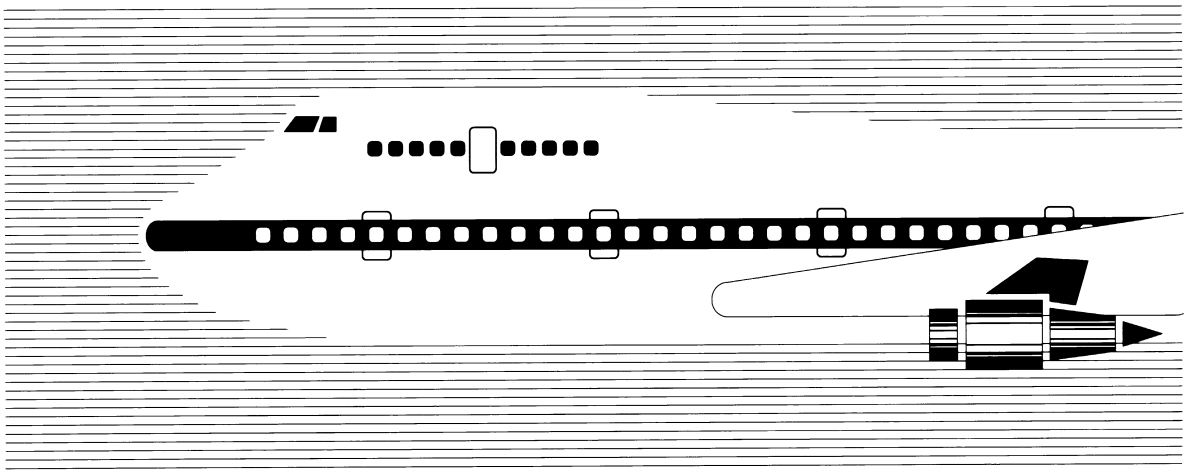
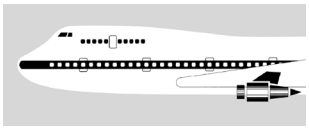
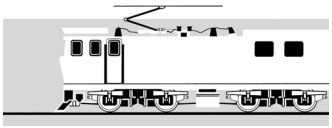


AVIATION OCCURRENCE REPORT

03-001	**Kawasaki BK-117 helicopter ZK-III, collision with tree tops at night, Tararua Range**	**14 January 2003**


TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

Report 03-001

Kawasaki BK-117 helicopter

ZK-III

collision with tree tops at night

Tararua Range

14 January 2003

Abstract

On Tuesday 14 January 2003, at about 2220, Life Flight Trust BK-117 helicopter ZK-III was on a night VFR flight from Wellington Hospital to Masterton Hospital to pick up an injured patient for an emergency medical transfer. After inadvertently overflying a waypoint by a short distance towards high terrain, the pilot began an emergency climb through cloud. During this climb the helicopter collided with trees, but was flown on to an emergency landing at Masterton. The helicopter sustained substantial damage, and the pilot received a serious hand injury. The other occupants were uninjured.

Safety issues identified include:

- the need for air operators to include in their operations manuals practical guidance material for night VFR flights
- the need for guidance material for all night VFR flying.

Contents

Figures

Abbreviations

°M	degrees magnetic
°T	degrees true
AIA	Aviation Industry Association of New Zealand
AIP	Aeronautical Information Publication
CAA	Civil Aviation Authority of New Zealand
CAR	Civil Aviation Rule
GAWX	general aviation weather
GPS	global positioning system
IFR	instrument flight rules
IMC	instrument meteorological conditions
kt	knot(s)
METAR	aviation routine weather report
nm	nautical mile(s)
QNH	altimeter subscale setting to obtain elevation when on the ground
TAF	aerodrome forecast
VFG	Visual Flight Guide
VFR	visual flight rules

