and most important planning item, and one that can and should be acted on by the person receiving the call, is to <u>make sure that medical response or rescue units have been notified.</u> Too many times, investigations have revealed that there were delays in calling emergency units and the

injured didn't make it because of the delay. Double calls to 911 or the rescue number are better than a delay because someone mistakenly believed the call had been made. If two units get called and get launched, let them go, don't call any of them back. Let the EMTs or the Coast Guard make that determination on scene. Time and time again, the Coast Guard is called while en route to tell it to stand-down, that the local EMT helicopter will handle it, even though the Coast Guard would have been there far earlier. That's the first and the most important rule. Your plan should not require notification of anybody, until life-saving units are en route to the scene, and the caller is certain of it.

Key Personnel Notification - Share the Workload

It's common to have plans that have detailed "who-to-call-when-it-happens lists." The odd thing is that often following an accident, despite an abundance of key people, even after a continuous day or two after the accident, often the same single manager is making most all of the decisions! A single person often is directing the efforts to respond to investigators, officials from government, families, insurance adjusters and even the press. Stress is high, and mistakes can be made. Plans must include not only who's to be notified, but in general terms, what their duties will be in the first hours and days following an accident.

Make assignments to an accident team before you need them

In order to plan for these assignments and tasks, I would like to discuss, in general, what sequence of events will likely occur and who will be the players that arrive from outside your organization. Likewise, your phones will be ringing off the hook. Let's talk about the first calls that may come with no surprise to many of you. The way you handle them will be most important, probably the most *critical response you'll need to be in control of.* I'm speaking of course, about the news media.

The Media

Most of us, when under stress, have a tendency to "get it off your chest," explaining the who, what, when, to interested parties who "want to hear the details." Many people are only too glad to tell a concerned person all about the accident, just to get rid of the information. There's a human tendency in the time of disasters to spill it all out so that someone else can carry a part of this terrible information. One only has to watch the six o'clock news to see the microphone in the face of an eyewitness to every accident scene of the day. This is where your carefully worded response is most important. Early and loose communication with the media can create a serious problem both for the company in the loss of proprietary information and possible litigation somewhere down the line. And, it may also compromise the objectivity of the investigation that will follow, not to mention the hardship on the injured persons' families who might not yet have been notified.

Handle the media with respect and caution

While in this country, it's often said, "the people have a right to know," it's equally fair to say that they have a right to know the correct information and not that which is skewed by the emotions of the communicating parties, or is blown out of proportion with unsubstantiated bits of information. The reporters have got a job to do, of course, but it's not in anyone's best interest to give out information too soon, or make sensational remarks part of the six o'clock lead story. It's probably part of any good Pre-Accident Plan to focus media contact through one person only, and only if he or she has a direct

line to the decision maker. As another way of handling it, you may want to refer the media to the NTSB Investigator-In-Charge, by saying that, "the National Transportation Safety Board is in charge of the investigation, and we've been asked to refer questions to them." I will cover more of that role in a moment. By the way, now that we're on the media, let me share some observations of media capabilities I've observed at the scene of large accidents.

Use caution when speaking at accident sites

Even though you may have informed the press that press releases will be handled by a designated person, or referred questions to the NTSB, the press will try to get to the site for accident photos and on-scene interviews. For obvious reasons that could compromise or complicate the investigation or disturb the physical evidence, no NTSB investigator should let the media inside the safety boundary, and certainly not inside the wreckage. When the wreckage is released to the owner, media entry is up to you, but I'd use caution of what goes public, even then. It's usually not a problem, as after a day or two it usually loses media interest. A word of caution may be important regarding what is said at the accident site, or, for that matter, said anywhere. Eavesdropping is quite common, especially at larger accidents. Parabolic microphones are not uncommon, and with a telephoto lens, it's fairly easy to put your face with your voice even from a considerable distance, as you discuss your theory with your partner of what caused the accident. This is not to over-dramatize the risk of that eavesdropping, but the more newsworthy the accident, the greater the risk. I emphasize the media first in your Pre-Accident Plan, because they represent the most likely first outside contact and have the potential of being the most difficult mistakes to remedy in the damage control department.

Contact with the NTSB, the FAA and "Party Participation"

Of course, any aviation accident requires the notification by the operator or the pilot, to the NTSB who in turn, notifies the FAA Flight Standards District Office in the location of the accident. Often it's the other way around, simply because the FAA operates a system of "Regional Operations Centers" or "ROC" that communicate on a 24-hour basis with local law enforcement, air traffic control facilities and rescue coordination centers. A call to any one of these agencies links the FAA ROC and then normally the NTSB investigator on duty is notified by them. As a way of a background to your company's Pre-Planning response, the notification of the NTSB sets a series of steps in motion. After a conference between the NTSB investigator and the FAA duty inspector, your company contact will often have the first contact with the those agencies in the form of a three-way conference call, with both the NTSB and the FAA on the line.

It's important to understand the roles of the two agencies here, and to understand your company's rights, advantages and disadvantages, when you are involved in an accident that brings those two agencies to your property. Depending upon the severity of the accident, and especially with loss of life, NTSB investigators will likely conduct an on-scene investigation. It is conceivable that more than one Board investigator, possibly from the National Go-Team, may be assigned in an accident with high loss of life, or one having political or newsworthy impact, beyond a regional basis. In theses cases, they will likely form groups to examine, in detail, engines, airframes or pilot operations, as examples.

Every accident, of course, brings with it the risk of lawsuit. Any information that surfaces has the potential for being used in litigation. While the Board will not be part of any future action, what is

discovered can be considered by others. First, while the NTSB investigator is in charge of the accident investigation, remember that all information can potentially be made public, and therefore cannot be kept from the FAA. Don't speak "off the record" to anyone. And, while the FAA inspector comes to the site assisting the NTSB, an FAA enforcement action on a certificate, pilot, or company, may result. No matter what assurances to the contrary, the FAA inspector always wears an enforcer's hat. So the risk of lawsuit, and the risk of enforcement action, leads us to the second important consideration. That is, your Pre-Accident planners should have a good understanding of your rights during the investigation, and afterward. The law[1] allows the NTSB investigator to extend "party status" to qualified employees of your company to assist in the investigation. That means that you may have a representative participate who can offer technical expertise. Once this "party status" is extended, it will apply to all field phases, group discussions, engine tear-downs or technical meetings. There are some limitations, that being the participants can't be lawyers or claims adjusters or represent claimants. Generally, "party status" is extended to full time employees, but there have been exceptions made in the past in the case of small companies. "Party status" does not mean these members will join into the analysis phase, but of course, your input at all times certainly makes a big impact on how causes are determined. Simply put, assign your best qualified experts to assist the Board investigator, and be alert to protect your interests.

Lawyers and litigation

With the exception of representing those being interviewed, attorneys are generally not present at field investigations or group deliberations. Board investigators, especially from the National Team wouldn't allow it. Lawyers and claims representatives are expressly excluded from progress and technical meetings conducted by Board investigators and attended by your "party" representatives. Remember that which is developed in the investigation, however, will be high on the list of that which is sought during the "discovery" phase of any lawsuit that may follow. Even though the Board may exclude certain documents from public disclosure, the knowledge that certain documents exist, may prompt a "request for production" in later litigation. That brings me to the third recommendation as it relates to the field investigation. Protect your trade, commercial or financial information. If it is part of the record review, or in document or even in interview information, you have a right, under law,[2] to request the Board exclude that information from public disclosure. That would prevent the information from being disclosed, at least from government sources, as part of the official record, or through the Freedom of Information Act.[3] In all cases, it is better to protect proprietary information from the very beginning of the investigation.

Last, but not least, you have a right, if granted "party to the investigation" to provide a "submission" of your own findings, analysis and determination of cause, to be appended to the public record of the NTSB report. If submitted within the prescribed time period, the Board will undoubtedly review and consider your side of the story. In nationally prominent accidents, it is routine for aircraft manufacturers and other "parties" to investigations to submit lengthy reports of their own, so that the official public record reflects their views. The key here is to press the NTSB for "party status", and get your views on record.

---

[1] 49 CFR Part 831.11 National Transportation Safety Board, Parties to an NTSB Field Investigation.
[2] 49 CFR Part 801.59 Trade secrets and commercial and financial information
[3] 5 USC 552, amended as Pub. L 93-502, FOIA

Support the investigation - Protect your interests - Know the difference

We've all come to realize that the fear of litigation has just about eliminated the free flow of accident information in the aviation community, as well as other sectors of industry. Companies are becoming more reluctant to share what they know about the cause of accidents because of the possibilities that the information can be used against them in court. The reality of litigation against your company is, of course, always present, and it would be naïve to believe that information revealed to an NTSB investigator will never surface in some form or another. Even though the law[4] prevents litigants from getting the Board investigator's written report admitted into court evidence, the information can be extracted one way or another through deposition or the use of experts in court. While these considerations are beyond the scope of what is said here today, it is important to remember that part of your Pre-Accident Planning should address supporting the legitimate findings of the facts and circumstances of the accident to determine the cause, while protecting your company's interests at the same time. As a rule of thumb, if the information is going to surface anyway and it supports the central inquiry into the cause of the accident, it is better to appear genuinely supportive, than to obstruct the investigation at each turn of the road. Just make sure you are prepared to object to "fishing expeditions" that do not serve to support the investigation into the cause of the accident. Requesting and using "party status" is the best way to keep informed of the process and the findings of the investigation.

Family assistance

I cannot over-emphasize the importance of dealing with victims' families with great sensitivity and compassion. This is important whether the families are of your employees or private citizens that may have been at the crash site. A Pre-Accident Plan should always designate contact persons, both male and female, that can have as their primary duty, the job of arranging transportation, lodging and, very importantly, providing answers to their many questions. Families have a way of remembering when they have been treated with care during that stressful time, and certainly remember when they have not been cared for. A personal call should be made by the president of the company, and the family member should be put in touch with the contact person, for a close and sensitive connection over the first few days or weeks.

Damage to private property

This part of "damage control" is very important, and often gets overlooked because of the more important aspects of an accident investigation. Your Pre-Accident Plan should designate someone to handle the details of getting private property back to original condition as soon as possible. Regardless of who you believe was responsible for the accident, if your name was on the side of the aircraft, it is very important in the long run, to spend reasonable sums, or push your insurance company to provide for quick repair settlements. This means immediate repairs to residential roofs, lawns, hedges and yards, or other real or personal property than might have been damaged. Try to get a release of liability, but don't make it a condition of the repair or replacement. I recall when I participated in the investigation of a corporate helicopter and twin-engine fixed wing mid-air collision over a suburb of

---

[4] 49 CFR Part 835.3 et seq. Scope of permissible testimony

Philadelphia a number of years ago. It was the worst of all circumstances, having taken the life of Senator John Heinz, the aircrews of both aircraft, and school children in their playground. With all the serious accident investigation going on in the foreground, one of the parties did not lose focus on damage control. Their attention to repairing private property was especially noteworthy. By the morning the school reopened, three days later, the corporation had taken it upon themselves to replace the mature trees on the school lawn, the flowers, the flag pole as well as removing and restoring all of the grass with fresh turf, in the field next to the school. A number of homes had roof damage, and this too was well on the way to being repaired. The point is here that this was damage control at its best. And, when people thought of litigating sometime later, the small amount spent in the first few days after an accident was probably well worthwhile for that company.

Control the communications by your employees

As I indicated before, if it is possible, have one of your qualified persons sign on the investigation as "party" to the inquiry. He or she should be present whenever the investigator is examining wreckage, records or conducting interviews. Your party member should be relieved of all other duties and stick to that task as his only job until the field phase is complete and the investigator is gone. As "party", he should submit a copy of his field notes, and expect to get a copy of the investigator's field notes, as well as a receipt for anything the investigator carries away for record, or further examination. Interviews of your employees, when you are "party" to the investigation, allow you a presence to pay close attention to communication. Federal regulations allow that all persons interviewed by Board investigators be afforded the right of representation.[5] At such interviews, the company representative acting as "party" to the investigation, will not share the responsibility as advisor to the person being interviewed. That way, no conflict of objectivity can be claimed and the employee receives effective support. Representatives of witnesses should be chosen from those who have no role in the investigation themselves, of course. Outside of these interviews, control should be exercised that employees do not discuss the accident or their jobs with anyone on an "unofficial" or "off-the-record" basis. As I indicated before, there is no such protection.

In summary

The key points of the discussion here today are these:

- Publish a written plan, key people may not be there when the call comes in.
- The most important first step is to make sure medical or rescue help is en route.
- Share the workload, spread the duties among key people.
- Have teams organized before the fact.
- Deal with the media with caution, and through a single spokesperson.

---

[5] 49 CFR Part 831.7, by counsel or any other duly qualified representative

- Guard against unwanted and speculative communications.
- Cooperation and support for the investigation is beneficial. Obtain "party status."
- Potential litigation and the protection of proprietary information requires control of communications and interviews.
- Plan for effective family support and assistance.
- Address damage to private property as an effective damage-control policy.

QUESTION AND ANSWER

MR. MANWARING (NIOSH): In the subgroup that met at last year's meeting, one of the recommendations that came out was for companies to develop and publish standards for maximum flight and duty time. So, what is an appropriate maximum flight and duty time for a helicopter logging pilot, both for single pilot and also for two pilot operations?

MR. WARREN (Columbia): We use, as a guideline, six hours in the left seat. That means that a person could spend more time than that in the cockpit, but we don't want them doing intensive logging type of work more than six hours at a stretch. And that would include breaks.

MR. HAMMERSCHMIDT (NTSB): Let me just take this opportunity to close the loop on a question that was asked yesterday towards the end of the session, which was in reference to an NTSB 1993 recommendation to the FAA, which read, "Assign operational and maintenance oversight responsibilities of 14 CFR Part 133 operations at remote sites in the United States to the Flight Standards District Office with geographic responsibility for the area. Assign a priority to this surveillance that will allow onsite inspections of these operations".

And, for the record, the Board classified this recommendation, which is A-93-80, as a closed, unacceptable action, following the FAA's response that onsite surveillance was not feasible.

And, just to put it all in perspective, in terms again of NTSB operations and methodology, we issue a great number of safety recommendations to the Federal Aviation Administration, and in recent years the acceptance rate, that is when we close recommendations out as acceptable action, is in the vicinity of 85 to 90 percent. And so there are times when the FAA and the NTSB just do not agree on a subject.

DR. CONWAY (NIOSH): The International Federation of Airline Pilots Associations has just recently distributed an international consensus opinion on flight and duty time for all air operations last year. And early this year they published flight and duty time limitations and rest requirements for helicopter operations. It's something that the new HAI Helicopter Logging Committee might be interested in.

MR. WALLACE (FAA): I think most of you are already aware that there is a flight and duty NPRM that's on the streets right now. This is part of a program to take the existing regulations which, under

some portions, the 121 and the 135, and meld them into one regulation and also to simplify them. Of course there's been a number of problems that have been brought up by specifically helicopter operators. But, if you do have any concerns with it, I know there's a number of you in the helicopter community that does, please get your comments in. And I believe the period for comment closes the middle of next month.

MR. WARREN: I'd like to emphasize what Bill just said. I've talked to a number of the people in this room about an NPRM relating to Part 61, and there were some pretty bad provisions in there, at least when it came to their effect on helicopter operators. Therefore, I'd certainly urge you to go through this NPRM that Bill just mentioned on crew and duty time.

Like many NPRMs, it's directed at airplanes and airplane crews, but it applies to everybody. So many of these rules don't draw a distinction between helicopters and airplanes, and again, what may be a perfectly rational rule, if you're applying it to an airline working out of an airport, is completely unreasonable when you apply it to a helicopter working out in the bush somewhere.

This NPRM, I understand, is alpha driven, and a cynical person might be led to think that they were trying to establish something in the FARs that they couldn't get through as a union rule. Thank goodness I'm not a cynical person.

MR. KEMP (Silver Bay Aviation): One item that came up with the HAI that was of interest to anyone who does want to return comments to an NPRM is, if you get form letters from the HAI or anyone else to sign and send on, those count as one comment. So, if all of us in here sign that same piece of paper, the FAA regards it as one comment. Therefore, it's very important to put it on your own letterhead and send it as your own entity.

And the other part, discussing how the flight hours and duty hours work, is we have to look at the way we pay within the industry. There's a number of factors that will either promote a long work day or a short work day, such as if you pay by the flight hour, if you pay by the work hour, or whether you pay by salary. So, there's other considerations within our industry, within the way the operators compensate their employees.

CRASH SURVIVAL

By Roy G. Fox, Chief, Product Safety, Bell Helicopter Textron Inc.

Risk in Aviation

Over the years, safety has been measured by various methods depending upon the primary need for the measurement. For insurance purposes, financial planning, and government agencies' concerns, the frequency of accidents/100,000 flight hours has been commonly used. This combined with a damage cost allows the forecasting of potential dollars lost from accidents. It has allowed the military to anticipate future fleet losses and replacements needs. The accidents/100,000 flight hours has been the safety measuring standard for many years. This is the risk to the aircraft. Unfortunately, the frequency of an aircraft accident does not measure the risk of injury to occupants.

