



Fatigue!

The following report was published by the Canadian Aviation Safety Board.

Bell 206B Jetranger III • Cardinal, Ontario • 10 May, 1989

LOCAL TIME:	1253 EDT	
OPERATION:	Private Company Business	
DAMAGE:	Destroyed	
PILOT LICENCE:	Commercial	
PILOT HOURS:	ALL TYPES	ON TYPE
TOTAL:	13,410	7,500
LAST 90 DAYS:	85	85
INJURIES:	FATAL	SERIOUS
CREW:	1	-
PASSENGERS	-	-

HISTORY OF THE FLIGHT:

The pilot departed his overnight location at South Bend, Indiana at approximately 0605 eastern daylight time and flew a non-stop pipeline patrol to London, Ontario. He cleared Canadian customs and refueled before proceeding with the designated line patrol to Toronto and Montreal. His next destination was Kingston, where he ate lunch and refueled. Shortly after 1215 EDT, the pilot departed the Kingston area for Montreal. At 1253 EDT, Ontario Hydro experienced a major power interruption in the Ottawa region. An Ontario Hydro helicopter was dispatched to conduct an airborne search for the cause of the power outage. This search located the

wreckage of the helicopter close to broken high tension power lines.



The pipeline pilot was fatally injured in the accident.

PERTINENT INFORMATION:

The weather at the time was good visual conditions. The visibility was 15 miles, the temperature was 13 degrees Celsius, and the sky condition was 1,700 feet broken. The wind was from the southwest at 11 knots.

The pilot had been employed with the company for 10 years and held the position of Chief Pilot for rotary wing. He held a commercial licence with a valid Class I instrument rating for helicopters and multi-engined aeroplanes (land and

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sea). The pilot was type-endorsed for 11 helicopters and held a valid Class I helicopter instructor rating. Since 1977, he had annually attended a 206B Transition Flight Training Course at the manufacturer's training center in Fort Worth, Texas. Three weeks prior to the accident, the pilot completed a training ride at Canadore College in North Bay, Ontario which involved emergency procedures and operational manoeuvres. He had also completed a Mountain Recurrent Training Course 39 weeks prior to the accident. Comments in the remarks portion of the pilot's training records described the pilot as "an excellent pilot", "a knowledgeable and professional pilot", "current on type with a high level of competency both in operational flying techniques and emergency procedures", "a pleasure to fly with", "an outstanding pilot in all areas" who "displayed exceptional judgement and skill."

The average flying that the pilot had flown for 1989 while doing the solo pipeline patrols was 4.6 hours per day. The average flying time he had flown during the last two and one-half days was 9.8 hours per day.

The company had scheduled the pilot to fly the entire pipeline patrol over a five-day period, but he intended to do the patrol in three days returning home two days early. The pilot departed Toronto, Ontario on 08 May 1989 at 1000 EDT and finished his flying for the day 9 hours and 15 minutes later in Duluth, Minnesota. He departed Duluth at 0830 the following morning and finished his flying for the day 12 hours and 15 minutes later in South Bend, Indiana. On 10 May 1989, the pilot departed South Bend at 0605 in the morning and

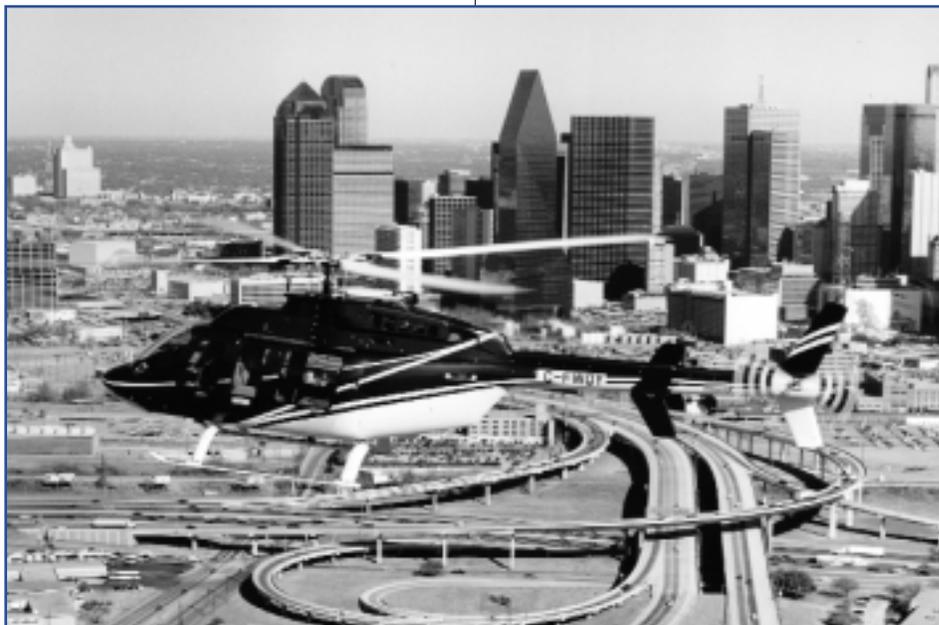
made two stops prior to the accident.. The first was in London for customs and fuel, which took 26 minutes until he was airborne again. The second was in Kingston for fuel and food, which took 30 minutes until he was airborne. People who knew the pilot reported that he looked fatigued and that he had commented on how tired he was. It was reported that he did not sleep well in hotel rooms. It could not be determined how much actual sleep time the pilot had in the last three days.