Data Summary

Aircraft registration:	ZK-III
Type and serial number:	Kawasaki BK-117 helicopter
Number and type of engines:	two Honeywell LTS-102-750-B1
Year of manufacture:	1991
Operator:	Helilink Limited
Date and time:	14 January 2003, about 2220[1]
Location:	1 nm southwest of Mount Tauherenikau latitude: 41° 03′ south longitude: 175° 18′ east
Type of flight:	Air Transport-Emergency Medical Services
Persons on board:	crew: 2 passengers: 2
Injuries:	crew: 1 serious, 1 nil passengers: 2 nil
Nature of damage:	substantial; landing gear, fuselage and right horizontal and vertical stabilisers
Pilot's licence:	commercial pilot licence (helicopter)
Pilot's age:	41
Pilot's total flying experience:	6151 hours on helicopters (about 196 hours on type)
Investigator-in-charge:	J J Goddard

[1] All times in this report are New Zealand Daylight Time (co-ordinated universal time + 13 hours) and are expressed in the 24-mode.

1 Factual Information

1.1 History of the flight

1.1.1 On the evening of Tuesday 14 January 2003, at about 2115, the rostered duty pilot of the Wellington Life Flight Trust BK 117 helicopter, ZK-III, was at home in Wellington when she received a request for an emergency medical transfer of a patient from Masterton Hospital to Wellington Hospital. She checked the weather forecast, and decided that conditions would allow the transfer to be done by helicopter, the most expeditious method. She considered the alternative, which was for the ambulance aeroplane, operating under instrument flight rules (IFR), to do the transfer, but this would take more time.

1.1.2 The pilot filed a visual flight rules (VFR) flight plan with Air Traffic Control, and met her crew at the hangar at Wellington airport. After a normal start, ZK-III took off at 2151 to fly to Wellington Hospital to pick up the doctor and nurse who were to accompany the patient on the return flight. The helicopter left Wellington Hospital at 2157, en route to Masterton.

1.1.3 The flight to Masterton began normally, with the helicopter being flown at 2500 feet to the northeast, up Wellington Harbour and Hutt Valley. The pilot was navigating visually, and using the global positioning system (GPS) as a supplementary aid to follow the company standard navigation plan FPL 13, which was pre-programmed into the GPS. This navigation plan used waypoints at Wellington Hospital, Twin Lakes (Te Marua Reservoir), Kiwi Lodge, Puffer Saddle, Tauherenikau River (Smith Creek junction), Tauherenikau Gorge, and Masterton Hospital.

1.1.4 The pilot and crew subsequently reported that they flew up Hutt Valley in clear visibility. There was some intermittent moonlight, and the ridges were visible, with some cloud to the northwest. Ground lights in Hutt Valley were visible, as were some lights in the Wairarapa to the east, beyond the Rimutaka Range. Some rain was observed near Upper Hutt, but this did not impair visibility.

1.1.5 The actual route flown, from a recording of the computer memory of the Skymaster moving map system on the aircraft, was up Hutt Valley to abeam Twin Lakes at 2210, parallel to and southeast of the GPS track by about 0.5 nautical mile (nm), then direct to Kiwi Lodge at 2212, and Puffer Saddle 30 seconds later, at 2213. From Puffer Saddle the helicopter was flown to the east for about 0.5 nm, then on a northeast heading to parallel the GPS course to Tauherenikau River. After about 1.0 nm it was turned north to overfly the Tauherenikau River waypoint, at 2214.

1.1.6 The pilot reported that after Kiwi Lodge and Puffer Saddle the cloud base was lower, and the lights in the Wairarapa to the east were no longer visible. There were no ground lights beyond Kiwi Lodge, and the terrain, which in that sector was bush-covered hills and valleys, was indistinct. She elected to continue, placing more reliance on the GPS for navigation between waypoints.

1.1.7 On the sector between Puffer Saddle and Tauherenikau River she reported that she had experienced some difficulty reading the GPS presentation of track and distance to the next waypoint. This was because of some vibration on the display, and because her attention was split between increased scanning of her flight instruments, visual scanning of the terrain, and the GPS display, which was located to the left and below the other instruments. Because of this difficulty she asked her crew, seated in the co-pilot seat, to assist by reading out the GPS tracks and distances. This resulted in the pilot turning onto a northerly heading towards the Tauherenikau River waypoint, but also in some misunderstanding about the distance to run. The pilot heard the crew read out the distance as "3", but it was probably 0.3nm.