Diversity Affects Safety

Analyses of aviation accidents over the years have shown that there are wide variability of the several factors that affect the actual safety outcome. This diversity in aviation precludes the risk from being a constant value; the risk varies. There are major factors that determine the helicopter risk which includes how an aircraft is used, where it is used, the hospitality of the takeoff/landing area, the professionalism of operating personnel, and the repeated nature of the operation (i.e., scheduled service). The type of aircraft is also important but different usage of the same aircraft type can result in dramatically different safety histories. Table 1 shows the major variability categories affecting helicopter safety. Within each category there are characteristics that tend to be found in accidents. These factors seem to be distributed between a riskier and a safer extreme. For example, within the Pilot category, the risk of an accident is relatively high with a new pilot with minimal experience, no structured control who goes out and says "Watch this!" At the other extreme, the safer end, are the very professional pilots in a very structured environment, using Aeronautical Decision Making (ADM) and Cockpit Resource Management (CRM) training, simulators, and have significant positive management involvement. Most pilots fall in between these extremes. The human element (pilot and other humans) will be somewhere in the range between riskier to safer. The management influence on the pilot is a factor in this category. This same concept applies to the other categories of Machine (aircraft), Environment, Mission, and Crash Survival. The likelihood of injury can be affected by where your particular factors fall within each category. Likewise, you can reduce your potential for injury or aircraft damage by moving your situation toward the safer end within a category. Those operators in the logging industry cannot change their mission but they can compensate by improvement in the other categories.

Table 1. *Trends of Variability Affecting Safety*

PILOT	MACHINE	ENVIRONMENT	MISSION	CRASH SURVIVAL
RISKIER	***RISKIER***	***RISKIER***	***RISKIER***	***RISKIER***
Private license, minimal control and experience	Aircraft misused and abused beyond design limits	Harsh landing surfaces (water, etc.) First time to land at remote spot in unknown conditions (on a mountain ridge)	Logging/external loads in remote sites, operating near gross weight, severe use	Lap belt only use
Qualified, commercial FAA license	Unauthorized (Bogus) parts, salvaged, & multiple rebuilds	Low level flying, obstacles, little emergency reaction time	Personal, Instructional, Agricultural spraying	Rugged cockpit and cabin, life vests, good emergency egress
Professional, self-induced standards	Strictly observe operating and maintenance procedures	FAA approved sites, sporadic use, VFR flights	Business, On-Demand Air Taxi, Corp/Exec.	Shoulder harness for each occupant (increase spinal tolerance by 6X)
Highly structured professionalism, CRM/ADM, simulators used	On-board monitoring systems to identify problems prior to failure, allows scheduled maintenance	Regimented IFR, scheduled use, same landing sites (airports/heliports) are used	Scheduled Air Carriers	Energy attenuating seats where feasible to reduce spinal injury. Crash Resistant Fuel System to reduce thermal injuries
SAFER	***SAFER***	***SAFER***	***SAFER***	***SAFER***

Aircraft Risk

Figure 1 is a good example of the accident rate per 100,000 flight hours variability of helicopter operations among U.S. aircraft. If all rotor wing aircraft (piston and turbine-powered) are considered together, that accident rate is worse than General Aviation (all fixed- and rotary-wing aircraft except those operating scheduled Part 121/13). The type of mission underway at the time of accident includes personal use, business, instruction, corporate/executive, aerial application, aerial observation, public use, ferry, positioning, logging, external loads, and on-demand air taxi. Safety history in these missions vary. Civil turbine helicopters (Civil Turb R/W) and Gulf of Mexico turbine helicopters (GM Turb R/W) consist of single- and twin-turbine helicopters. These Gulf of Mexico data are from the Helicopter Safety Advisory Conference (HSAC) which is an organization of helicopter operators and their oil company customers who have banned together to ensure safety in the offshore helicopter operations.

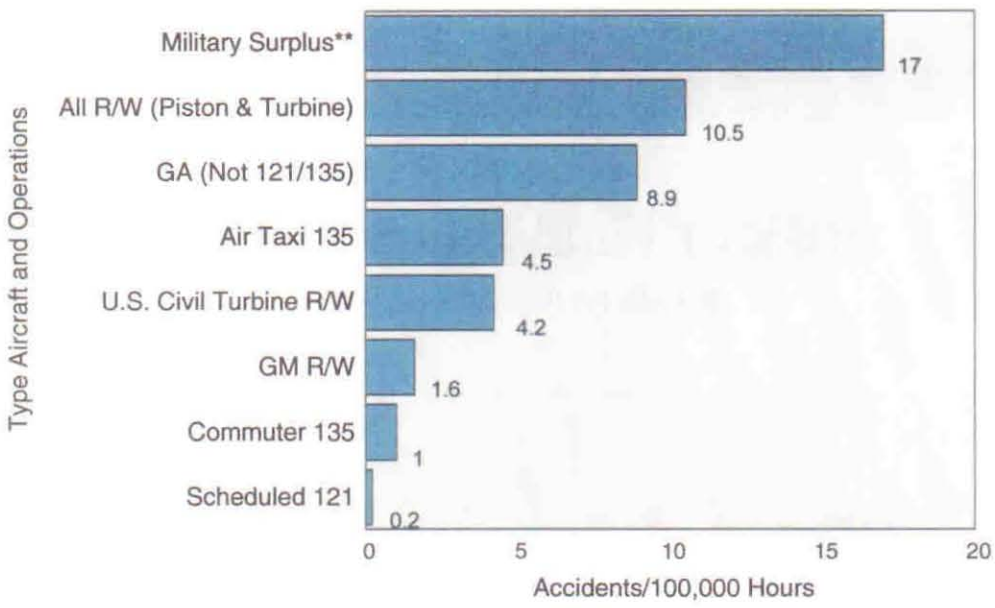


Figure 1. *U.S. Registered Aircraft Safety History*

Note that the Scheduled Part 135 Commuter accident rate is 76% less than the Non-Scheduled Part 135. The accident rate of the Gulf of Mexico turbine helicopter operation is 62% less than the U.S. civil turbine helicopter fleet even though it is not a scheduled IFR operation. So the same civil turbine helicopters have dramatically different accident rates depending on factors other than the Machine (aircraft). Similarly, the military surplus turbine helicopters have a significantly higher accident rate (17 versus 4.2/100,000 hr) than the U.S. civil turbine helicopter fleet. In some cases, these military helicopters are being misused in missions for which they were not designed. Military helicopters are designed to military requirements, not civil helicopter requirements.

Risk to Occupant

The risk to an occupant is not the same as the risk to the aircraft. The actual risk to an aircraft occupant is based on his/her likelihood of injury over that individual's period of exposure to harm. This can be calculated as Risk of Fatal Injury (RFI). This risk is the occupant's risk of a fatal injury per 100,000 occupant hours of exposure. It is:

$$RFI = \frac{\text{Number of Accidents}}{\text{Flight Hours Flown}} \times \frac{\text{Number of Fatal Injured}}{\text{Total People Onboard}}$$

An occupant's risk of a fatal injury per 100,000 hours of exposure in that aircraft is shown in Figure 2 for Gulf of Mexico helicopters and the scheduled airlines (commuters and large air carriers). The occupant risk of fatal injury in Gulf of Mexico operations of single and twin helicopters is slightly lower than the Part 135 Scheduled Commuter but still higher than the Part 121 Scheduled Air Carrier. For those concerned with per departure comparisons, by replacing the flight hours exposure with number of departures, the RFI per departure can likewise be calculated and is also shown below with the RFI per occupant hour. It shows that the present risk for occupants of the Gulf of Mexico helicopter fleet is quite low and close to Scheduled Part 121 Air Carriers.

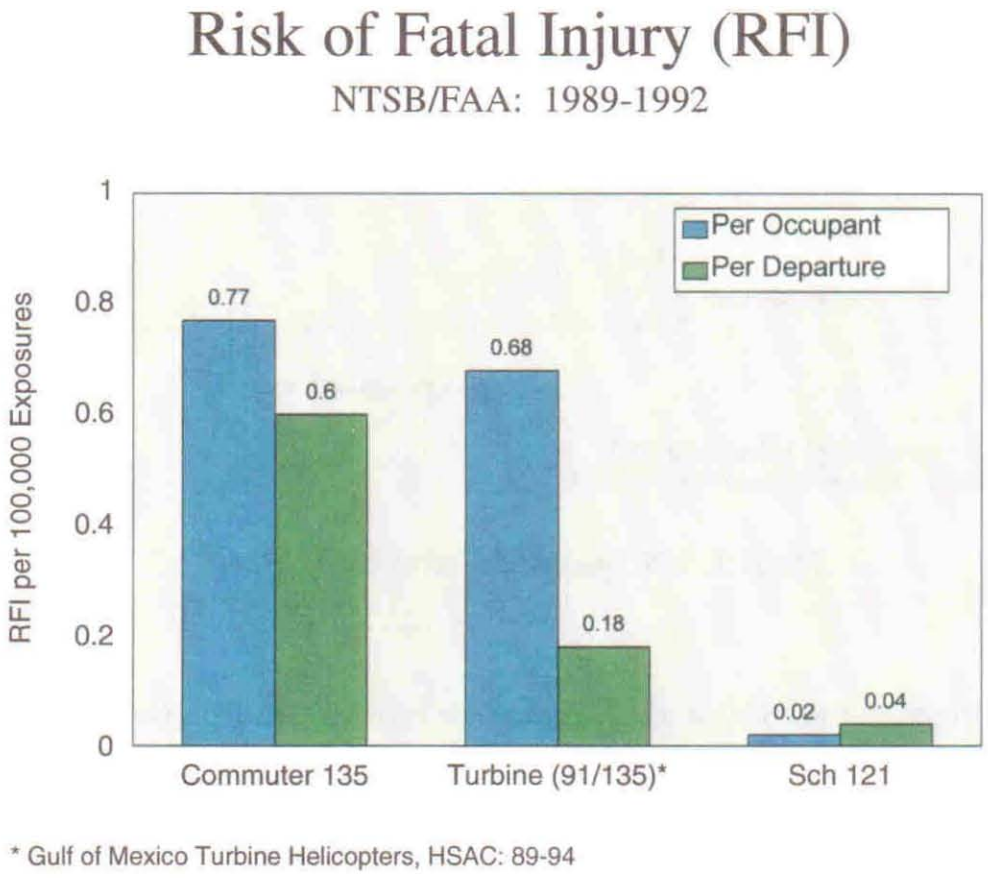


Figure 2. *Individual Risk of Fatal Injury*

Accident prevention has, since the Wright brothers, been the main focus in aviation safety. This includes factors of aircraft design, regulations, standardization, enforcement, training and many others. The training is not only primary training, but includes recurrency training, specialized training such as for the logging mission and the improved judgment (ADM) training. The injury reduction program includes aircraft design features to reduce the major threats of injury, survival gear, survival training, and pre-accident planning. For example, survival gear and training is dependent on the climate and terrain in which you are flying. Planning can include a pre-accident response plan to streamline and shorten rescue times if an accident occurs. A major key to survival is a quick rescue.

Civil Helicopter Crash Scenario Study

A study of civil helicopter accidents was conducted for the FAA to identify the injury and crash environment of civil helicopters (Reference 1). Table 2, extracted from this study shows the most significant five crash hazards (based on combined severity and frequency) of the 14 identified crash hazards. The most significant hazard was the post crash fire, followed by high deceleration loading causing spinal and other internal injuries. The third hazard was related to wire strike initiation and the resulting out-of-control aircraft attitude at impact. The fourth and fifth were related to restraining the occupant.

Table 2. *Hazard of Injury in Civil Helicopter Crashes*
(Extracted from Reference 1)

Hazard No.	Hazard Description
1	Body exposed to fire when fuel system failed on impact.
2	Body received excessive decelerative forces when aircraft and seat allowed excessive loading.
3	Body exposed to impact conditions due to in-flight wire strike.
4	Body struck aircraft structure because design provided inadequate clearance and/or restraint allowed excessive motion.
5	Body struck aircraft structure due to lack of upper torso restraint.

SURVIVING THE CRASH

Now that the basic crash survival problems are known, an understanding of what happens in a crash is needed. There are certain physical requirements that are needed to survive a crash. These requirements are applicable to each individual occupant at a specific location, not to the whole aircraft. These requirements apply in any helicopter, airplane, automobile, or any other moving vehicle. The four basic requirements to survive a crash are:

1. Maintaining a livable volume throughout the crash sequence.

2. Restraining the occupant.

3. Keeping the occupant crash loads experienced within human non-injurious tolerance.

4. Providing a means and time to escape.

Livable Volume

A livable volume must be maintained around an occupant at all time throughout the crash sequence. If a limb or rock penetrates into the point in space occupied by the pilot, that specific seat location is not survivable. A "survivable accident" is define in Crash Survivable Design Guide, Reference 2, as:

"Survivable Accident. An accident in which the forces transmitted to the occupant through the seat and restraint system do not exceed the limits of human tolerance to abrupt accelerations and in which the structure in the occupant's immediate environment remains substantially intact to the extent that a livable volume is provided for the occupants throughout the crash sequence."

Restrain the Occupant

Assuming that the livable volume for each occupant has been maintained throughout the crash sequence, the next survival requirement is the restraint of the occupant to the aircraft. A restraint system can reduce secondary impacts, provide body positioning, and allow an occupant to benefit from the airframe deformation. The type of restraint used can be important depending on the specific crash condition.

Occupant Crash Load Tolerance

Disregarding thermal injuries, an occupant receives traumatic injuries because of different deceleration loads experienced at different times during the crash sequence. The magnitude of the loads can vary at one seat location throughout the crash sequence and vary between different seat locations. When the load goes above a certain value for a certain amount of time, the crash load is considered injurious (i.e., a major or fatal injury may occur). Conversely, if the loading is lower, the load is considered to be within the injury tolerance. This change from tolerant (i.e., no serious injury to either a major or fatal injury) to intolerant is considered the impact tolerance level. Unfortunately, each occupant has a unique impact tolerance level. The significant factors causing the tolerance levels to vary include (1) direction of deceleration loading, (2) type of restraint used, (3) peak deceleration experienced, (4) duration of loading, (5) rate of onset of deceleration, (6) age of occupant, and (7) sex of occupant. These variances help to explain why one person may be seriously injured in a crash while sitting beside another person who escaped serious injuries. The effects on crash load tolerance levels for the first two variables of direction of loading and restraints are evident in Table 3.

Table 3. *Uninjured Human Tolerances to Impact Loading*

Direction of Deceleration	Lap Belt Only[1] Peak G for time duration	Shoulder Harness with Lap Belt[2] Peak G for time duration
Longitudinal ($-G_x$) [eyeballs going forward]	15 G (0.002 sec)	45 G (0.1 sec) 25 G (0.2 sec)
Vertical ($+G_z$) [eyeballs going down]	4 G (injured)	25 G (0.1 sec)
Lateral ($+/-G_y$) [eyeballs going to either side]	11 G (0.1 sec)	20 G (0.1 sec)

Impact loads in humans are essentially transmitted through the bone structure rather than the flesh. Age is a factor due to bones having less strength with increasing age. The strength of bones is basically a function of calcium content which decreases with age. Women in their later years lose calcium at a rapid rate, and thus their bones fracture at much lower loads than ones they could have tolerated in their younger years. A study that tested the strength of cadaver vertebrae (Reference 4) indicates a decrease in bone strength with increasing age as shown in Figure 3.

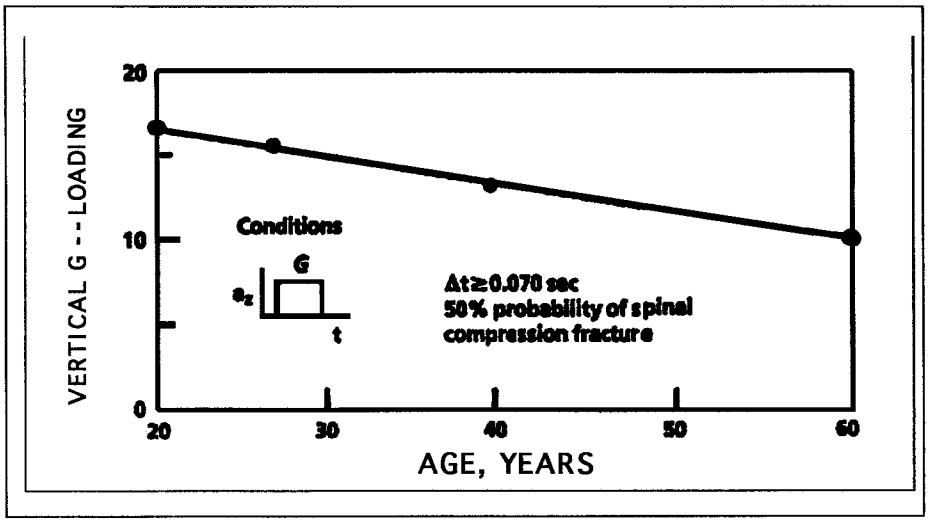


Figure 3. Age Effects on Spinal Injury Tolerance.

An FAA study of civil helicopter crash scenarios (Reference 1) compared the major and fatal injuries of occupants in survivable military and civil helicopter accidents as shown in Figure 4. The age effect on bone strength is believed to be one of the reasons why spinal injuries are more prevalent in occupants of civil helicopters than in occupants of military helicopters. The study indicates that the average age of the military pilots involved in accidents was 26 years, whereas the average age of general aviation pilots was 38. Since most human injury tolerance testing has been done by the military, those results have been more applicable to military pilots who are generally young and healthy. This bias causes published human injury tolerances such as Table 3 to be somewhat high for the civil population.