The pipeline right-of-way and high-tension power lines ran through a level, swampy, wooded area. The high-tension power lines were located approximately 500 feet north and parallel to the pipeline on a magnetic course of 060 degrees.

Six hours and 43 minutes after departing South Bend, the heli-

copter struck the tops of three groups of trees (one to two trees per group) approximately 30 feet high, over a distance of 300 feet, prior to striking the high tension power lines at 54 feet above ground level. Pieces of acrylic plastic from the chin bubble and paint chips were found long the trail near the base of the trees. The profile of the flight path, indicated by breaks in the trees, shows a gradual descent with a steep pull-up at the last group of trees 53 feet from the power line. The helicopter struck the lower south power line ascended through the lines exiting at the top north power line. Four of the six power lines were marred (two severed, two damaged). The main wreckage struck the ground tail first and came to rest 319 feet from the first contact with the power line. It laid in a thicket-laden bog partially submerged in two feet of water. The emergency locator transmitter (ELT) did not activate because the impact angle and direction did not impose forces on the ELT sufficient for activation.

The helicopter suffered catastrophic damage as a result of the power line strike and subsequent



crash. Parts and pieces of the helicopter were strewn along a 769 foot wreckage trail on a heading of 020 magnetic.

The wreckage was recovered and transported to the CASB Engineering Laboratory. Examination and disassembly of the helicopter and certain components

were carried out by the CASB staff and representatives from the manufacturer. Functional testing of the flight control servos initially indicated a fault in the collective servo. Subsequent examination determined the fault was related to impact damage. All major components of the aircraft were identified and examined to the degree possible; no evidence of a malfunction was found.

The aircraft was equipped with Bristol Aerospace Limited Wire Strike Protection System (WSPS). The upper wire cutter was found to have the paint removed along its cutting edge. The northernmost one-inch diameter top high tension line was found to have been cut by the wire cutter.

The radio altimeter was examined and found set to provide altitude alert notification, both aural tone and indicator light, at an altitude of 50 feet above the ground (or other surface).

The helicopter was equipped with LORAN with waypoints entered to carry out the pipeline patrol and alert the pilot of the location of obstacles in his flight path (hydro lines crossing the pipeline right-of-way, towers, etc.). In this instance, the hydro line paralleled the pipeline and thus was not entered.

The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

The helicopter's weight and balance and centre of gravity were within the manufacturer's prescribed limits.

The company provided flight helmets for the helicopter crews, but the pilot was not using one at the time. The pilot did not have an observer or second pilot to help relieve the workload.

Full autopsy and toxicological



testing did not reveal any evidence of impairment that would have affected the pilot's performance.

The progressive decrement in performance ability due to prolonged or extreme mental or physical activity, or sleep deprivation is called fatigue. Stresses such as noise, vibration, flicker, wearing effects of psychological problems, backache, and thermal stresses contribute to fatigue. Proper rest and diet are important in the prevention of fatigue.

ANALYSIS:

The helicopter systems were examined to the degree possible, and no evidence of a malfunction was found. The autopsy and toxicology reports revealed no physical abnormalities or impairments.