1.1.8 Shortly afterwards the pilot observed that the GPS indicated a new easterly track, and she realised that they had overflown the Tauherenikau River waypoint. She turned the helicopter onto an easterly heading, and asked her crew to continue reading out the GPS track. Shortly after that, she advised her crew that she would climb the helicopter into instrument meteorological

conditions (IMC). This was because they had overflown the waypoint by an unknown distance in an area of higher terrain, and she was unwilling to "fiddle with the GPS" to re-establish their navigation.

1.1.9 The pilot promptly started climbing the helicopter, using maximum continuous torque, from its cruise altitude of 2500 feet. She reported that they were in cloud at 2700 feet when the radio altimeter alarm (which was set at 250 feet) illuminated. She immediately pulled back on the cyclic control, pitching the helicopter to a steep nose-up attitude. Very shortly afterwards the helicopter collided with trees near the top of a spur on the southwest side of Mount Tauherenikau, in the Tararua Range.

1.1.10 The helicopter received substantial damage to the fuselage and empennage, and intrusion of much tree debris to the cabin, but remained controllable and continued flying across to the southeast side of the spur. The tree debris caused injury to the pilot's right hand and temporarily obscured her vision. She subsequently reported that the artificial horizon was "mainly brown", indicating a steep nose-down attitude. She recovered the helicopter from this unusual attitude and continued climbing on a northerly heading. The electronic communications systems, intercom and radio had failed and conversation with her crew was by shouting. She established that the other occupants were unhurt, and that the helicopter instruments and gauges indicated normally except for no air speed indication. Several lights on the warning light panel were illuminated, however. She noticed that a lot of cyclic trim was needed to remove the out-of-trim cyclic control force.

1.1.11 The helicopter came out of cloud as it climbed above about 3500 feet, and the pilot could see the lights of Masterton. As they headed to Masterton, she discussed with her crew that they would land at the aerodrome (rather than the hospital), and that because of the damaged landing skids she would hover the helicopter while the others disembarked. This plan was carried out successfully, and the pilot continued to hover the helicopter while her crew organised assistance to allow her to land the helicopter without its landing skids.

1.1.12 The Skymaster log showed that the helicopter had overflown the Tauherenikau River waypoint by about 20 seconds and about 0.4 nm before the easterly turn started. The helicopter started climbing from about 2500 feet at 2214.59, at about 0.8 nm northeast of the Tauherenikau River waypoint, as the turn to an easterly heading was being completed. The groundspeed slowed from 115 knots (kt) to 89 kt, as the climb was established, and the collision occurred at 2215.50, at an altitude of about 2900 feet (GPS altitude), with the helicopter on a heading of 120 °magnetic (°M). Shortly after the collision the groundspeed had slowed to 22 kt, and by 2216.10 the helicopter had made a rapid left turn onto a heading of 320 °M, and had climbed to 3300 feet. A normal right turn followed, with the helicopter accelerating and climbing, and by 2217.00 it was heading 030 °M, at 3700 feet, with a groundspeed of 103 kt. The climb continued to just over 4000 feet as the helicopter turned towards Masterton. This was followed by a steady cruise descent to arrive at Masterton Aerodrome at 2227. The helicopter was hovered until shortly before the end of the Skymaster log at 2354.