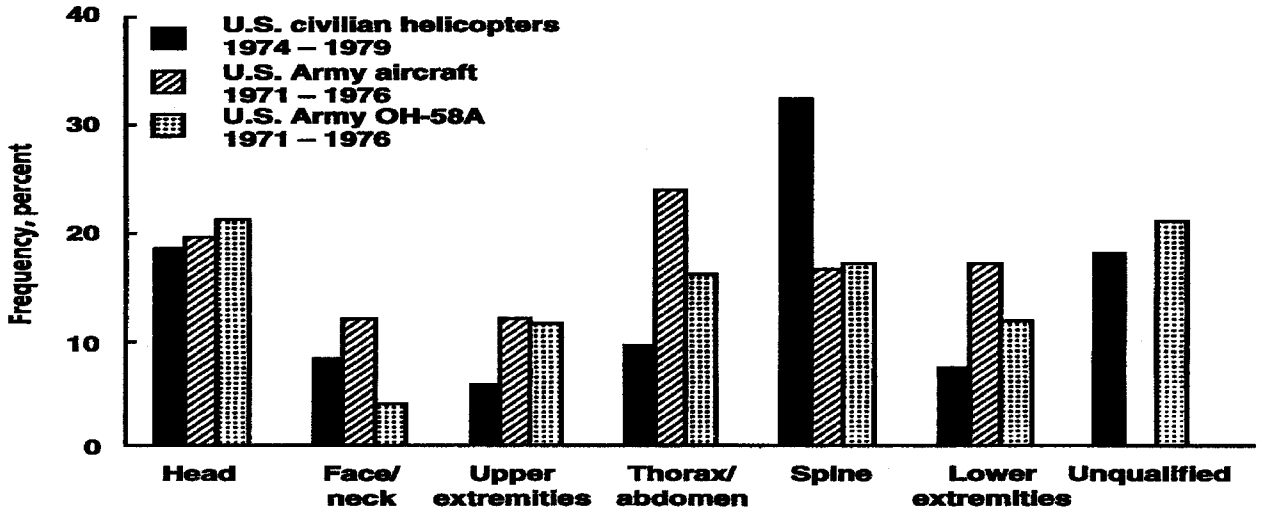


Figure 4. Frequency of major and fatal injuries to each body region as percentage of total major and fatal injuries in survivable accidents.

Shoulder Harness Effectiveness

Does a shoulder harness work in a crash? Yes, it reduces risk in most crash sequences. The FAA study of civil helicopter crash scenarios (Reference 1) analyzed the injuries of crash victims and the type of restraints that were used. Abbreviated Injury Scale (AIS) was used for classifying the injury severity. Table 4 shows that the percentage of people receiving severe injuries was 34.3% of those wearing only a lap belt as compared to only 9.6% for those wearing a shoulder harness with lap belt. Clearly, the shoulder harness is a significant safety improvement. The logging pilot should wear a shoulder harness with an automatic inertia reel at all times when flying the helicopter. The inertia reel allows the pilot to lean outboard and fly the long line for normal operation but will remove all slack as the pilot returns to the upright position prior to the crash.

Table 4. *Shoulder Harness Effectiveness*

Injury Received	Lap Belt Only (percentage receiving injury)	Shoulder Harness with Lap Belt (percentage receiving injury)
Moderate/None AIS = 1 or 2	60.0 %	84.6 %
Severe AIS = 3 or 4	34.3 %	9.6 %
Life Threatening AIS = 5 or 6	5.7 %	5.7 %

Energy Attenuation

Since the human can only accept so much load before bone failure occurs, this is the major limitation in surviving a crash. Energy attenuation is a means of allowing an occupant to tolerate higher impact speeds (i.e., higher kinetic energy that must be absorbed) but stay within his/her injury tolerance level throughout the crash sequence. This is shown in Figure 5 for the vertical loading component in a crash. From points A to B, the crash loads are low (typically less than 3 Gs) as the skid gear deforms. Point B is where the fuselage lower skin contacts the terrain. The loading from points B to C to D to E is extremely high as the aircraft floor comes to rest at point F. Note the dotted horizontal injury threshold line below the serious injury zone. An occupant sitting on the floor would have experienced these loads shown by points B through F. Serious injury would have occurred as his/her loads went above the threshold line. Likewise, an occupant on a seat would experience loads of points B to C and drop to point G. The occupant loads do not exceed C (at this point) as this is the maximum strength of the seat at which it fails. The occupant's load is about zero from points G to H because the occupant is basically free-falling from the seated position until contacting the floor at point H. However, the floor is just about to come to rest at point F. Thus the occupant impacts a nearly stationary floor causing the

occupant crash loads to go from points H to I to J. Unfortunately, occupant load penetration above the injury zone threshold would indicate a serious injury for the occupant. The key to extending the ability to survive more severe crash impacts is to use a means of accepting the higher impact energies but still keep the loads experienced by the occupants below the load that will injure that person. This means is called "energy attenuation" which will spread the energy that must be absorbed, over a much longer time which then allows the crash loads experienced by the occupant to stay below injury levels. An energy attenuating seat is the mechanism that is used. An occupant on an energy attenuating seat in Figure 5 would experience loads from points A to B to D to K to L. The loading on the occupant never goes beyond the serious injury zone threshold and therefore, the occupant is not injured. In essence, the kinetic energy of the occupant is spread out at a controlled low-level load for a relatively long time period.

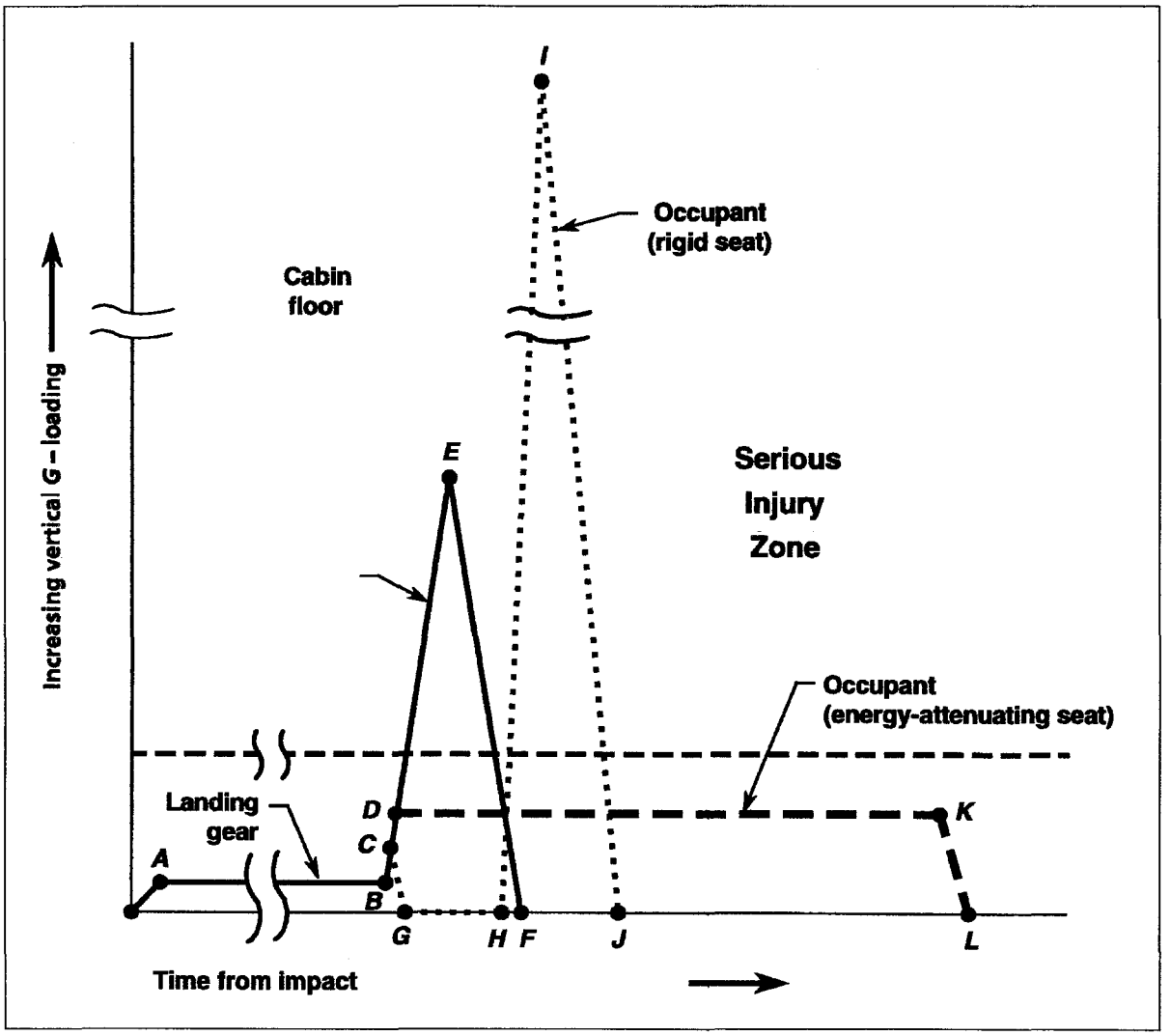


Figure 5. Vertical G Loading Applied to Occupant in Crash.

The Model 222 was the first civil aircraft to have energy attenuating seats for crew and passengers starting in 1980 (Figure 6). Since then, there are several other civil models to have energy attenuating seats. Energy attenuating seats are in over 600 civil Bell helicopters . There are a few seat manufacturers that offer energy attenuating seats to be retrofitted into existing aircraft. The FAA now requires dynamic seat testing (e.g. energy attenuating seats) for new helicopter designs.

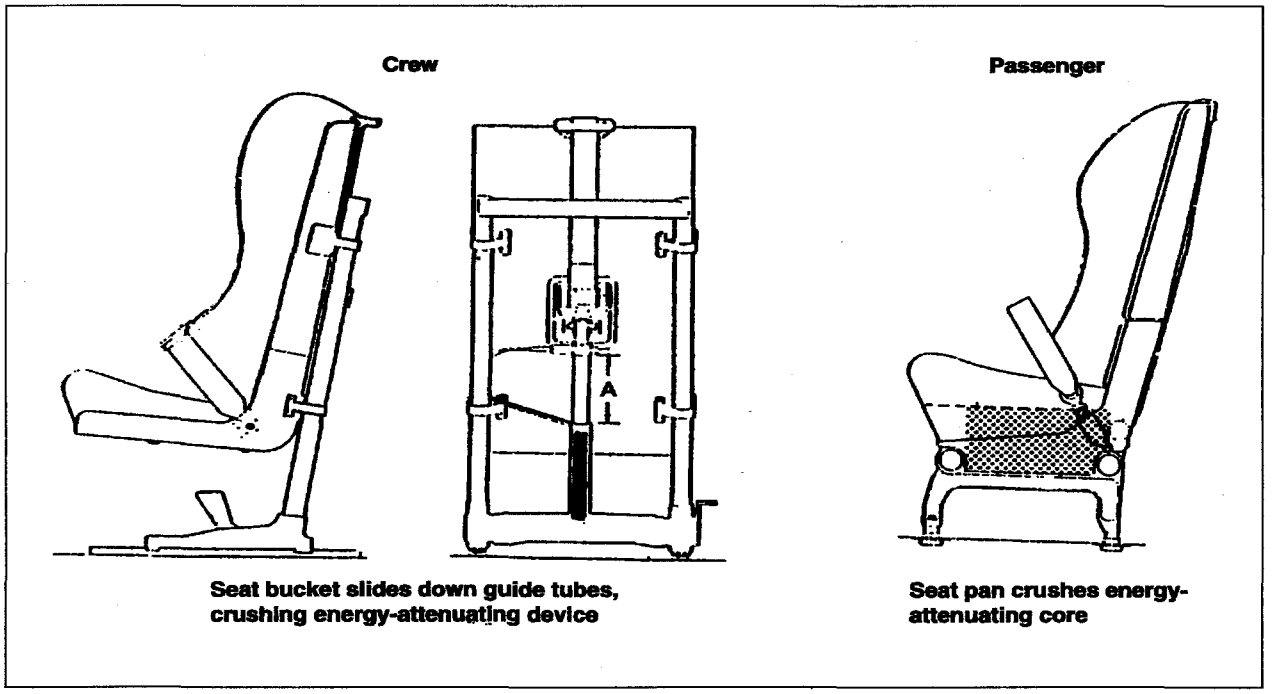


Figure 6. Model 222 Energy Attenuating Seats

Post Crash Fire Protection

The last crash survival requirement is to provide time to escape and a means of doing so. Emergency exits have worked quite well, but the main threat is the lack of time to escape a massive post-crash fire. Table 2 showed that post-crash fires were the most serious threat to the occupants of civil helicopters. A Crash Resistant Fuel System (CRFS) contains fuel long enough for occupants to escape a survivable crash before a post-crash fire becomes significant. It is not expected to prevent all fires, but only to delay the sudden massive fire (fireball) until the occupants have escaped. If, for example, a small fire near the engine area gradually grows to a roaring fire in 5 or 10 minutes, the CRFS will have still performed its function by providing time to escape.

CRFS are primarily tough, rupture-resistant bladders that can take the crash load abuse and still not leak. One of the CRFS tests is to fill a CRFS cell 80% full with water and drop it from a height of 50 feet. This CRFS cell impacting the hard surface at 56 ft/sec must not spill any water. The U.S. Army has had excellent experience with their CRFS since it was introduced in 1970. There are about 2,500 civil Bell helicopters produced with CRFS since 1980. The FAA has changed their certification requirements to include a CRFS in 1990.

FAA Responses in Crash Survival

Over the last decade, there have been significant efforts to improve crash survival in helicopters. Table 5 shows those regulatory changes relative to Table 2 injury hazards.

Table 5. FAA Rule Changes to Improve Crash Survival

Hazard No.	Hazard Description	FAA Response
1	Body exposed to fire when fuel system failed on impact.	Require CRFS for new Type Certificated models, Amendments 27-30 and 29-35.
2	Body received excessive decelerative forces when aircraft and seat allowed excessive loading.	Require Energy Attenuating Seats for new Type Certificated models, Amendments 27-25, 29-29, TSO-C127.
3	Body exposed to impact conditions due to in-flight wire strike.	
4	Body struck aircraft structure because design provided inadequate clearance and/or restraint allowed excessive motion.	Require shoulder harness for each occupant of all helicopters made after 1992. Requires shoulder harness be worn if installed. Amendments 27-28, 29-32, 91-223.
5	Body struck aircraft structure due to lack of upper torso restraint.	Require shoulder harness for each occupant of all helicopters made after 1992. Requires shoulder harness be worn if installed. Amendments 27-28, 29-32, 91-223.

SUMMARY

You can improve your chances of surviving a crash with little or no injury if you pay particular attention to occupant restraints, seats, and fuel systems. A logging pilot should wear a shoulder harness with an inertia reel for all flights. The proper brace position, if needed, is to sit up straight with shoulders touching the seat back. In some cases, an energy attenuating seat can be fitted to the helicopter to reduce spinal loading. Likewise, a CRFS installed in a helicopter significantly reduces the post crash fire threat to the helicopter occupants and the area around the impact site.

REFERENCES

1. Coltman, J. W., et al., "Analysis of Rotorcraft Crash Dynamics for Development of Improved Crashworthiness Design Criteria," DOT/FAA/CT-85/11 (U.S. Federal Aviation Administration, 1985).

2. USAAVSCOM TR 89-D-22, "Aircraft Crash Survival Design Guide," 5 Vols., December 1989.

3. Eiband, A. M., "Human Tolerance to Rapidly Applied Accelerations: A Summary of the Literature," NASA Memorandum 5-19-59E, (U.S. National Aeronautical and Space Administration), 1959.

4. Stech, E. I. and P. R. Payne, "Dynamic Models of the Human Body," AMRL-TR-66-157 (Aerospace Medical Research Laboratory, 1969).

5. "Airworthiness Standard; Occupant Restraint in Normal and Transport Category Rotorcraft," FAA Amendments 27-25 and 29-29 (55FR47310), November 13, 1989.

6. "TSO-C127, Rotorcraft and Transport Airplane Seating Systems," FAA Technical Standard Order TSO-C127, March 30, 1992.

7. "Airworthiness Standard; Shoulder Harness in Normal and Transport Category Rotorcraft," FAA Amendments 21-69, 27-28, 29-32, and 91-223, (55FR41048), August 16, 1991.

8. "Airworthiness Standard; Crash Resistant Fuel Systems in Normal and Transport Category Rotorcraft," FAA Amendments 27-30 and 29-35, October 5, 1990.

INVESTIGATION FINDINGS OF HELICOPTER LOGGING CRASHES

By Doug Herlihy, President, The Herlihy Group

Until September of last year I worked for the National Transportation Safety Board at Anchorage. I was one of the investigators-in-charge in Anchorage. There were three investigators in that office, and we worked approximately 200 accidents a year. I think last year we investigated 208. That's about average for Alaska each year. Each investigator gets the opportunity to work about 80 accidents a year. Spreading the work between us means you can do more work on some, less on others. We've done some helicopter logging accidents here in Southeast, and that's why I've been invited here today.

Basically, your work at an accident site is to take photographs, measurements, documentation, and some of the time assist in the recovery of the victims if you're out there with a trooper or FAA inspector. We work together to gather the facts.

I've chosen an accident for discussion which is representative, and we've talked about it a little bit. I chose a 214 helicopter accident. I hope to shed some light on what happened there, so that we can fill in some things between the lines.

What I'd like you to do is look, with the focus of a wide angle lens, at some of the photographs so that you can pick out, as the experts you are, some of the things that we see here in terrain, availability of emergency landing site, and some of the connections we found, and the long-line apparatus that perhaps played a part. No accident finding is clearly outlined by causals. You can't say that this, or that, is the cause. It's a causal string of events, like dominoes.