The activities required to prepare for the start and the end of the day, which would diminish the rest/sleep period must be taken into consideration. The pilot increased his workload by condensing his flying schedule from five days to three. Flying at extremely low levels imposes a heavy workload on a pilot, not only mentally but physically. The "inspection" portion of the job is an additional duty and strain to the actual piloting. Fatigue

is the natural result of continuous exposure to this environment and proper periods of rest are required to recuperate.

The profile of the flight path, indicated by the breaks in the trees, showed a gradual descent with a steep pull-up at the last group of trees 53 feet from the power line. This flight path is consistent with the pilot's falling asleep and the helicopter beginning a gradual descent into the tree-tops. There is no other plausible explanation."

Fatigue is subtle and insidious.

It is not always recognized, even by the individual who is affected; and like other human conditions such as hunger or anger, it is very difficult to quantify.

After a fatal accident, its presence and impact is impossible to prove conclusively. There is no way for an autopsy to determine if sleep was present at death, or if fatigue was indeed a primary cause. There is no irrefutable, post mortem test that can clearly show if a person's judgement and performance had been affected by fatigue.

Consequently, this report could only conclude that the most plausible explanation for this accident was that the pilot probably fell asleep.

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We do know enough about the negative effects of fatigue to make some assumptions. For instance, if we had information that would describe an individual's pre-accident activities, condition, and life style, we might determine if fatigue was a likely factor.

Is fatigue a problem in aviation? Is it a factor in incidents and accidents? According to the NTSB, FAA, and NASA it is. According to their statistics and studies fatigue may be a factor in 20% of all aviation occurrences; and that it is time for aggressive programs that address the problems of sleep and fatigue in transportation safety.

NASA's Human Factors Branch has developed and distributed a program that addresses Alertness Management in Aviation Operations. It includes a variety of up-to-date scientific information concerning fatigue, sleep, and circadian rhythms; but more importantly provides some guidance on how to cope with fatigue.

Fatigue covers a variety of conditions. The feeling of exhaustion after long and strenuous physical exertion. The lack of alertness from being involved with a long and monotonous task. Or simply the difficulty in remaining awake when overwhelming sleepiness occurs.

Sleep is a basic physiological function that is as important as eating or drinking.

It is simple. If you don't drink you get thirsty. If you don't eat you get hungry. If you don't sleep you get sleepy. When you get sleepy every measure of human physical and mental performance decreases, consequently increasing the vulnerability to errors.

A lack of a sufficient quantity and quality of sleep is a major fac-

tor in sleepiness in the workplace. There is no substitute for sleep. It is the only way the body can replenish its physical and mental vigor.

The quantity of sleep a person requires varies from one to another. Some need less than others; but the average is somewhere near eight hours sleep per night. The amount of sleep a person can obtain is often affected by the duty and flight schedule. Law Enforcement, EMS, Search and Rescue, Aerial Applications, ENG and other types of helicopter operations demand long, irregular, and shifting work schedules. These schedules may not allow sufficient time for sleep; or the shifting schedules may continuously disrupt the circadian rhythms. In either event the flight operations schedules directly affect the quantity of sleep obtained.

Not all sleep is good sleep. Sleep must be of the proper quality. A normal sleep episode will have alternating states of NREM and REM sleep. Each state has its own purpose. The NREM state is believed to be the state that replenishes physical vigor. For NREM sleep to "recharge the batteries" it must reach and remain in "deep sleep" for the right length of time. A regular lack of NREM deep sleep will result in a regular feeling of sleepiness the next day.

Several physiological conditions can largely prevent NREM deep sleep. A common problem is Sleep Apnea. It is basically a breathing problem, and is frequently accompanied by snoring as well as periods when breathing stops for a short length of time. The person afflicted by Sleep Apnea may not recognize he has it. He may never notice that he stops breathing, or that he snores as much and as deeply as he does. It may be only his sleep partner who notices these symptoms.

This snoring and stopping breathing are serious conditions that can be diagnosed and treated. They interrupt the NREM sleep and can essentially prevent all of the deep sleep required. With such a condition a person can sleep all night long; but get up feeling tired and not at all refreshed. He can, later that day, fall asleep at almost any time; and will have the feeling of sleepiness affect his working performance.

Fatigue, and its causes, symptoms and prevention, is a complex issue that has no simple answers. No one work and sleep schedule is right for every individual and operation.

Perhaps the first step is to take an honest look at how fatigue affects you in the work place, and for you to take charge of your sleep habits.