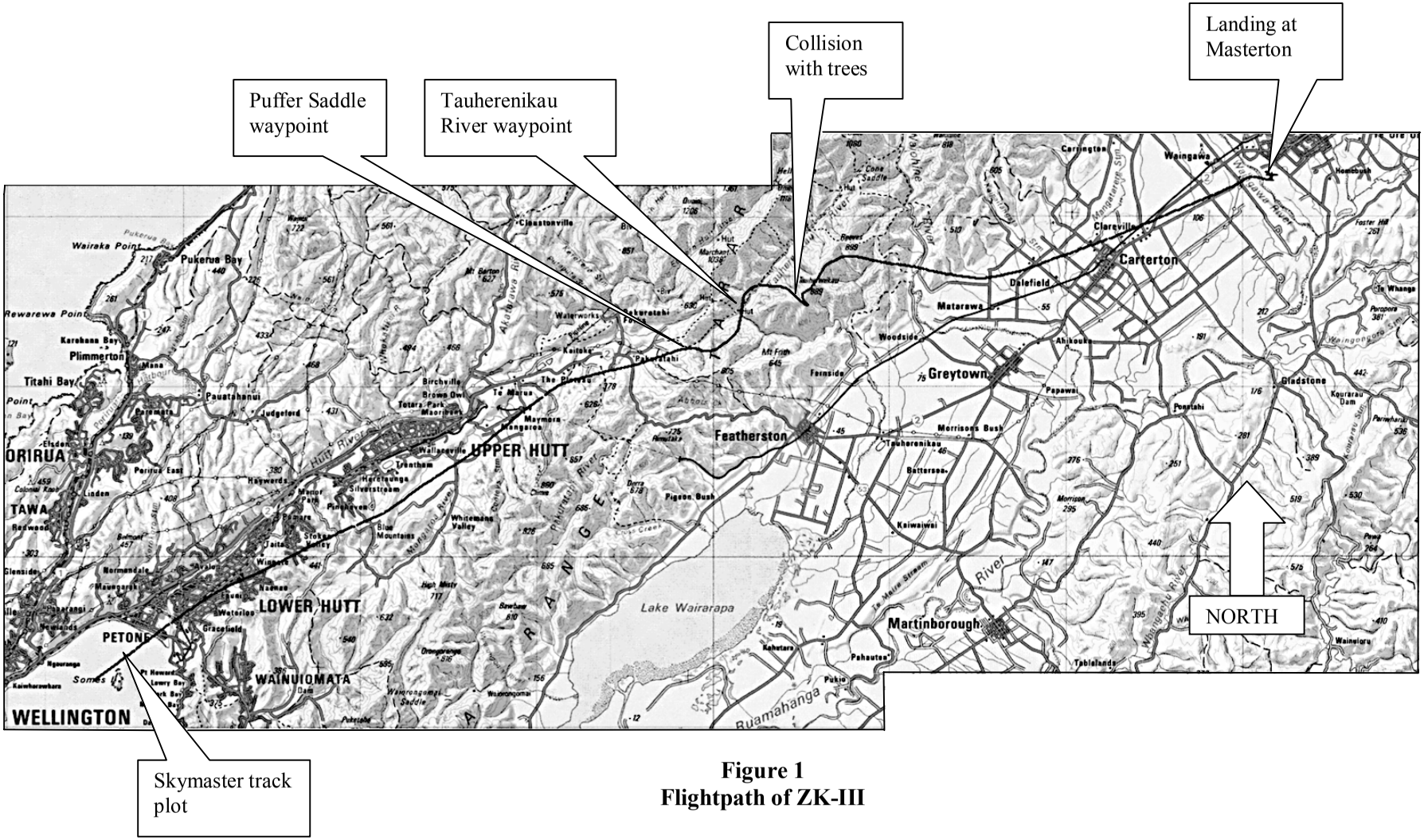


Figure 1
Flightpath of ZK-III

1.1.13 The crew, on the ground at Masterton, contacted the Life Flight Trust operations manager by mobile telephone to explain the situation. The operations manager alerted local police and rescue services, as well as a company pilot who was in the area. Between them they got a local tyre company to deliver old vehicle tyres to the aerodrome. The tyres were assembled into a suitably shaped bed for the belly of the helicopter. The Fire Service removed some protruding skid remnants while the helicopter was hovering, and then the pilot was able to make a landing on the tyres.

1.1.14 After completing a normal shutdown of the helicopter, the pilot was admitted to hospital for treatment to her injured hand. A severed tendon required surgery, which involved 2 days in hospital. No other person was injured in the accident.