All of you know that there's a whole series of events that goes on. Violation of regulations is often cited as prime cause of accidents. One of my jobs is to look beyond the regulations, beyond the violations. I'm not going to go back and say there it is, a violation, a regulation was broken; ergo, we have an accident. My counterparts in the FAA, who come with me on many accidents, and I, have common arguments and common agreements about the requirement for FAA regulations and their enforcement.

Let's take a look at some photographs from one accident. Perhaps we can generate some questions. I brought these first two photographs along because they may answer some questions for me.

This is a model of a belly hook removed, in the closed position (Figure 1). I just wanted to have you take a good, close look at it because we might talk about this a little bit. It's an 8,000 pound Breeze Eastern hook that came off of the 214. It's similar to most belly hooks.

Identifying a few of the items in this, we see the hook, and there's a snubber and a tang on the back. When the tang hits against the rubber snubber, it stops the unit from opening beyond a certain flexing. This is the same hook in the open position (Figure 2).

This is a variety of a remote hook that we found in the 214 cases. We found in this case, a remote hook was hanging on the long-line somewhere about 150 feet or so down from the belly hook. It's electrically actuated from the cockpit. This remote hook, of course, is the one that the hooker hooks the choker into, that hangs below the helicopter (Figure 3).

This is the helicopter over at Dora Bay when we came onto the site on the morning of the accident (Figure 4). I was with Bob Colvig and Ned Horne. The aircraft, as you can see, has rolled about 135 degrees off to one side. The pickup place was up a slope about 1,100 feet in elevation to the left of the center of the photo, to the north, and the water is to the south at the top of the photo.

The wreckage is just to the right of the "Y" in the logging road (Figure 5). The helicopter was in its fifth cycle, and I think about the fifth or sixth turn of its fifth cycle, and it was seen to come in to this position into a stationary hover and set two logs down, one on an extended choker, and one on a choker attached to the remote hook. The logs happened to sit balanced on top of each other for a moment.

The yarder operator did not see the helicopter at that moment, and looked up in time to catch the helicopter starting a series of yaws and pitches and a rolling movement in position, both left and right, up and down, not very rapidly. He described them as coming in approximately half second intervals. The helicopter was then seen to move down slightly in a descent from about 200 feet or 175 feet, out-of-ground effect hover, still wobbling in a right turn. The witnesses said they thought it was heading for the flat area right above the crash site.

Logs were still attached to the remote hook that was still attached to the long-line lying about 150 feet south of the wreckage. The clevis of the long-line stopped approximately 11 feet from the belly hook on the bottom of the helicopter (Figure 6). The belly hook was closed.

Witnesses saw the helicopter descending with rotor RPMs decaying and dragging the two logs over a distance of about 55 feet until they hung up in some snags. Descending to a point 25 feet over the stump at the crash site, the helicopter, with its line still tethered to the two logs, caught up taut by dragging the logs, and stopped its forward movement. The helicopter was seen to pitch over from that 25-foot altitude. I feel that the helicopter accident, at that point, became unsurvivable. A stump penetrated the cockpit.

We might say here that we've found that there are only three things that'll kill you in an accident: 1) the bubble that you're sitting in, the capsule, the cockpit, or the cabin, is penetrated or crushed; 2) you're either burned or asphyxiated; or 3) neither of the aforementioned factors exists, but your body, the organism, is exposed to g forces beyond human tolerance limits. You'll see ripping of the aorta and certain organs come apart, even though you're not penetrated or burned. This accident became unsurvivable at this point when the stump penetrated the cockpit.

This photograph is the view from aft (Figure 7). The helicopter's main rotor is shed, of course. One of the things we noticed here was that the short shaft, the drive shaft between the transmission and the engine, and the rear coupling had come apart (Figure 8). At first when we looked at the broken coupling as it had penetrated the cowling, we noticed pieces of it had penetrated the hull, and so we began to think we were looking at a partial problem of the short shaft uncoupling, which was contributing to the decay in the rotor RPMs. As it turned out, we discounted that. It's more likely that the coupling came apart on impact, even though we didn't find a lot of the pieces.

The aircraft rolled to about 135 degrees. We were able to get into the deck from underneath, to the transmission and the engine deck, where we found evidence that there was something wrong in the cyclic linkage. An extension of the right cyclic piston had broken from some limited-cycle fatigue

right where a binding nut and some threads first show on the rod that comes out of the assembly. It broke where you would expect it to break. There was a fracture where stress risers on the rod were introduced and that's where you'd expect a break (Figure 9).

This component was photographed on scene and we sent it to the NTSB lab in Washington and then over to the Southwest NTSB office, where a second tear-down with the Bell lab was conducted. The work that we saw in that component was consistent with a binding in a spherical bearing in the center of that unit. This binding was seen when we tried to move the piston up and down through the spherical bearing. The spherical bearing had scratches on it that were inconsistent with what we'd normally see if had it been overhauled. The records showed the component itself had a history of being sent back and forth from Japan. As I remember, it was overhauled, or there was a record that it was overhauled. However, there's some question on what was done in the overhaul. So, that's where we leave it.

I hope that gives you a brief picture of the kind of inquiry that we tried to do in this one to try to find why this component could have failed in fatigue. The binding of the spherical bearing translated to bending, as the piston went up and down. Normally, the spherical bearing allowed it to flex side to side. That binding in this spherical bearing translated to some increased torque needed to move it, thereby imparting a bending force to the rod, which of course wasn't able to bend when it was down in the assembly, because it was held by a series of bearing and shims and collars all the way up through the assembly. When the rod got outside the assembly, there it could bend, and that was where the stress risers of the threads and the milling of the key were introduced, resulting in a failure. We believe the crew worked hard to fly a helicopter that had loss of pitch and roll control. That's what witnesses told us.

The investigation also identified human factors. One of the interesting things we found in this helicopter crash was a plywood bench seat that ejected in the crash. This seat was used for transporting the folks to the logging area. It's probably against regulations, but that's not the point. And of course it didn't figure in the accident. But we do see a seat that's not crash worthy, a hard wooden bench seat. It does provide a small picture of the disregard for passenger safety in this operation.

We looked at other areas concerning human factors. We found the pilot's cycle sheets with both pilots' names on them, and we brought them back and examined them and went through the numbers. Looking at the load of the helicopter, we figured that he carried off 1,500 pounds of fuel, and we verified that with the fueler.

He burned down to about 250 or so, in an hour and five or ten minutes. He had, therefore, a range of logs he could carry. Essentially all heli-logging operations work the same way. With more fuel, you have to carry fewer logs. Right after refueling, the pilot of this helicopter could carry a load or combination of logs that would be around 5,700 pounds, increasing to about 6,900 pounds at the end of his work cycle.

At the end of about an hour he had about a 1,200 pound difference in log weight limitation. Limits of the first log carried were 5700 pounds; the weight of the log at the end of the cycle was somewhere around 6,950 or so. His cycle sheets showed that they consistently carried logs in excess of 7,000 right after fueling. There were occasional notations of 8,000 pounds. This was not a one-time thing, it was done a number of times.

On the cycle that this accident occurred, during the sixth turn of his fifth cycle, in either four or five of the turns before this accident, he was overweight by 1,000 pounds. Now how does this translate to the fatigue failure of the right cyclic servo? I don't know. But the continued overload could not be discounted.

Other things were seen in the toxicology report. The NTSB required a tox report of the pilots, and found one pilot had 20 times the minimum detectable level of marijuana metabolite in his system. How does this translate to his capability to handle the helicopter in an emergency, and his job to get rid the load manually? I don't know. It does say something about the way the operation was run in terms of human oversight and stress.

I'd like to briefly discuss an engine failure we alluded to earlier that resulted in a helicopter autorotating from and out-of-ground effect hover onto a very hazardous piece of country (Figure 10). It occurred in this Bell 214 when nuts backed off from two of the cross case bolts up forward in the compressor section of the D55 engine. The two nuts that backed off were particularly hard to tighten because of their location under a bleed band. In fact, they sat in a little pocket underneath the bleed band of the number 6 opposite a hole directly over the number six compressor section. When we took the bleed band off in the tear down, we found two of the bolts had no nuts on them. When we cracked the case and got in to examine the debris, we looked particularly for debris that didn't belong in the compressor, burners, or turbine. The compressor section was fodded-out from the sixth stage aft. Everything aft of the sixth stage was destroyed.

When we did a material analysis of the particles, or just the shreds of particles, back in the hot section, some of the particles sent to the lab turned up as belonging to the two nuts . The helicopter involved in the accident had a recent engine change. It was a field installation, where someone had put the two major engine components together in the field under poor conditions, the kind many mechanics must work under.

This particular engine was put together and installed in temperatures of 20 degrees, in an open and unheated shed. FAA inspectors and I saw that helicopter going together under those conditions while on site following a previous accident. That's the unfortunate situation.

The area of that crash, quite typically, shows the degree of hazards and obstacles you face trying to crawl down through all that bucked and felled timber, from the top of a hill. It's impossible to reach someone in a hurry. These are tough places to get around. It must be incredibly tough to work.

I want to close my remarks by saying that since I've left the Board, it's interesting for me to see a part of accident investigations I hadn't seen before. Some of the things discussed this morning concern the interpretations in courtrooms of these accidents, and a belief by the public that this business is a real dangerous operation. The numbers support that it is, but what's also important is the public perception of it, and the impact of the newspapers and the media make it so.

Like in a courtroom, the public is also the jury. When the same people get to sit on a jury and decide these cases of negligence against operators, they are affected by what is printed in the news about the industry. It's very effective for plaintiff attorneys to argue negligence to the public sitting in a jury box. It's very effective. So, whatever the industry can do to control risk factors, is going to help immensely when it comes to the litigation risk affecting field operators, and the cost of doing business.

MR. DALE HOKE (Aerial Crane Systems): On the 214 accident, did you determine what the wind was at the time of the accident at aircraft level, roughly?

MR. HERLIHY: Yes, sir. Northeast. I don't want to quantify it and say it was no factor, but it looks like the aircraft came down the hill with a slight tail wind and turned around into the wind. However, these weren't high winds. This wasn't the case on the 204B accident that followed over at Copper Harbor (Figure 11). That pilot had a strong wind coming down the hill behind him, probably 17 to 22 knots. A strong tail wind with a load coming down. He flew around 1,200 feet and the helicopter came down with that smoking tail rotor. He did drop the load up at the top from the remote hook. Then he came down with the long-line and for some reason went into an out-of-ground effect hover above the maintenance site. He then started a vertical descent to coil the long-line, still with the smoking tail rotor.

In that accident, the tail rotor, the whole 90 degree gear box, departed. We found that the six studs that held the 90 degree gear box had failed catastrophically. We saw that there was high heat and abrasion at the output quill, which was probably the source of the smoke. The movement of the studs was backing the unit out, with loss of oil and heat buildup. That's why we saw some scoring and the smoke was coming from oil heat coming out.

UNIDENTIFIED VOICE: On the next to the last slide (Figure 10) you showed, did you say that the pilot survived the impact of the crash?

MR. HERLIHY: Both of those individuals walked away, or crawled away. They were hurt. That was engine failure.

MR. JIM LEMATTA (Columbia Helicopter): On that 214 accident where the log and the long-line hung up, was it determined that they punched it off, or not? Was there an O or a D-ring or a shackle, or was it a swedge that was in the hook?

MR. HERLIHY: Swedge clevis is a loop, like a teardrop loop, that's swedged in.

UNIDENTIFIED VOICE: It's put in by the manufacturer of the cable.

UNIDENTIFIED VOICE: Or a thimble.

UNIDENTIFIED VOICE: That's a thimble, not a clevis.

MR. HERLIHY: Yes. I call it a clevis. To answer your question on the belly hook, we had a mechanic out there by that time, and we brought out that hook, among other parts that we brought back. We hooked up a battery to that hook and we got it to trigger effectively. It was electrically fine, and mechanically fine.

The cockpit was so damaged that we could not recreate continuity between any part in the cockpit, either mechanical or electrical, to that switch, so I don't know whether it was hooked up correctly or not. I can't rule out that it wasn't working. Now, why was it closed and the swedge outside? The

most probable scenario that investigators have to go on is that it was never punched off. The pilot may have suffered from task overload. There's not a person in this room who doesn't believe that these guys were overloaded in tasks at that point, with a helicopter that was coming out of the sky. Perhaps they never got to it. When the impact occurred there's a lot of twisting, moving, pulling, ripping, and compression, as you know, that happens in a few microseconds in all of these systems, and either electrically or mechanically the hook opened. We have noted, in flight data recorders and cockpit voice recorders, that there's a huge electrical spike that goes through the electrical system at impact. Those surges may have caused electrical energy sufficient to open the hook. An alternate explanation is that the pulling and stretching of the mechanical kick out switch, as it's connected cable-wise to the hook, also could have been actuated. There's a possibility that the hook was carried closed.

But there may be another explanation. Unlike other hooks, perhaps the hook used in this operation opened to some degree short of 90 degrees down. Would it have released? Probably not, when the helicopter is in forward flight with tension at approximately a 30, 35 degree drag angle on the cable as it's pulling these logs behind. We found that in that particular hook there was a wearing notch, which is quite normal. We looked at other ones that wore a notch in the hook. Had the thimble been hooked in that wearing notch, it would have been directly under the center of that hook, even with the hook down and fully open, the part design would not have allowed the hook to slide off. It may have slid off if the helicopter was in a hover, and there was dead load on it, but not in the dynamic condition that occurred following the loss of control over the log yard.

I presented both scenarios as food for thought for you in the industry to say, "Hey, could this happen?" Could we have a pilot attempting to jettison from a belly hook that will only open 70 or 80 degrees down? Efforts to discuss this event with the manufacturer were not successful.

UNIDENTIFIED VOICE: Another possibility would be that the thimble didn't come off of there clean, that it hung up on the closing. If the thimble wasn't of sufficient size, this might have been the case.

MR. HERLIHY: Thank you. I took a thimble the same size, and slid it easily on and off. It was large, twice the size of the hook itself. I didn't see any squeezing. That thing would easily just slap right on and off. I talked with engineers in Washington to see what their best guess of restriction or constriction would be under dynamic loads, because we have no way of dynamically testing either that thimble or the hook. We just did it statically. Does that mean it worked effectively under load? No. That does not mean that. I can't be certain of that, but that's as far as we could go.

UNIDENTIFIED VOICE: I think most of the pilots here would agree that they don't open if you get them too heavily loaded.

MR. HERLIHY: In this scenario, witnesses said that at the onset of loss of control over the dump there was no load on it, and that may be a problem, too. It was slack. The load was absent all the way around until the pilot started picking up the slack. So, there was an immediate strain on that thing. During the period of the time where jettison activity could have occurred, there wasn't high strain. We just can't say for certain what occurred.

UNIDENTIFIED VOICE: A logging pilot's typical reaction would be to attempt to jettison the log first, not the long-line.

MR. HERLIHY: Using the remote.

UNIDENTIFIED VOICE: The lower hook.

UNIDENTIFIED VOICE: I talked to some of the crew who were on the ground when that crash occurred. From what they said, it appeared that either the hook was on the ground or that there was a great deal of slack in the choker. You have a spring return on your load beam, so you can hit that button, release your solenoid, and if it doesn't have a load on it of some sort, just the weight of the choker to spit it, the choker will remain in the hook. It's very likely that these fellows thought they had released the load. As they were dealing with this malfunction of the aircraft, it came tight on them.

MR. HERLIHY: There are a lot of unknowns that are part of this. We don't have a cockpit voice recorder, and for me to speculate on what was going on up there is not a professional approach.

Figure 1. *Belly Hook in the Closed Position.*

Figure 2. *Belly Hook in the Open Position.*

Figure 3. *Remote Hook.*

Figure 4. *Helicopter Accident at Dora Bay.*

Figure 5. *Dora Bay Wreckage to Right of the "Y" in the Road.*

Figure 6. *The Clevis of the Long-Line.*

Figure 7. *Aft View of the Helicopter at Dora Bay.*

Figure 8. *Drive Shaft and Rear Coupling Separated.*

Figure 9. *Location of Break on Right Cyclic Piston Rod.*

Figure 10. *Bell 214 Autorotating Accident.*

Figure 11. *204B Accident at Copper Harbor.*

APPLYING LESSONS FROM INDUSTRY ACCIDENTS, HELICOPTER LOGGING SUPPORT: AN INVESTIGATOR'S PERSPECTIVE

By Douglas R. Herlihy, Partner, Herlihy & Leonard

Good morning and thank you for the opportunity to share some thoughts again at the Ketchikan Helicopter Logging Safety Workshop. My comments today deal with the nuts and bolts of the events as a result of a helicopter loss in this industry. Not the determination of cause, per se, but the lessons that arise from the aftermath. As a private aviation accident investigator, I deal with the circumstances and issues following the official inquiry, which, unfortunately, in this small segment of aviation, often leaves more questions than answers. Today, I would appreciate the opportunity to discuss a few issues that can cause almost as much damage to your pilots, their families and your company, as a tragic accident itself.

Before I discuss the logging support helicopter case study, I would like to briefly touch on recent changes that may be coming as a result of the Sikorsky 58T crash on top of the 13-story building in San Jose, California, in January 1994. As some of you may recall from our discussion at the last meeting here in Ketchikan, the aircraft had just placed an 1800-pound steam cleaning machine on the roof of the building when the ground crew on the roof below heard, "both N_1's unwinding".[1] The helicopter settled to a one-wheel landing on a small cooling tower, falling to one side as the rotor RPM decayed. The main rotor contacted the roof wall below and the helicopter was destroyed, fatally injuring the pilot.