Plan for the sleep you need. Avoid excessive food and drink before going to bed, particularly alcohol and caffeine. Develop and follow a prescribed pre-sleep routine. Keep your sleep time reserved for sleep.

If you awake spontaneously and cannot go back to sleep within 30 minutes get up and do something that can induce sleep, such as read a book.

Naps are good. When you feel sleepy and the circumstances permit, take a nap.

The negative effects of sleepiness on the job can be counteracted by the strategic use of caffeine, and simple physical and mental activities that maintain interest and motivation.

Don't wait for someone else to solve your fatigue problems. Determine what you can do, and what you will do to get the best rest you can.

There I Was...

Here is an account submitted to us by a reader.

Night Over Water.

"This was on the East Coast, out of Providence, Rhode Island. I had been working a contract with one of those huge offshore research ships – the Glomar Something. I don't remember the ship's name.

The contract was to support their operations. I had a 206B that was dedicated to their needs. One night – the middle of the night – sometime around 0200, I was awakened by the contractor's operations duty officer.

I had a helo mission

Was it serious? Yes!

A Life or Death mission!

Really? Really!

(As it turned out it was a case of a severe hand mutilation. A worker ultimately lost several fingers on one hand.)

I launched, and in 10 minutes I was offshore.

It was a dark night. Not a distant horizon

This vessel was somewhere around 35 miles offshore.

When I was about half way to the ship I began to experience some problems with the instrument panel lighting. Suddenly all the instrument panel lighting failed. The attitude indicator still had some luminescence so I could see it. I decided to check the overhead switches and circuit breakers. In the 206B that requires the pilot to turn his head to the left, and tilt it back. Without

lighting I couldn't read anything, and I was back and looking up at the panel for only a few seconds. When I brought my head back down into the normal position I was hit by a powerful feeling of vertigo. I had an overwhelming feeling that the aircraft was rolling and turning to the right. It was amazing how powerful the sensation was. I could hardly resist the urge to make a left cyclic input to counteract the continuing, overwhelming feeling of being in a right roll. I was making sporadic cyclic inputs mainly in response to this vertigo feeling.

I consciously had to tell myself that if I wanted to survive I would have to control the aircraft. Even with the lighting malfunctioning I was able to see enough of the attitude indicator to see the aircraft attitude. I convinced myself to trust the instruments, and then locked on to keeping the wings and nose level. It was incredible how long that vertigo lasted. Even after I was consciously in control of the aircraft attitude I continued to experience the feeling that I was in a significant roll rate. After a while the feeling went away and I was able to complete the mission. This happened almost 20 years ago, but I can clearly remember how strong the feeling was, how long it lasted, and how difficult it was to resist the urge to incorrectly respond to this vertigo sensation.

I also remember the brief demonstration back in flight school. The one where the instructor had you put your head down and he would put the aircraft into an unusual attitude and then have you recover on instruments. Somehow I thought that was what vertigo would be like. Believe me, it's not like that. My experience was that it was extremely strong, and long lasting."



YOUR ANSWERS.

In the last issue we asked "Is fatigue an issue in your operation? What are primary causes, and how do you counteract them?"



Here are some of your responses:

Human AD.

"Fatigue is usually not a problem in my flying assignment with Petroleum Helicopters. However, there is an occasional 8 hour day. The 135 FAR is well designed. After 8 hours at the controls of a helicopter one's body and mind is usually spent."

"Yes, fatigue is an issue in our operation. Law enforcement U.S. Customs Air Operations."

The primary causes... there are three that I see.

a. Shift work, it's the nature of the beast.

b. Frequent schedule changes during a work cycle to cover admin or pop-up missions because of improper staffing.

c. The opinion of the U.S. Government that sleeping while on standby on midnight shift is evil, but flying in the wrong portion of the circadian rhythm is OK.

How do we counter them...luck and the ability to turn down a mission when you are not fit to fly. The problem is that most will fly one anyway because at the time the buzzer goes off, they don't recognize their level of fatigue."

"Fatigue has always been an issue in our operations. I am a heli-

copter pilot for 7 years and an instructor for 3 years. I am rated in the UH-1, Blackhawk, R-22, H-300 and the AB206. As an Army pilot it has always been important for us 'pilots' to deal with our customer 'troops' needs versus fatigue. And it has always been in training flights trying to achieve some training objective and reach flight hours versus fatigue.