The aircraft was operating under Part 133, and a load plan had been approved by the local Flight Standards District Office. The plan identified a parking lot as the staging area; however, the fact that the parking lot was studded with light poles was not taken into account until the day of the lift. This necessitated the rigging and the hookups to be done from a hover over the light poles. At the time of the power loss, there were very few options left to the pilot for autorotation.

The NTSB investigators found that there was likely 267 pounds of fuel on board when the helicopter departed the San Jose Airport, 17 minutes earlier. It was also likely that fuel exhaustion occurred at 64 pounds (9.5 gallons) remaining as unusable in the forward and aft tanks.

Additionally, the investigators found that consistent with Part 133, the pilot didn't have any recurrent training, nor was he required to have, in the past 12 months. There was no record of the company requiring any training or checking in emergency procedures, autorotation with or without the load, load jettison, or flight and fuel planning.

The NTSB found that there had been 19 external load helicopter crashes attributed to fuel starvation in the past 12 years, and another 21 engine failure crashes of unexplained or fuel system anomalies.[2] In the opinion of the Board, "those helicopters' fuel quantity gauging and indicating systems may not be sufficiently accurate for the safe conduct of such operations without periodic calibration." On January 9th of 1997, the Board issued four Safety Recommendations to the Administrator of the FAA relating to this accident,[3] calling for changes to Part 133, requiring initial and annual recurrent training, "similar in frequency as in Parts 135 and 121."[4] The Board's recommendations also added additional requirements addressing fuel planning, changes to rotorcraft-load combination manuals and periodic calibration of fuel gauges.

Photo 1. *A steam cleaner, 100 foot long-line cable and lifting slings, set below the location of the dual engine power loss.*

Photo 2. *Wreckage of tail cone and tail rotor on the 13th story roof of the building in downtown San Jose, January 28, 1994.*

Photo 3. *Wreckage of main rotor and gearbox consumed by titanium-fed fire.*

This event is highlighted today to keep you abreast of changes to Part 133 training and checking requirements that was a topic of this workshop in 1995 and 1996. The FAA administrator's reply to the NTSB and changes to Part 133 are pending at this time.

Case Study of the Bell 206 Crash at Warren, ID, 7/24/96

In order to present the difficult issues faced after a helicopter accident, I would like to present a brief case study of an accident that occurred last year involving a logging support Bell 206 in Idaho. In the afternoon hours of July 24, 1996, a Bell 206 crashed at a clearing, as it was attempting to lift two cutters and their equipment following a day's work at about the 6,500 foot level. The pilot had recently been discharged from the U.S. Army as a pilot of more powerful machines in military operations and had begun his civilian career as a Bell Jet Ranger pilot only a few days earlier. Unknown to the logging operator, the pilot had applied for but not yet been granted a certificate to operate under 135.[5] Weather reports indicated clear conditions, uphill winds, and temperatures in the 80 degree range. The cleared site was sloping about ten degrees, with split logs placed perpendicular to the helicopter's skids. The uphill log was about 18 inches on the chord surface and about 15 feet long. The downhill log was split 15 inches and 50 feet long. The circular clearing cut in the forest measured approximately 50 yards in diameter, uphill approach path, having tree tops approximately 40 feet above the landing zone center at a distance of 100 yards. Standing timber of 100 to 130 feet surrounded the landing zone on three sides. The zone center was clear of obstructions of brush and tops for a distance of approximately 40 feet.

The helicopter set down across the two set logs and loaded the workers, the first in the left front seat and the second in the rear, who recalled strapping into the middle of the bench seat. A recreation of rotor clearance on the uphill slope indicated that his tip clearance ahead was about 60 inches. A summer uphill breeze, believed to be about ten to 12 knots was believed to be coming from the helicopter's left quarter. The temperature put the density altitude at between 7,000 and 8,000 feet. And as the helicopter attempted its lift off, a main rotor blade tip struck the ground and sheared at about one-third of its blade length. As the helicopter rolled, as a result of the torque, the shattered blade struck the top quarter of the forward cabin on the left side and fatally injured the front seat worker.

This summarizes the facts as gathered at the scene of the accident. We have evidence of a rollover event, a blade tip strike on the ground, followed by a catastrophic blade failure and impact of the helicopter cockpit. There was no evidence of pre-event malfunction, or post-crash fire. The fatal injuries to the front seat passenger were blunt trauma in nature.

Not diminishing the terrible tragedy of this loss of life accident, those events which occurred following the accident have very important and far-reaching results in these types of accidents which are the focus of my discussion.

NTSB Investigation

Following notification of the accident, the National Transportation Safety Board elected to conduct a "limited" investigation of the mishap.[6] Essentially, a "limited" accident differs from a normal field investigation in that the investigator does not conduct an on-scene investigation, but gathers information for his report from telephone inquiry or by use of reports from police and/or FAA inspectors, or

Photo 4. *The landing zone, in the mountains above Warren, Idaho, was cleared by the cutters on the day of the accident.*

Photo 5. *The Bell 206 rests on its right side, with it's main rotor separated at the mast. The left forward cockpit structure compromised by downward and rearward energy at the door frame from the broken blade. The tail cone and tail rotor showed neither damage nor pre-impact stoppage.*

other observers. In this case, following an NTSB interview of the pilot by telephone, the scene was visited by an FAA inspector, who provided his observations for the report. The interview of the pilot and the FAA's view of the scene provided the major input to the NTSB report. Typical of other "limited" investigations, this inquiry was conducted without the benefit of input from trained helicopter experts, or other technically qualified persons from the logging company who could have been afforded the "right of party" to the investigation under Safety Board regulations.[7]

Photo 6. *Left cockpit door post structure showing blade impact crushing.*

Photo 7. *Logs placed as a landing pad to accommodate the Bell 206 skids showed indications of pivoting as a result of the rollover and airframe impact.*

NTSB Interview of Pilot by Telephone

Also typical of "limited" accident investigations, the telephone interview of the pilot by the NTSB investigator was conducted long distance from Boise, from the offices of the FAA's Flight Standards District Office. During this particular interview of the helicopter pilot, in a state unquestionably traumatized from his ordeal, the FAA inspector assigned to the case *listened on the speaker phone to the conversation*. The pilot knew neither of his right of representation, nor appreciated the role of a regulation enforcement official who had the advantage of utilizing the NTSB as an interrogator of the certificate-holding pilot. It is unknown whether the interview was recorded through the FAA telephone system; the pilot was not so informed.

In an event such as an unexpected rollover, and a blade strike and destruction of a helicopter that occurs in the span of a second or less, it is doubtful the pilot can recall the events, and equally doubtful that he understands or appreciates the cause or the rapid sequence of events in the crash. There are certain human tendencies to explain the cause of tragedies as not being of one's own making. Pilots involved in accidents routinely point to conditions outside their own ego and responsibility as being the cause of their misfortune. Notwithstanding these commonly accepted realities, the FAA and the NTSB investigators use the account of the pilot that "a log rolled over onto my skid as I attempted the takeoff." The pilot also stated "the passengers had known the log was unstable but failed to inform him of the instability prior to liftoff." That information was simply a mischaracterization of the statement relating to the skid tip location as recalled by the back seat survivor. That witness told investigators later in a recorded interview that at the time of boarding, he noticed the tip of the skid to be barely on the front log.

Following the FAA inspector's visit to the scene, the log-rolling-onto-the-skid scenario was entered as probable cause of the accident in official government reports.

Facts Do Not Support The Report

Without detailing the process of the investigation that followed the FAA investigator's visit to the crash site, the facts, circumstances, measurements and performance calculations simply do not support the pilot's rendition of the event, and contradict the government report.

Limited Government Resources and Interest

This brief case study is not intended to be an indictment of the government investigators whose case load greatly exceeds their time and resources. Mindful of limited budgets, travel time, and competing requirements of accidents having higher visibility, NTSB regional offices limit the time allocated to aviation accidents in the timber, aerial firefighting, and agricultural industries. Logging helicopter accidents continue to be low priority, where fatalities involved "workers only" in an industry that is considered patently hazardous.

Moreover, cases involving helicopter performance, calculations of rotorcraft dynamics are clearly outside the investigative capabilities or experience of general aviation NTSB or FAA inspectors. Such inquiry demands that all the facts, crash kinematics, ground scars, measurements and testimony be afforded careful analysis by a number of disciplines. In this particular case that was not done, and the

"probable cause" was a subjective validation of a pilot's report of cause. The important lesson learned in this case was the serious regulatory and litigious chain of events that were set in motion.

Inaccurate Reports Inspire Litigation and Regulatory Action

As a result of a report with serious errors, a broad range of legal and potentially litigious issues were placed in record, and became difficult to refute without considerable effort by owners, operators, insured parties, and their experts. What was considered by the federal authorities as a low priority accident investigation having few issues, potentially resulted in litigious and regulatory problems for many parties and the helicopter logging industry. Since the government investigation took place without the benefit of representation or input of interested parties, and the findings, albeit erroneous, focused on a deficiency in the landing site construction, the government remedy was soon misdirected toward changes in that area. The potential for additional state or federal government oversight was soon added, not to mention the potential of lawsuit against the logging operator.

And, further snowballing government involvement, the NTSB investigator followed up months later with an inquiry to the logging operator to ascertain "plans for changing the way helicopter landing sites are constructed." This inquiry introduces another potential layer of government oversight and surveillance on the design and construction of forest landing sites, which now widely range from steeply sloping benches onto which platforms are built, to openings in the forest requiring more vertical approaches and departures. A wide range of conditions, approaches, terrain, natural and constructed landing sites simply require the experienced pilot to be the final judge on any and all landings. A site construction which may be deemed excellent by one standard on a certain day, can be hazardous with changes in wind direction or density altitude. There are simply many variables, and any site construction must be the result of experienced coordination between the pilot and the forest workers.

Photo 8. *An example of a platform built on a steeply sloping bench. Pilots flying to these platforms contend with uphill rotor clearance, favorable landing conditions considering winds, and passenger safety when leaving and boarding.*

NTSB and FAA Investigations - Pilot and Operator Safeguards

Government agencies with limited time and resources, and a wide experience spectrum of "inspectors and investigators" on the job, generate investigative reports also widely ranging from very brief to very detailed. The quality and accuracy of their findings range from extremely flawed to quite detailed and accurate. Theoretically, an NTSB investigation is conducted with objectivity, without the biased regulatory influence of the FAA, or from the manufacturers or operators who understandably have self-serving interests. Clearly, regardless of the intent to remain objective and unaffected by the realities of civil litigation that may follow a tragic accident, the NTSB plays an important role and consistently facilitates civil litigation to follow. Likewise, with its broad statutory powers to demand records and interrogate witnesses (without the requirements to offer caution against self-incrimination, or self-damaging statements), NTSB investigators lay a foundation for the lawsuits and certificate actions to follow.

Congress Intended the NTSB to Conduct Inquiries Apart from the Actions of Litigants and Claimants, Specifically Excluding Them from the Investigative Process[9]

While the framework of regulations under which the NTSB conducts its investigations and develops it's findings are *specifically designed to avoid involvement in civil litigation*, many links to future legal actions actually arise out of the Board's conduct of investigation. Actions by federal agencies against pilots and certificate holders, as well as actions by claimants and litigants in court against those involved, in reality, arise directly from the findings and conclusions of the National Transportation Safety Board.

Regardless of the oft repeated claim that the Board reports cannot be considered by courts or are not admissible as evidence, introducing the government's report is a commonly accepted practice. Witnesses routinely refer to the Board's report, investigators routinely are deposed on the factual findings, and indeed factual reports, with their analytical attachments, often get appended to documents submitted to, and accepted by, courts. Parties litigating against one another routinely introduce the NTSB reports and the FAA enforcement actions that grew out of the facts gathered by the Safety Board, and expert witnesses often use the reports in affidavits and testimony.

"Party Status"

A word about "party status" is in order at this point. NTSB regulations allow the Safety Board's IIC (investigator-in-charge), to be assisted in the investigation by those persons, government agencies, companies, and associations whose employees, functions, activities or products were involved in the accident and "can provide suitable qualified technical personnel to assist in the field investigation."[10] Routinely, "party status" is offered and accepted from employees of airframe, engine, avionics and component manufacturers. Likewise, in cases involving air carriers, "party status" is obtained by unions of the pilots, flight attendants, mechanics, and the air traffic controllers. "Party status" is not offered or allowed for *those representing insurers or claimants.*[11] Neither is "party status" offered to persons representing survivors, passengers, those injured, or pilots.[12]

Limited Application of "Party Status" in NTSB Field Investigations

Routinely, the crash of a helicopter will bring the representatives of the airframe and engine manufacturer to the scene within a day, usually to coincide with the arrival of the NTSB investigator. Like the Safety Board's on-duty investigators, most all manufacturers have full time investigators on call. Upon arrival, they are granted "party status" and accompany the government investigator to the scene, who, by regulation takes custody of your aircraft. With the technical assistance of the manufacturer's representatives, the parts can be removed, the aircraft can be dismantled, records can be examined and witnesses and survivors can be questioned. The NTSB investigator may do whatever he or she deems necessary to conduct the inquiry.[13]

Unfortunately, it is uncommon to find that the operator or an owner of an aircraft or the logging operation has been made aware of "party status", or has participated in the "party" process. It's even more unlikely the operator has sought legal representation of legal counsel or other experts familiar with the protection of his property during the time when he is most vulnerable.

Ask for "Party Status"

Consistent with the needs to furnish "technical expertise" to the NTSB, be prepared to supply someone of experience to assist the investigator-in-charge throughout the investigation. Ensure that that individual observes and assists the investigator in all phases of his on-scene inquiry, examination of records and, if need be, travels to the location of the engine or component tear-down. Caution all of your *employee participants to refrain from speculating*, or offering anything but factual information. It is the job of the NTSB to be analytical at this point, not theirs. More often than not, speculation at this time will lead to erroneous conclusions, difficult to undo. Likewise, statements by your employees have a way of surfacing in the NTSB factual report and can be used against you in future litigation. Even if not admissible as part of an NTSB report, such statements may be used to challenge statements at a later date when damaging information is being clarified for the record.

FAA and the Removal of Records

Following an accident, and in conjunction with, or before the arrival of an NTSB investigator, an FAA Flight Standards District Office inspector often arrives and demands the aircraft records. While his role at this point may be understood to support the Safety Board in its inquiry, make no mistake as to the purpose of the FAA's record search. The examination of records by the FAA is to determine the compliance with the Federal Aviation Regulations, and is first and foremost for enforcement purposes.

The safeguarding of your records, and the review by the NTSB and the FAA should be done with close and continuous representation by your company. Since these records, their completeness and accuracy, will most likely play an important role in future legal actions, insist on protecting these records in their entirety, including each page and attachment, yellow tag, and overhaul report. Insist on a presence at every examination of your records, and producing copies of every page removed from your possession. Any and all records removed by the NTSB or the FAA under the direction of the NTSB, should be by receipt, after copies are made.

Submissions to the Safety Board

Finally, a little understood avenue is available to you as the operator to provide input to the government on your behalf. Safety Board regulations[14] provide the opportunity to make your own written contribution as to the facts and circumstances, as you see them, to be placed in public record with the report. The Board may choose to consider or ignore your submission when issuing the "probable cause", however, they will remain as part of the public record.

Summary

As a way of concluding this brief discussion of lessons learned from routine interaction with federal agencies following an accident, I would recommend that all operators prepare a short, precise checklist to be used should there ever be the occasion of a tragic accident which draws the attention of the NTSB. As a minimum, your checklist should include the following points:

1. Cooperate and stay involved with all phases of the NTSB investigation.

2. Keep control and accountability of all your records.

3. Press for "party status" in all phases of the investigation, engine or component teardown, or technical meetings by supplying and supporting the investigation with technically qualified personnel at any location where others with "party status" are interacting with the NTSB investigator.

4. Insist that all of your employees, pilots or other personnel who are questioned by the NTSB or the FAA, have the benefit of representation at the time of their interviews. Ask that those interviews be recorded.

5. When party to the investigation, support the NTSB investigator and follow the required "flow and dissemination of accident investigation" as per Board regulations.[15]

6. Consider preparing and submitting to the Safety Board, your own report of accident investigation and recommendations to prevent the recurrence of another accident "prior to the issuance of probable cause". (Usually within six months of the accident date.)

REFERENCES

1. The witness, an A&P mechanic, described a simultaneous power loss on both engines, followed by a settling to the building top. NTSB Operations Group Chairman's report of LAX94FA106.

2. During the past 12 years there was recorded 187 external load crashes. The fuel exhaustion, unexplained, and fuel anomaly crashes accounted for 21 percent of the total crashes. (NTSB statistics through 1996.)

3. NTSB Safety Recommendation A-96-180 through 183, Office of Safety Recommendations 1/ 9/97.

4. Ibid. A-96-180.

5. 14 CFR Part 135, air carrier, on demand helicopter.

6. SEA 96LA165. Preliminary Report, NTSB Northwest Regional Office.

7. 49 CFR Part 831.11 "Party Status" Inasmuch as the worker's employer was on scene, and as the contracting helicopter operator had extensive experience, party status to provide technical expertise would have clarified many issues and undoubtedly supported the investigation.

8. While federal regulations 49 CFR Part 831.7 allow all those who are questioned to have representation, NTSB investigators are not required to advise the public of those rights. And, while the presence of an FAA inspector can routinely result in certificate actions and penalties to airmen and operators, NTSB investigators are not required to caution witnesses against speaking in their presence.

9. Ibid. 49 CFR Part 831.1 (c) on exclusion of claimants and litigants.

10. Ibid. 49 CFR Part 831.11(a) Parties to the Field Investigation.

11. Ibid.

12. With the exception of pilots' or other flight crew unions.

13. 49 CFR Part 831.8 and 831.9, duties/authority of IIC.

14. 49 CFR Part 831.14.

15. 49 CFR Part 831.13.

CHAPTER VIII
HELICOPTER ASSOCIATION INTERNATIONAL

HELICOPTER ASSOCIATION INTERNATIONAL (HAI)

By Glen Rizner, Vice-President of Operations, Helicopter Association International (HAI)

I want to thank NIOSH and Mike for the opportunity to be here and to participate in the symposium. Many people will speak later on HAI's specific role in the helicopter logging industry. Phil Kemp, the chairman of our Helicopter Logging Committee, will follow me. What I'd like to do now is back-up and ensure everybody has an understanding of HAI's mission. Everybody has heard of HAI, but a lot of people don't know the true realm of all the different things that we do. So, I'd like to provide an overview of a variety of the work that our committee's and staff do.

HAI is coming up on our 50th anniversary. It's going to be a great show. We started back in 1948 with the Helicopter Council. The first meeting was in Burbank, California, where 14 operators and one manufacturer, Bell Helicopter, participated. Within one year, the Helicopter Council became the California Helicopter Association, quickly going on to become the Helicopter Association of America, and in 1981 HAI.

Currently, we have 1,400 member organizations of which 650 are helicopter operators that fly 4,000 helicopters about 2 million hours each year. Also, of the 1,400, we have 750 associate members that include manufacturers, repair facilities, brokers, insurers, lessors, and other supporters of the industry.

In a more global perspective, today's world helicopter fleet totals about 22,000 helicopters. The breakdown is about 10,000 in the United States, 1,500 in Canada, and about 1,000 in Japan. The value of the current helicopter fleet is estimated to be around 11.3 billion dollars.

HAI has a variety of committees, currently numbering 21. The work that the committees are doing is amazing. For instance, the Acoustics Committee is still processing the numbers from the Heli-Star program conducted at the 1996 Olympics in Atlanta. Heli-Star was the program where a GPS-based helicopter route structure was used to deliver packages being shipped via Federal Express and UPS, and to test the economics of using rotorcraft in an urban environment that was already operating at capacity. The Heli-Star team also set up monitoring stations to record all the acoustics from those rotorcraft, and to document every complaint, of which there was exactly one in the entire Olympic period. They are now calculating the numbers for the economics and acoustic data to demonstrate how rotorcraft can fly economically and friendly in an urban environment. We expect results to be out in the next month or two.

The Flight Operations Committee recently met with the Southern Region of the FAA, to help develop a GPS derived, IFR route structure for rotorcraft, that's going to start around the North Carolina border and go up to New England. It will allow rotorcraft to participate in the IFR system, while staying below those altitudes that airplanes use. The route structures were test flown VFR last summer. Right now, we're working out the final changes to the route structures, and will hopefully start flying them IFR within the next year. The Southern Region is reviewing the routes with the appropriate military branches, and that action will be completed very shortly.

The Helicopter Tour Operator Committee has been overwhelmed working with the National Park Service, and Department of the Interior trying to demonstrate that helicopters are part of an environmentally balanced solution to visiting the national parks. When rotorcraft visit the national parks they're not knocking down the rocks, not leaving the rubbish, not picking up any of the artifacts. We visit it, we see it, we leave, and we're gone! It's part of a balanced solution, and that is the message that we're trying to relay to Capitol Hill.

The Regulations Committee is actively working with the European JAA to harmonize the aviation regulations.

The Safety Committee is working on what we call an HOB, Helicopter Operator (Data)Base survey. They're trying to get actual hours of operation by rotorcraft for each type of operation, so that we will have the actual data we need to say what the crash rate is in each type of operation, whether it's EMS, or logging, et cetera.

The UPAC Committee, or Utilities Patrol and Construction Committee, is just finalizing a document that discusses how rotorcraft can work effectively with the utilities industries. There's a lot that the helicopter pilots don't know and understand the needs of, or the terminology of the utility personnel, when they're working with people that are below the helicopter.

If your organization's not up on the web yet, hurry. There are some unique things that you could do here. For instance, if you subscribe to the Federal Register you're paying probably $1,500 a year for that document. We came on board, and within a week we were able to find the Federal Register on the web, reduced our cost to zero, and we now scan it daily.

On HAI's home page you will find a variety of sites -- one of which is the heliport search site. We took the FAA heliports directory, and reproduced it onto our home page, so you can search by state, location, type, etc. Also, when you click into a particular heliport and see that there's an error in the database that's presented, you're going to be able to enter in the correct data, whether it's location, site, or fuel availability, you can send the information back to HAI and we'll forward it to the FAA where they'll update and enhance their database.

The Helicopter Parts Search (HELPS) is new. HAI is providing a site so that distributors and operators can make their parts inventory available for sale. This "HELPS" keep our members in the air and flying.

Of course, HAI is probably best known for its annual HELI-EXPO convention. It's the largest show for the civil helicopter industry in the world. We just concluded HELI-EXPO '97 in Anaheim, California, and had about 13,000 attendees. Next year is HAI's 50th Anniversary which will also be held in Anaheim, California.

More pertinent to what we're looking at today, an overview on how the industry is doing. From 1970 to 1996 crashes in the rotorcraft world per 100,000 flying hours have been reduced. We've come a long way! From 30.3 down to 8.9, and that's preliminary 1996 data. We were going in the right direction. Unfortunately, the end of '96 showed a slight upward trend again.

Some of the factors that have contributed to improved safety are the tremendous advancement in the machines over the years, the maturation of the civil helicopter industry, and the dedication to safety shown by organizations such as the FAA, NASA, NTSB, HAI members, NIOSH, and others. We're working together and doing a pretty good job.

Some of the current events that certainly will continue to enhance safety are GPS/data link, such as was demonstrated in Heli-Star. Let me talk a little bit more about that. It was state of the art technology. It was a demonstration program where NASA, AGATE (the Advanced General Transport Experiment), industry, and the FAA got involved and said, how can we demonstrate the newest technology in the real world? The Olympics offered that venue.

On board the aircraft they used ARNAV equipment that actually showed the location, altitude, airspeed, and direction of each of the 125 aircraft participating. In addition, weather was overlayed on the display. All a pilot had to do was look down at his panel in order to see the other traffic that was participating in the system. We had all the security (aircraft), as well as all the people participating in the moving of packages, in that system. It was absolutely a success!

These are just some of the things that we're doing to enhance safety, and this is the overall slogan of how we're going to get there this year, "HAI IS FLYING TO A HIGHER STANDARD". We'd like all operators to participate.

HAI HELICOPTER LOGGING COMMITTEE

By Phil Kemp, Maintenance Director, Silver Bay Logging
Chairman, HAI Helicopter Logging Committee

At the Helicopter Association International (HAI) Board of Directors meeting in June, the Board approved the Terms of Reference for HAI's Helicopter Logging Committee. This committee was initiated following a very well attended meeting in Dallas during HELI-EXPO '96. It brought together many major worldwide participants from the operating, manufacturing and regulatory sides of this industry, to determine the interest, the objectives and how to organize to be effective in achieving the goals of the membership.

What is Helicopter Logging?

Helicopter logging is the business of flying logs from the units where they are cut, to the log landing, for onward transportation by land or water for processing. Due to the economics of helicopter operation, the distances flown are minimized, allowing 10-30 loads per hour to be flown. The operations comprise all aspects from cutting, hooking loads, handling at the landing and sometimes trucking, barging or rafting to the customer.

In addition to the helicopter, service and fueling equipment, heavy log handling loaders and shovels form the full complement of required equipment. A single large helicopter can provide direct employment for up to 40 people. Operators are often working in very remote locations, sometimes from land or floating camps with operations currently run worldwide.

The helicopter logging industry began in the Pacific Northwest in the early 1970s. Some early proponents of helicopter logging have evolved into major operators, with large fleets of heavy lift helicopters and the capability to provide every maintenance, overhaul and even manufacturing and design services in-house. An increasing number of operators have become heli-loggers over the years using a growing variety of helicopter types and models with lift capacities from 2,000 - 28,000 lbs.

Committee Formation

As the heli-logging industry grew in response to increasing forestry demands such operations acquired a reputation for high accident rates and questionable operating practices. Following a number of accidents in Alaska in the early 1990s, a report by epidemiologists at the Center for Disease Control and Prevention (CDC) stated that helicopter logging in Alaska was the States most dangerous occupation -- the report made national news. As an employee in the Alaskan helicopter logging business, I believed that this report may have been statistically true, but was not representative of the way the industry and operators were moving in regard to committed safety and operating programs.

In February 1995, the National Institute for Occupational Safety and Health (NIOSH) organized a meeting in Ketchikan, Alaska, to discuss helicopter logging safety. The result was a very successful two-day meeting with most of the major operators, regulators, some manufacturers and other interested parties assembled in one place, the first time a meeting of this nature and scale had taken place within the helicopter logging industry.

As we all headed for home and the demands of another season, the resolve may have faded, but the seed was certainly planted. When NIOSH started to set the agenda and attendee list for a follow-up conference in 1996, I became quite involved with trying to attract participants, who for whatever reason had not attended the previous year, and to expand the list to include others whose participation would be beneficial. As the list was completed, it became apparent that we were building on the success of the previous year, but we still failed to organize within the industry. It was also noticeable that most of the participants, directly involved in the business, were also members of the HAI. It made sense, therefore, to organize under our existing association, rather than form some new entity. HAI President Frank Jensen was able, at short notice, to arrange the venue and publicize the well-attended meeting that we held at HELI-EXPO '96.

Why Do We Need a Committee?

One key comment at HELI-EXPO '96 in Dallas was the need to avoid further regulation within the industry. Participants in this meeting were unanimous in the opinion that current rules, effectively enforced, are quite adequate in controlling all aspects of helicopter logging. Interaction among operators, manufacturers and regulators is necessary. In this manner, progress can be made toward resolving the real issues and achieving realistic solutions to the problems affecting each of the diverse areas within the industry.

The way to avoid regulation is to address the issues and provide our own solutions, rather than wait for someone else to provide them on our behalf. Once legislation is passed, it is much harder to change than to be actively involved in the process that led to the decision.

The Committee

Goals of the committee will be to promote the safe operation of helicopters within the helicopter logging industry; the members will decide all other goals.

Members of the committee must be representative of the leaders in the industry. We are looking for the participation of operators of heavy and medium lift ships, manufacturers, regulators and insurers.

Achievement of goals will be obtained by opening and maintaining dialogue with all of the participants in every aspect of the industry and by dealing with the issues that drive every facet of our day-to-day business.

Within the industry, we are working with the Federal Aviation Administration in a review of the helicopter logging industry. This will no doubt include a number of changes. The fact that regulatory agencies want to work with the HAI as a representative organization is indicative of the association's success, reputation and credibility in past dealings. This standing offers an opportunity to define the course the helicopter logging industry will take into the 21st Century. We are looking for interested individuals to participate in the committee activities. If you are interested, please contact me at tel: (907) 789-9033; fax: (907) 789-9516.

DRAFT HAI HELICOPTER LOGGING SAFETY MANUAL

By Mr. Michael Weaver, Caledonian Insurance Group

I showed up for the Helicopter Logging Committee meeting down in Portland, and Phil was struggling to have someone put together the plan or the document for the guidelines, and so I put my hand up. I'm taking all of your input and then writing a helicopter guideline for everyone to use.

You'll notice I've divided the document into several segments. A general introduction pointing out the advisory nature of the guide and that it can be used and changed by any of the companies. The goal of the guide is to improve the safety without governmental agencies having to add more regulation.

I haven't gotten any further input from anyone since the HAI, and therefore this presentation is an appeal to all operators to give me feedback, whether it's fax, or e-mail, or by phone. I feel that we're probably very weak on the maintenance items in the plan, and probably in the public information handling. You'll notice that in the pre-accident plan there's just one little space that I put in the document that had any reference to how to handle the public perception of a helicopter accident. That was in the pre-accident plan, item number E. The supervisors out in the field, normally inform the company headquarters of an accident, including accurate information to the public relations officer so that he can distribute correct information to the public. We are trying to counteract inaccurate information provided by the press.

I need input from everybody. We're going to convert the current MS Word document into an HTML document and place it on the http://www.rotor.com server.

MR. KLATT: I'd like to take up some of your time. Would you like to have the people review it for about 10 or 15 minutes and comment?

MR. WEAVER: We can certainly do that.

(Ten minutes elapse while attendees read the guidelines.)

MR. WEAVER: Are there any comments?

MR. WARREN: Yeah. Well, I like the idea of the public relations. I'm wondering about this whole idea of a pre-accident plan though. The idea of this was to provide information to the public in general, as well as to provide guidelines for the operators individually. And while I think that it's a good idea for every operator to have a plan, I'm not so sure that this particular document is the place where you put it. Remember that this was, among other things, a PR document to provide to the public, and I'm just wondering if it's appropriate to have something in there saying okay, here's what we do when we crash and burn. And while that plan should be extent, I'm not entirely convinced that it belongs in here.

MR. HERLIHY: Reflecting on what George just said, I think he has an excellent point. Some of the issues on what you, as an operator do, some of events of what you do after an accident is highly litigious and it would expose operators unnecessarily in events where, in someone's perception, they

did not necessarily do step A, B, and C. I would echo what George just said. I think there's another forum for what we have to contribute, Mike. I think we can work with you in another direction.

MR. WEAVER: Okay. That's fine.

DR. CONWAY: There were some fairly well organized and comprehensive recommendations made by the working groups that were convened here a couple years ago, and there's a few cracks in the current document that those might fill in. They're summarized recommendations from subgroups for improving safety in helicopter logging. And I notice they're organized a little bit differently. They're organized topically by things like human factors and training rather than the same scheme that you've used in the logging guidelines, but I think there may be some domains covered in those recommendations that aren't yet covered in this, and whether or not you see fit to incorporate any of this, or just use it as kind of prompts for other areas that might be worth addressing, I defer to you on that.

MR. WEAVER: Okay. Thanks. Phil, do we want to go and take this pre-accident plan completely out and give it to, say, the Public Relations Committee and separate it out from the rest of the guidelines?

MR. KEMP: I don't know. I think that the accident response within each organization, within each company, is very important that it be laid down and available to everybody, but the points are taken that this will be a public document, so maybe the other way. And we need to look within the HAI, to Christine Eberhart, and the report that she's just written for the HAI. It will be another online document and we may want to look at that document and maybe edit our plan in conjunction with hers and come up with one format that is filed somewhere separately from this. Because that's the purpose of the safety manual, to be a generic document so that people can edit the portions that they want. I need to hear other people's opinions, because I think that a pre-accident plan is important. And I think everyone agrees to that, but I think that Doug's point there, exactly, that if you have a pre-accident plan that you don't follow exactly, maybe you're exposing yourself to additional liability. I'd never even considered that.

MR. WEAVER: I hadn't either.

MR. KLATT: Mike, do you want to repeat your e-mail address and your fax number again for them?

MR. WEAVER: All right. The e-mail address is mweaver@netcom.com, and then the fax number is 206-232-9515. I'll give you an example of how the Internet saved me a ton of time and the very gracious folks at Kimberly Clark. I e-mailed a copy of the entire document, and they took that document, opened it up in Microsoft Word, they made changes to it, they highlighted those changes in red, and then e-mailed them back to me. When I received them, all I had to do is print it out on our color printer, collate all of those different changes, add it into the main document, change the name on it to guideline number 3, this happens to be the third version of this thing in my little handy book on my server, and presto, I had it so we could send it out again. And so that really makes it nice for me. I'll accept anything, of course, but that makes it handy for me. Any other items?

MR. KEMP: Do you have a scanner?

MR. WEAVER: Yes. We have a scanner.

MR. KEMP: Because if you find paperwork in an additional manual, or from another source, fax it in, we can scan it, turn it into a Word document, and it's right in the computer. We don't have to double enter all this stuff, and that's been the key to a lot of what we've been doing here, is the ability to take a paper document and turn it into a computer document, and it's fast and easy. And it's like Mike says, this document probably will never be finished. If it is, then we've probably all gone out of business. There's always going to be work on this. And that's it's purpose. It has to be generic because it has to encompass every issue for every application. And it's never going to do that. But then we give it to everybody, so you have the means to edit it for your own application, and for your own specific needs. That is our goal with this document, is that anyone who wants to use it, and it'll be readily accessible, so if the FAA comes to ramp an operation, there's a good chance that someone who's never seen a helicopter logging operation before may be briefed internally to use this document. Likewise, anyone else who comes to view that operation, at least when they come out there they're going to have a real good idea of what it takes to run a safe, successful operation out there. And that's one of the parts that it lacks right now. It's very difficult for anyone to independently assess whether it's being run or managed properly or not. And this is the industry's opportunity to again set its own voluntary guidelines. This is the way to avoid regulation, is to demonstrate the ability within the industry to address the issues.

MR. WEAVER: Would any of the other companies here be willing to share your operation guidelines with me? That would be very helpful. If I could have more examples, more things to include in the plan, the document would be better. One of the fun things that I included in the document was the glossary. My address is Caledonian Insurance Group, 3023 80th Avenue Southeast, Suite 300, Mercer Island, Washington 98040-2985.