I want to tell one story about fatigue and what happened at last.

Three years ago I was flying a Blackhawk as a copilot with one of my seniors who was more experienced than me. It was a long day from the beginning and by noon we had 6 hours of operational flying at high terrain and in adverse weather conditions; dropping teams, supplying food, and doing some reconnaissance flights. When we came back to our base to fill up again and to have some lunch I, my pilot and our technician were very exhausted. While we were happy to



be back and having our lunch, our battalion commander called us to go back to the flight region saying that we were familiar with the terrain and the location of the troops. Our technician was not able to come back with us because he was feeling bad after all that hard work. So we had another technician and went flying again with the same helicopter.

Knowing we were so exhausted we were very careful at takeoff and landing. We did the rest of the job and near nightfall were preparing to go back home. When we were on the way back to the base a call came from one of the troop commanders saying that one of the soldiers was seriously ill and asked us to come back to get him and bring him to the hospital near our base. We were available and decided to help. We asked for directions to where he was in the high terrain. We got the directions. It was almost dark and we were in a valley. The soldier was on the rocks that were surrounded by tall trees. Since we had plenty of power, as well as personal courage we didn't hesitate to try to pick up the soldier where he was. The pilot was on the controls. I was in the left seat and with the technician, was helping him to guide our helicopter through the narrow opening. After some minutes of trying, I happened to look to the left rear to see what clearance we had. I saw that the main rotor blades were shaving the trees! I quickly pulled up the collective and told my pilot that we were about to hit the rotor blades at the thicker branches of the trees. We aborted the mission, and arrived at our base after 35 minutes of flight without any vibration. It was dark when we landed. The technicians and maintenance inspected the helicopter seeing that all four blades were damaged and we were lucky."

"Our company heliport is at 6,600 feet in a desert climate (Density Altitude often 10,000 feet). Most pilots carry water bottles and snacks. We are a tour company. A spare pilot who is not assigned an aircraft is usually available to break others throughout the day."

"I'm a pilot in a law enforcement agency using rotorcraft only. We operate during the day and night, and mostly during the small hours of the night and at the hot hours of midday.

Even though we have strict rules regarding sleeping hours, etc. one can find himself close to nodding during the "dead" part of the flight. I try to fight off the fatigue by resting well before a flight, having a cold (or hot) drink before and during the flight, and if I'm too tired – I use the helicopter's top advantage – I just land, shut down, and have a chat with the ground troops. There is no mission so important that I'll risk my (and other's) life for."

"Let me tell you a short story.

A couple of weeks ago I had the privilege to fly one of the flooded areas in Vera Cruz, Mexico to deliver food and medicines to the damaged people. I was there only a week but we flew 8 hours in one day and the rest of them about 6 hours a day.

When I came back home, my wife asked me "How fatigued are you?" I told her I left "Fatigue" here at the hangar. I am tired, but I will be "fatigued" the day after tomorrow when I will be back at my normal job and the same every day routine. Takeoff early in the morning, pick up my passengers at the corporate building's heliport, fly 25 or 30 more minutes to my destina-

tion, wait there all the day long, then fly the same time and route back late in the afternoon. Doing the same routine each and every day of every week you realize that "Fatigue" means the routine. The last five days delivering food and medicine and landing at unprepared landing spots and avoiding vultures and birds, meant a real pleasure.

About the question ... of course "Fatigue" is considered in all my operations. When you fly the VIP Corporate each and every day as a daily routine 90% to the same place and almost on the same schedule you have to figure out how to be "patient," and how to avoid "becoming crazy" when you have to be there more than six hours. Thank God there is a cinema nearby where you can waste some time.

At the beginning you arrive enthusiastic and every day read a little bit of the Flight Manual, give a short review of the FAR-AIMs, check the newspaper, write cross-words, play tetrix or game boy, walk around, count the bricks around your heliport, even count how many rivets our helicopter has. But two months later you will be right at the madness threshold. It is hard to keep the "Situational Awareness" when your routine is this hard. You cannot be talking with those around the factory or offices because everybody is doing their job. Most of the time you may not go too far from your helicopter because as soon as you are a couple of miles away, it happens that your passenger **MUST** fly back **IMMEDIATELY** or you have to fly and pick up someone else who **HAS TO BE** in the meeting.

This kind of fatigue is harder than to fly a lot during the day."