MR. KEMP: How do you get rapidly changing information that you can post everywhere you need it? These are clear plastic laser print labels. They're extremely durable. They stick on windshields, trucks, support helicopters, logging helicopters, inside, outside, they cost about 10 bucks a box. These things cost cents, and they come in different sizes, up to full page sizes, and you just stick them in your laser printer, when you're done, you tear them off and throw them away. We were trying to figure out, how do you get that rapidly changing safety information where it needs to be? And these, you don't have to go outside your business. You do them all yourself. They'll stick to every window, truck, paint, it doesn't matter what it is, and you can read them. And they last a long time. We've had them on areas like handles. That wasn't where they were supposed to be put, but people put them there and they last for months. But they work really well. I did all the CPR card information, and we made those in a label this size you could stick inside a hard hat. There's one thing in the woods everyone's got is a hard hat. They aren't going to lose that. And you can put a lot of information inside of one. This is very cheap and very effective. You can put graphics on it, anything you want. We found it worked out really good. It's like a Mylar laser print label. I mean they're transparent so you just peel one off. They're just an Avery laser print label, and they work for everything. Man, they're just amazing.

MR. WIGGINS: My comments are really to just sort of reiterate the purpose of, I think, where you're trying to go. The procedures manual, if you will, is really a target generic document for an industry that's going to have several different uses, such as addressing the heavy lift, addressing support ship, the ground operations, fueling, maintenance. The perception is that's an educational document that's going to be used by several different groups. New entrants, who don't have the benefit of a lot of historical information like the Columbias, the Silver Bays, the folks who've been in it, and you want to

create a standard so that they know where they're supposed to go and you, as an industry, you, as insurers, have the ability to tell, is this a company who's measuring up to what we expect as an industry.

You can rest assured that that's going to go a couple other places. It will be used as a standard document for FAA. Folks are going to go out on site, perform surveillance and ask the questions, how should this operation be conducted, and that will be what people are looking at. Another time that it's going to show up is when there is an accident or an incident. You show up, you look at an accident and say, "How was this being done? Was there a standard by which they should have operated? If there is, were they operating in accordance with that? Or, if there isn't, why wasn't there one?" And that same question's going to be asked by litigants and the news media. "How should this have been being performed?" And there's your easy answer. Or at least guidelines that you've got to offer.

Pre-accident plan, good thing, but that's a detail. I think I agree with the comment that that should be separate. Provide an outline for the individual companies to be able to tailor to their own operation. A place were that might be appropriate would be to incorporate that pre-accident plan in the rotorcraft load combination manual. That's something that people are producing and are required to produce. You probably don't want to create a whole bunch of extra documents, because, like Mike said, the paper's going to go away. If that's something you already have, that may be a very appropriate place to put in an appendix which can be tailored to the different job sites. You need to go talk to the local operators, the local law enforcement folks, and the local fire chief.

My experience was always, no matter when I went out somewhere dealing with an accident, the first place I would go for local knowledge was the sheriff or the police department. In most rural areas that's the place where local knowledge resides. And, if you don't know what you need, they can go find it, even if they don't control it.

MR. HERLIHY: I'd like to remind you that everything that you put in print will be revisited and it'll come back to you, and there's nothing that can be held separate and say, well, we're going to keep this as a pre-accident plan, and that's not going to be for the public. The litigants will get it, the lawyers will get it, the FAA will get it. It's a balance here. You have to have plans. You have to have standard operating procedures, and you can't just say, well, I'm faced with the reality of a lawsuit, therefore, I won't have a standard plan. No. We've got to have a standard plan. We've got to work at this. But you've got to realize that you need to review the quantity, the quality, and the fine points of these plans before they get in print and published because somebody's going to hold you to it, and the lawyers and the juries are going to hold you to it, so keep that in mind.

MR. WEAVER: I totally agree with that. Let's go back to think what I was really trying to do here. I was trying to compile this document for the logging committee. I'm not a logger. I'm in the insurance industry. And I need your feedback to write this guideline as you want it.

There are a lot of good points that came out of here. I can remember one that was really important that George Warren gave me when he first reviewed one of these things. I got it out of a Canadian manual and I just put it in there and I didn't even think about it. It said something about providing a 20-pound fire extinguisher so many feet upwind from the operation. And George very quickly said, fire extinguisher of adequate quantity. We're not trying to be specific to the point where that document becomes a very crucial part of the litigation.

I went down to the local fire department and I asked the chief, I said, "Can you give me some information on this that I can put into this plan?" And one of the things that he gave me that I thought was very important was the wording such as "provide treatment only to the level of your own training and only with the victim's permission." You never would have seen that wording in past years, but due to the USA legal climate, you do see it now. So, there are a lot of things that we need to include. The document needs to be a guide for all operators to modify to fit their own needs.

Pre-Accident Plan
(DRAFT COPY, DRAFT COPY)

1. It is important to recognize that all accidents are different. Some accidents pose a danger not only to those who are involved, but also to would-be rescuers.

    a. Site supervisors should inform all employees at each worksite which employees have first aid training.

    b. Supervisors or their representatives should complete and distribute a copy of the site and/or logging emergency plan(s) to each employee.

    c. If you decide to be of assistance in an accident, provide treatment only to the level of your own training and only with the victim's permission.

        i. Approach the scene with caution, watching for hazards such as traffic, power lines, spilled fuel, sharp glass/metal, falling objects, fire, etc.

        ii. Notify emergency personnel of accident, providing location, type of accident, nature and number if injuries, and any other known information. Call 911, use phone, cell phone, radio or send someone to make the call.

        iii. If the accident site is hard to find, send someone as a guide to lead emergency personnel to the scene. The bystander with the highest level of first aid training should remain with the victims.

        iv. If victims are conscious, tell them your level of training and ask if they want you to help them. Limit your actions to the level of first aid training you have, unless the victims are in imminent danger. To prevent further injury, do not move victim unless necessary.

        v. Keep individuals who are not helping away from the accident site.

    d. As soon as possible, provide accident details to the site supervisor.

    e. Supervisors should inform company headquarters of the accident and provide accurate information for the public relations officer.

Site Emergency Plan
Work Location

Name: _____

Directions: _____
_____
_____

Lat & Long: _____

Emergency Rescue Information

Police: _____

Sheriff: _____

Fire: _____

Rescue Squad: _____

Hospital: _____

EMS Helicopter: _____

Logging Emergency Plan

In the event of an emergency, the following information should be used to identify work location and available emergency resources.

Employer name_____

Address _____

Telephone number_____

Company radio frequency _____

Work Location

Township	Range	Section	Sale name
_____	_____	_____	_____ _____

Direction by road system _____
_____

Property Ownership _____

Lat & Long _____

Emergency Rescue Information

Ambulance/Aid car location_____

Phone number _____ Radio Frequency_____

Sheriff location _____

Phone number _____ Radio Frequency _____

Helicopter Location _____

Phone number _____ Radio Frequency _____

Helicopter Landing Area * _____

Hoist needed? Yes_____ No _____

* Helicopter may not be able to respond due to weather and/or availability of craft. Helicopter requests may require authorization of medical aid or law enforcement personnel.

TABLE OF CONTENTS
(DRAFT COPY, DRAFT COPY, DRAFT COPY)

Introduction
(DRAFT COPY)

The purpose of this document is to offer general information for landowners, contractors and helicopter operators. This document reflects procedures generally accepted as fundamental to the helicopter logging industry. The HAI Helicopter Logging Committee encourages the use, modification, and adaptation of this document as necessary by each individual operator, as an addendum to an existing manual, or as additional information. This entire document or any portion thereof may be freely reproduced. The information contained in this document should be considered advisory in nature and shall in no way supersede any applicable regulations, safe practices, or limitations. Additional copies of this manual or further information can be obtained by contacting the Helicopter Logging Committee through the Helicopter Association International.

General Helicopter Safety for Forestry Operations
(DRAFT COPY)

Every operator must ensure adequate employee supervision and instruction in the safe performance of all duties. Before operations begin, supervisors must plan the operation and communicate the following items to all employees.

- safe work procedures to be used around helicopters
- all employees should recognize how their actions can endanger the safety of others both on the ground and in the air
- location of first aid services and equipment
- means for emergency transportation and evacuation
- method and equipment to be used to communicate between crews and between pilots and crews
- written procedures to be implemented for eliminating or controlling snags, danger trees, unbucked logs and other worksite hazards
- safe means for getting into and leaving worksites
- who is responsible for the various operations and activities
- procedures to be followed or the actions to be taken under adverse weather, wind and terrain conditions
- man-check procedures to periodically check worker well-being
- procedure for reporting unsafe conditions, personnel injuries, or accidents

Integration of Ground and Flight Activities
(DRAFT COPY)

For each day's activities, site supervisors should ensure that crews are familiar with the following items:

1. Capabilities of logging helicopter and any support aircraft
    a. All employees should recognize how rotor wash will affect the work environment
    b. Ground crews should be constantly alert for changes in the movement, sound and exhaust from the helicopter which could signal an inflight emergency

c. No employee is permitted on any load supported or suspended from the helicopter

d. Hookers should be familiar with the following:

i. The helicopter lifting capability; log loads must be within the lifting capacity of the helicopter

ii. Helicopter fuel duration and length of cycles

iii. Use of support aircraft: proper loading and unloading of people and equipment (if applicable)

iv. Aircraft flight paths and log pickup rotation

v. Monitoring the helicopter radio frequency

vi. Identifying the location of the log load to the pilot (using the "clocking" method)

vii. The operation of the remote helicopter hook and what to do if hook fails to operate properly

viii. Always keeping his eyes on the hook or load when the helicopter is approaching

ix. Ensuring that logs are properly choked; have sufficient end spacing on the logs to ensure that they do not slip out of the choker

x. Clearly identifying choker drop points for the pilot and coordinate them with ground activity

xi. Coordinating chokers with landing and clearly flagging choker drop points for the helicopter

xii. Allowing the hook to contact the ground to dissipate any static charge

xiii. Avoiding hang-ups in rigging and notifying the pilot when hang-ups or other problems are anticipated or occur during the lift

xiv. When sending out a turn, alerting the pilot immediately if any slack chokers, skinny (short) bites or hitchhikers come up with the turn that may fall from the turn during the trip to the landing

xv. In the event of an abort, have a back-up turn ready or direct the pilot to the next hooker for a back-up turn

e. Chasers should be familiar with:

i. The hazards of working around decks and loaders

ii. The importance of being in a safe zone when the helicopter approaches with a turn until the logs have been released from the remote hook

iii. Allowing the logs to settle before removing chokers and being watchful because the logs may roll while removing the chokers

iv. Monitoring the helicopter radio frequency

v. Helicopter fuel duration and length of cycles

vi. The operation of the remote helicopter hook

vii. In the event the remote hook will not release, waiting for the pilot's instructions to go in and manually release the chokers

viii. If the chokers will not come out of the hook manually, telling the pilot of your intention to unbell the chokers from the logs or other action

ix. Preparing chokers for return to hookers; watching for jaggers when coiling steel chokers and removing damaged chokers from service as necessary

x. Coordinating choker removal with the loader operator

2. Flight crews

a. Flight paths or corridors must be arranged so that logs or loads are not flown over ground crews.

b. Flight paths must be laid out taking into consideration the prevailing winds. Alternative routes must be established and ready for use should winds change direction.

c. The flight paths should not cross traveled roadways unless traffic is controlled by flaggers or road guards.

d. Flight paths should be planned to avoid noise-sensitive areas (fly neighborly).

e. Flight hazards in the area such as traveled roadways, power lines or tall trees should be identified.

3. Communication procedures

   a. All ground crews involved with the operation must know how to use the radio

   b. Exact voice commands must be established to avoid misunderstanding, and all communication should be pertinent and brief

   c. Pilots, hookers and chasers should continually monitor the same frequency

   d. Helicopter identification must be included in any command given to direct flight movement

   e. A worker who is in two-way radio contact with the pilot must wear a high-visibility vest or jacket, hard hat and eye protection (everyone working under the helicopter must wear an orange high-visibility vest)

   f. In addition to two-way radio communication, an effective system of hand signals must be known by ground crew and pilot, in case of radio failure

   g. If the statement "This is a First Aid Emergency" or "Aircraft Emergency" is heard, then stop all talking on the radio and listen for further instructions. Those not involved with the emergency should stay off the radio unless they are requested to relay messages or give other assistance.

4. Rigging

   a. The ultimate breaking strength of a choker must be 2 1/2 times the safe working load of that choker

   b. Slings and chokers must be inspected immediately before use. If any chokers show signs of burned eyes or broken strands, they should be removed from service

   c. Long-lines and hooks must be inspected daily

   d. Shackle pins must be lock-wired, or otherwise secured, to prevent accidental load release

5. Location of work areas for fallers, hookers and other workers

6. Falling and yarding plan

   a. Fall up the slope and down the slope so that unstable logs and debris will not endanger fellow workers below

7. Location for:

    a. Emergency landing areas should be established for:
        i. Ground employee injury evacuation with the support helicopter

        ii. Inflight emergencies

    b. Helipads, near the landing and in the logging area:

        i. Should provide a means for showing wind direction

        ii. Be reasonably level, have sufficient main and tail rotor clearance, and be effectively secured to the ground or other surface

        iii. If constructed, have all parts securely fastened, e.g., spiked together

        iv. Be free of all loose debris which could be picked up by rotor wash

        v. Have suitable approach and takeoff paths into prevailing winds

    c. Service and fueling areas

        i. Should be separate from log landing and ground crew areas

        ii. Sized to accommodate the logging helicopter, support helicopter (if applicable), fuel truck, fuel tanks, service truck and any other necessary equipment

8. Firefighting preparedness

    a. All employees should be alert for forest fires

    b. Site supervisors should establish forest fire reporting procedures

    c. Helicopter firefighting equipment, such as Bambi bucket, should be ready for immediate use

    d. Pilots should know the location of water sources

9. Area weather to include direction of prevailing wind and any storm warnings

Helicopter Specific Planning
(DRAFT COPY)

Helicopter safety briefing for both logging and support helicopters

1. Pilots or their representatives should provide the following safety information for ground crews.

    a. Wear high-visibility vest (orange), hard hat, boots, gloves, eye and ear protection as necessary

    b. Limitations and capabilities of the helicopter

    c. Hooker's and chaser's procedure for manually opening the remote hook

    d. Ground to helicopter communication (radio and hand signals)

    e. Passenger briefing to include proper entrance and exit from helicopter, emergency exits, and location of survival and emergency equipment

    f. Approach and depart the helicopter from the front in full view of the pilot and hold onto hard hat (even if the chin straps are used)

    g. Caution everyone about the danger area around tail rotors

    h. Walk in a crouched position when approaching or leaving the helicopter

    i. Never approach or depart uphill from the helicopter as the blade tips may come close to the ground on inclined surfaces

    j. Carry tools and equipment horizontally at or below waist level (never upright or over shoulder height)

    k. When deplaning men and equipment, crouch down at the side of the helipad and give all-clear signal to the pilot and wait until the helicopter has lifted off and cleared the pad before moving equipment to work area

    l. During flight, never throw anything out of the helicopter as it may strike the rotors.

Pilot Training

1. Helicopter model specific training should be provided for all flight crews on a periodic basis in accordance with FAA regulations and flight operating manuals

2. Actual flight training should include emphasis on smoothness and precision

3. Logging training to include vertical reference slung operations, both belly and remote hook operations and load cell recording

4. Emphasis should be placed on lifting loads that are within the helicopter's capability

5. Training should include "Fly Neighborly" information.

Maintenance

1. Helicopter maintenance personnel and fuelers should be informed of the day's flying activities so they can plan maintenance during down times.

2. Due to the heavy workload placed on the logging helicopter, preflight and maintenance inspections should be thorough and conducted in accordance with the manufacturer's and FAA's recommendations.

    a. Specific logging maintenance programs should be established

    b. Only approved parts should be used

    c. Good housekeeping must be maintained in all helicopter landing areas in an effort to keep loose debris from becoming flying missiles when blown around by rotor wash

3. Fueling

    a. No unauthorized employees are allowed within fifty feet of the refueling operation

    b. An adequate fire extinguisher should be within one hundred feet on the upwind side of the refueling operation.

    c. All fuelers should be thoroughly trained in the refueling operation including bulk fuel handling and the correct procedures for maintaining good fuel quality.

    d. Fuel quality checks should be made and recorded.

    e. All fuelers should be trained in the use of the available fire extinguishing equipment.

    f. Before starting refueling operations, the fueling equipment and the helicopter must be grounded. All grounding and bonding connections must be electrically and mechanically touching clean unpainted metal parts.

    g. To control spills, do not use jerry cans. Fuel should be pumped either by hand or power. Self-closing nozzles or deadman controls should be used and must not be blocked open.

    h. Procedures should be established for the disposal of contaminated or spilled fuel.

4. Maintenance training program

    a. Recurrent and/or initial training classes for maintenance personnel

    b. Classes should be model specific to the aircraft being operated, including all accessories.

Post flight (at day's end)

1. Inspect aircraft and all components for wear or damage
2. Flight crews should perform a walk around inspection and identify any discrepancies needing attention
3. Identify all pilot squawks and communicate them to the maintenance personnel
4. Inspect belly hook, remote hook and long line for wear or damage
5. Perform maintenance and prepare aircraft for the next operation

ACKNOWLEDGMENTS

HAI acknowledges the following people for their input and assistance in the preparation of this booklet:

Helicopter Committee Members

Mr. Michael Klatt
Mr. Chris Croff
Mr. John Tollenaere
Mr. George Schneider
Mr. Mark Lindamood
Mr. Daniel Stolee
Mr. Harold Baba
Mr. George Warren
Mr. Phil Kemp
Ms. Rita Carter
Mr. Brian Reynolds
Mr. Michael Weaver

Staff Liaison

Mr. Glenn Rizner
Mr. Ted Dumont

GLOSSARY

Abort	Any discontinued turn due to either excessive load or mechanical difficulties which can not be lifted
Back up turn	A turn to which the helicopter can be directed in the event of an abort
Belly hook	A helicopter's load hook directly attached to its frame
Bonus	Two logs in one choker
Chaser	A worker who removes chokers from logs at the log landing
Choker	A steel cable, or rope used to "choke" logs for transport
Crummy	A vehicle used to transport logging crews
Cycle	The length of time a helicopter will move logs before having to return to the service area for fuel or maintenance
Drop (choker)	A number of chokers for hookers during each rotation
Double nickel	A 5,500 pound turn
Escape route	A path, clear of obstructions and overhead hazards, used by hookers and buckers to move to a predetermined safe position
Flight path	A helicopter's path of operation while flying between the logging area and drop zone
Hang-up	A load which can not be freely lifted or experiences interference to lifting
Hitchhiker	Debris in a turn (not choked) which may fall free and become a hazard to ground crews
Hooker	A worker who directs the helicopter pilot to the load site and hooks up the load to the remote hook
Jaggers	Protruding broken strands on steel chokers (hazards to hands)

Log Landing	Work area which includes helicopter drop zone, knot bumping, chute, sorting, decking, loading and slash areas
Long butting	Cutting a cull piece off the stump end of a log
Long line	A helicopter load line attached to the belly hook
Max turn	A turn of one or several logs with weight approaching the helicopter's maximum lifting capacity
Helipad	A structure, or area, used specifically for helicopter landing
Pumpkin	A large (single log) solid turn
Remote hook	The cargo hook at the end of a long line with pilot-controlled release capability
Repo	The repositioning of a log to a new position, where it can be handled safely (term not universally used)
Rotor wash	The downward draft caused by the helicopter's main rotor blades
Short (skinny) bite	Choker set close to the end of a log
Snag	Dead standing tree or dead top
Snake eyes	An eleven-thousand pound turn (term not used universally)
Strip runner	Someone who sets chokers in conjunction with the hooker
Talk in the hook (clocking)	Directing the helicopter, by radio communication, to the load; usually by using the clock coordinate system (e.g. "I'm at your two o'clock")
Turn	The helicopter's load of logs
Unit	A large logging area
Widowmaker	A limb or rotten or broken top or overhead hazard that can fall out of a tree that may be hazardous to workers on the ground

APPENDIX

RECOMMENDATIONS FROM SUBGROUPS TO IMPROVE SAFETY IN HELICOPTER LOGGING

Equipment

The use of multi-engine helicopters is recommended for aerologging.

The design, weight & balance, and operating limitations established by the manufacturer must not be exceeded.

Aerologging equipment and components should be certified by the FAA, and overhauled in accordance with the manufacturers documentation or manuals.

Maintenance

The aerologging industry should establish standards for sound maintenance procedures.

Adequate facilities should be available for the level of maintenance to be accomplished.

An FAA-approved maintenance program should be established.

Only FAA-approved parts should be used.

All flight-critical components should have accurate historical records.

All maintenance work should be inspected prior to sign-off by certificated authority.

Human Factors

The use of a qualified second pilot is recommended for aerologging.

Companies should develop and publish standards for maximum flight and duty time.

Companies should establish and enforce standards and methods to monitor unsafe attitudes and unsafe types of competition.

The use of drugs and alcohol in aerologging should be prohibited, and aerologging camps should be dry.

There should be random drug and alcohol testing in the event of a mishap.

The FAA should not be permitted to sanction, by way of irrevocable certificate action, those individuals entering voluntary drug and alcohol rehabilitation programs.

It was also recommended that NIOSH conduct or sponsor a study of cockpit environment design for improvement of comfort and safety, and chronic injury reduction.

Training

Helicopter model-specific and flight-specific training should be provided for aerologging operations.

Flight and ground crew coordination training should be provided for all aerologging crews.

Companies should provide maintenance training in specific helicopter models, special inspections, and documentation of maintenance operations.

Companies should provide recurrent documented training for flight crews and mechanics.

Management

An aerologging association should be established to serve as a forum and spokesman for the aerologging industry.

Companies should be encouraged to develop a strong safety culture within upper level management.

Mid-level managers should be trained on the concepts and responsibilities of developing a strong safety management culture.

Employees should be encouraged to report safety violations without fear of punishment.

Companies should specifically designate a safety manager, with a specific job description.

The safety manager should receive formal training on a continuous basis.

Companies should establish an employee/management safety committee.

All employees should participate in the management of safety.

Company officials and employees should be made aware of the cost-benefits of an accident-free operation.

Companies should establish task termination safety rules.

Oversight

FAA must promptly enforce all known rule violations.

Staff of all local FAA Flight Standards District Offices (FSDO's) should be trained in all pertinent aspects of aerologging operations.

Companies should be required to give prior notification to the local FAA FSDO's concerning any proposed helicopter logging operations in their service area.

Interagency/Company Cooperation

Establish a helicopter logging association and encourage membership.

Companies should establish communication between each other when conducting aerologging operations in close proximity.

Companies conducting aerologging in the same areas should establish joint EMS and emergency action plans.

Companies and agencies should develop and disseminate a contractor's safety check list.

Companies and agencies should assist each other in writing and disseminating incident and accident reports.

Companies and agencies should develop and disseminate Standard Operations Procedures manuals.

Environment

Companies should provide improved and continual training concerning environmental hazards for all helicopter logging crews.

Companies should establish improved communication and educate U.S. Forest Service, state agencies, and environmental group personnel concerning the necessity of more adequate helicopter emergency landing zones, and concerning the potentially hazardous combination of danger trees and rotor downwash.

MINORITY REPORT ON SINGLE VS TWIN TURBINE ISSUE

By Roy Fox, Product Safety Chief, Bell Helicopter Textron, Inc.

Several people within the group were strongly opposed to the group recommendation that only twin-turbine helicopters be allowed to log. The people against this recommendation represented the only three helicopter manufacturers in attendance of the workshop. Such a recommendation (even if founded) can have serious consequences in other states and other uses including external load operations. The safety problem is not related to counting the number of engines.

A previous study using NTSB accident data and FAA flight hours for the period 1984 through 1988, Reference 1, was done to compare the safety of single-turbine vs twin-turbine helicopters. The resulting Table 1 provides the accident rate for various causes for three types of helicopters and the Bell 206 single-turbine helicopter. The 206 was singled out as it is the predominant helicopter in the world. In the USA. for the above time period, the 206 flew 7,035,846 hours out of the total helicopter fleet (single-piston, single-turbine, and twin-turbine) of 11,439,214 hours or 61.5%.

TABLE 1. U.S. Registered Helicopter Accident/100,000 Flight Hours

Type of Aircraft	Engine Only Airworthiness	Non-Engine Airworthiness	All Airworthiness	All Causes
Single-Piston	1.99	2.09	4.09	17.83
Twin-Turbine	0.35	1.25	1.59	4.37
Single-Turbine (All)	1.08	0.61	1.69	5.49
Model 206 Only	0.88	0.17	1.05	4.28

Thus, if one is only concerned with a engine failure, the twin is an obvious choice. However, if one is only concerned about components-other-than-engine failing and causing an accident, a single- turbine is the choice. Since one cannot pick the cause of the accident, we should be concerned about all causes, not just engine. In most twins, an engine failure at an Out-of- Ground-Hover at maximum load will likely still result in a controlled crash. The Risk of Serious Injury (RSI) is the occupants risk of a major or fatal injury per 100,000 occupant hours of exposure. Considering all airworthiness failure accidents (engine and non-engine parts) from Table 1, an occupant's risk is the same in single-turbine and twin-turbine helicopters as shown in Table 2. Occupant risk in a single- turbine Model 206 is about half that of riding in a twin-turbine helicopter. The 206 is a very simple (not complex) and reliable design.

TABLE 2. Occupant Risk of Serious Injury per 100,000 Occupant Hours

Type of Helicopter	Occupant RSI/100,000 Occupant Hr.
Single-Piston	0.98
Single-Turbine (All)	0.40
Twin-Turbine	0.40
206	0.21

Reference 1: Fox, R. G., Measuring Risk in Single- and Twin-engine Helicopters, AHS, February 24, 1992.

Morbidity and Mortality Weekly Report July 8, 1994/Vol.43;No.26

Risk for Traumatic Injuries from Helicopter Crashes During Logging Operations - Southeastern Alaska, January 1992-June 1993

Helicopters are used by logging companies in the Alaska panhandle to harvest timber in areas that otherwise are inaccessible and/or unfeasible for conventional logging (because of rugged terrain, steep mountain slopes, environmental restrictions, or high cost). The National Transportation Safety Board (NTSB) investigated six helicopter crashes related to transport of logs by cable (i.e., long-line logging*) that occurred in southeastern Alaska during January 1992-June 1993 and resulted in nine fatalities and ten nonfatal injuries. This report presents case investigations of these incidents.

Incident Reports

Incident 1. On February 23, 1992, a helicopter crashed while transporting nine loggers. The copilot and five loggers died; five others were seriously injured. The NTSB investigation revealed that a long-line attached to the underside of the helicopter became tangled in the tail rotor during a landing approach, causing an in-flight separation of the tail section (1). Passenger flights with long-line and external attachments are illegal (2) and violate industry safety standards.

Incident 2. On March 6, 1992, a helicopter crashed while preparing to pick up a load of logs with a long-line. The pilot and copilot were seriously injured. According to the pilot and copilot, the engine failed, and the pilot immediately released the external log load and attempted autorotation†

Incident 3. On November 10, 1992, a helicopter crashed while attempting to land at a logging site, sustaining substantial damage. The solo pilot was not injured. NTSB investigation revealed that the helicopter's long-line had snagged on a tree stump during the landing and that the company had no documented training program (1).

Incident 4. On February 19, 1993, a helicopter crashed from a 200-foot hover after transporting two logs to a log-drop area. The pilot and copilot were killed. NTSB investigation revealed in-flight metal fatigue of a flight-control piston rod.

**A typical long-line logging helicopter carries an approximately 200-foot load cable (i.e., long-line), which is attached by a hook to the underside of the helicopter. A second hook is fixed to the free end of the cable, where a choker cable (an apparatus designed to cinch or 'choke' around suspended logs) is connected to one to four logs per load.*

† Autorotation allows a helicopter to make an unpowered descent by maximizing on the windmilling effect and orientation of the main rotor-forward airspeed and altitude can be converted to rotor energy to reduce the rate of descent. Successful autorotation depends on helicopter airspeed and altitude when the maneuver is attempted (3). Most helicopters conduct long-line logging operations with minimal or no forward airspeed at less than 400 feet above ground level, while optimal conditions for autorotation require an altitude of at least 500 feet above ground level and airspeed of more than 60 knots per hour.

Incident 5. On May 2, 1993, a helicopter crashed during an attempted emergency landing after using a long-line to lift a log 1200 feet above ground level followed by rapid descent to a 75-foot hover. The pilot died, and a logger on the ground was injured. NTSB investigation revealed an in-flight separation of the tail rotor and tail rotor gear box from the helicopter. The company had been using a flight procedure that would have heavily loaded the helicopter drive train (1).

Incident 6. On May 8, 1993, a helicopter crashed after attempting to lift a log from a logging site with a long-line. The pilot and copilot sustained minor injuries, but the aircraft was substantially damaged. NTSB investigation found that the engine failed because machine nuts had come loose from the engine or its housing and became caught in the engine. The helicopter crashed when the pilot attempted autorotation.

Investigation Findings

Statewide occupational injury surveillance in Alaska through a federal-state collaboration was established in mid-1991, with 1992 being the first full year of comprehensive population-based occupational fatality surveillance for Alaska. During the time these incidents occurred, an estimated 25 helicopters in Alaska were capable of conducting long-line logging operations; approximately 20 were single-engine models from one manufacturer (Federal Aviation Administration [FAA], unpublished data, 1993). Approximately 50 helicopter pilots were employed in long-line logging operations in southeastern Alaska (FAA and Alaska Department of Labor, unpublished data, 1993). Using these denominators, the events in this reportare equivalent to an annual crash rate of 16% (six crashes per 25 helicopters per 18 months), 0.24 deaths per long-line helicopter in service per year (nine deaths per 25 helicopters per 18 months), and an annual fatality rate for long-line logging helicopter pilots of approximately 5000 deaths per 100,000 pilots (four pilot deaths per 50 pilots per 18 months).‡ In comparison, during 1980-1989, the U.S. fatality rate for all industries was 7.0 per 100,000 workers per year; Alaska had the highest overall occupational fatality rate of any state (34.8 per 100,000 per year) for the same period (4).

According to NTSB investigations to determine probable cause, all six crashes involved "...improper operational and/or maintenance practices" that reflected a lack of inspections of long-line helicopter logging operations (1). In incidents 4, 5, and 6, investigative evidence also indicated that log loads routinely exceeded weight and balance limits for the aircraft. Following increased inspections, no additional logging related helicopter crashes were reported through June 30, 1994.

Reported by. G Bledsoe, Occupational Injury Prevention Program, Section of Epidemiology, Div of Public Health, JP Middaugh, State Epidemiologist, Alaska Dept of Health and Social Svcs; D Study, Labor Standards and Safety Div, Occupational Safety and Health, Alaska Dept of Labor; National Transportation Safety Board, Anchorage, Alaska. J Manwaring, G Conway, M Klatt, Alaska Activity, Div of Safety Research, National Institute for Occupational Safety and Health, CDC.

‡*These rates refer to the period of intense collaborative investigation (January 1992-June 1993) and may not represent incidence over a longer period of time; however, they accurately reflect the high risk of helicopter long-line logging during this period.*

Editorial Note: The incidents in this report demonstrate that long-line helicopter logging is a technology application with an unusually high risk for occupational fatalities. General aviation regulations

restrict the number of hours pilots can fly during given time periods; however, long-line helicopter logging involves carrying loads outside the rotor craft, and there are no legal limitations on crew flight hours. Although flightcrew work schedules and daily flight hours vary greatly by logging company, flight-crew duty periods can exceed ten hours per day for ten consecutive days.

Helicopter logging operations often place heavy demands on helicopter machinery and associated equipment. The highly repetitive lift/transport/drop cycles are frequently conducted at or beyond maximum aircraft capacity in remote areas, where rugged terrain, extremely steep mountain slopes (as great as 70 degrees), and adverse weather conditions prevail. Complex operations under such circumstances may increase the likelihood of both human error and machine failure (5). In addition, conditions are unfavorable for successful autorotation during most helicopter long-line logging operations.

Regardless of where helicopter logging operations are conducted, the jurisdictional responsibility for inspection rests with the FAA office nearest the main or registered corporate office for the helicopter company (in all of the cases in this report, these offices were in the contiguous United States). This necessitates travel of great distances to conduct helicopter logging inspections, and remote operations may escape or evade inspection for long periods. The NTSB has recommended that operational and maintenance oversight responsibilities for remote sites be assigned to the nearest FAA office (1).

In response to these incidents, the Alaska Interagency Working Group on the Prevention of Occupational Injuries[1], met in a special session on July 8, 1993, to discuss approaches for reducing the number of such crashes and ameliorating the outcome of crash injuries. Based on these and other findings, the working group made the following recommendations (6):

- All helicopter logging pilots and ground crews should receive specific training in long-line operations.
- Companies should follow all manufacturers' recommendations for more frequent helicopter maintenance (because of intensity of use) and for limits on maximum allowable loads.
- Companies should establish and observe appropriate limits on helicopter-crew flight time and duty periods.
- Companies should consider using multi-engine rotor craft.
- Specific industry wide operating standards and procedures should be developed.
- Companies should provide training in on-site emergency medical care for helicopter logging crews at all work locations.
- State, regional, and local agencies involved in emergency medical services education should make low-cost emergency medical training available to persons likely to work in a helicopter logging environment.
- All flights over water should include appropriate survival equipment for all crew and passengers, who should wear personal flotation devices at all times during flights over water.

[¶] *Representatives from the Alaska Department of Health and Social Services, Alaska Department of Labor, FAA, CDC's National Institute for Occupational Safety and Health, NTSB, Occupational Safety and Health Administration, U.S. Coast Guard, and the U.S. Forest Service.*

References

1. National Transportation Safety Board. NTSB safety recommendation A-93-78 through -80. Washington, DC: National Transportation Safety Board, June 17, 1993.

2. Office of the Federal Register. Code of Federal Regulations, Vol 14, part 133. Washington, DC: US Department of Transportation, Federal Aviation Administration, January, 1992.

3. Roland HE Jr, Detwiler JF. Fundamentals of fixed and rotary wing aerodynamics. Los Angeles: University of Southern California, November 1967.

4. Jenkins EL, Kisner SM, Fosbroke DE, et al. Fatal injuries to workers in the United States, 1980-1989: a decade of surveillance. Atlanta: US Department of Health and Human Services, Public Health Service, CDC, NIOSH, 1993.

5. Aircraft accident investigation manual. Los Angeles: University of Southern California, Institute of Safety and Systems Management, December 1992.

6. Helicopter logging: Alaska's most dangerous occupation? State of Alaska Epidemiology Bulletin, August 16, 1993; bulletin no. 32.

For additional information about helicopter logging safety, please obtain a copy of *Safe Work Practices for Helicopter Operations in the Forest Industry.*

Copies of this document are available from:

Workers' Compensation Board of British Columbia
Films and Posters
Box 5350
Vancouver, BC
V6B 5L5

(604) 276-3200

INDEX

C

D

E

F

G

H

I

K

L

M

N

O

P

R

S

T

U

V

W

Y