1.2 Personnel information

1.2.1 The pilot of ZK-III held New Zealand Commercial Pilot Licence (Helicopter) number 58429. Her associated Class 1 medical certificate was valid to 27 September 2003. Aircraft type ratings associated with the New Zealand licence were for the AS 350B and BK 117 types. She also held United States and South African Airline Transport Pilot Licences (Helicopter), with instrument and instructor ratings, and various aircraft type ratings up to the Sikorsky S-61 type. She had flown 6151 hours on helicopters, of which 193 hours were at night, and 98 hours were instrument flying. A total of 2030 hours were on multi-engine helicopter types. She had flown 195.6 hours on the BK 117 since starting flying in New Zealand in October 2001. In the last 30 days she had flown 17.9 hours, of which 17.1 were on ZK-III. This included 1.5 hours at night and 1.0 hour of instrument practice. Other previous flying experience included about 200 hours on aeroplanes and about 1000 hours on gliders.

1.2.2 Her most recent flight crew competency check and biennial flight review were completed successfully on 24 October 2002, flying ZK-III. The initial training she had received with the company for her type rating and role training comprised 12.8 hours dual on the BK 117, in October 2001. Subsequent dual training was on the use of specific equipment or helicopter roles, such as winching, using a water bucket, or using the Nitesun floodlight for night operations. Instrument practice was generally 1.0 hour's flying every 3 months. There had been no specific route training on night VFR operations.

1.2.3 She had flown between Wellington Hospital and Masterton Hospital a moderate number of times, including 10 flights in the previous 4 months. These flights were by day, mostly using the company FPL 13 route. She had flown to Masterton at night, but not by this route. On those night flights she had either flown direct at higher altitude, or by an alternative low-level southern route via Turakirae Head.

1.2.4 She worked on a duty roster, shared during that period with one other pilot. When rostered on first call, as on 14 January, the duty was to be at readiness from 0800 to 1800, then on emergency call back from 1800 to 0800 the next morning. She had been rostered on first call on 10, 11 and 12 January, with 13 January as a day off. She had not flown on 14 January until the accident flight. She reported that she was well rested, and not feeling fatigued.

1.3 Aircraft information

1.3.1 ZK-III was a Kawasaki BK 117-B2 twin-engine 10-seat helicopter, serial number 1077, manufactured in 1991. It was imported into New Zealand in 1993, and registered as ZK-HHI. It was re-registered as ZK-III in 2002. At the time of the accident it had flown 3761 hours. The standard category Airworthiness Certificate was non-terminating. The Certificate of Maintenance Review was valid to 8 March 2003, and the next periodic maintenance was due at 3800 hours. No defects were outstanding, other than the engine trend monitoring system computer, which had been removed for maintenance. This did not affect the airworthiness of the helicopter.

1.3.2 Two Honeywell LTS-102-750-B1 engines, serial numbers 45851 and 45857, were fitted. They had each run 3761 hours.

1.3.3 ZK-III was approved as an air ambulance, category C. It was equipped with a stretcher, medical equipment and 2 rear-facing seats for the medical attendants.

1.3.4 The helicopter was equipped with flight instruments, radios and navigation aids to a suitable standard for flight under IFR with 2 pilots. Additional automatic flight equipment would have been required for single-pilot IFR operations.

1.3.5 A GPS receiver (King KLN 90B) was mounted on the central instrument panel, above the radio transceivers. In addition to the GPS display, it provided data to a Skymaster moving-map display on a laptop computer, which was mounted above the central console between the front crew seats. The pilot reported that the Skymaster display was too bright for use by the pilot at night, and was not in use on the accident flight. The principal use of the Skymaster was by the crew, to augment visual navigation, or to monitor specific tasks such as search patterns. The Skymaster computer memory contained track log data, which enabled details of the route to be recovered. The King GPS itself did not store any track data.

1.4 Meteorological information

1.4.1 The Meteorological Service of New Zealand Limited produced an aftercast of likely weather conditions between Wellington and Masterton on the evening of 14 January. It included:

> A high just south of New Zealand and a low to the east directed a relatively strong unstable and moist southerly flow across the area.
>
> The 2200 satellite image showed similar conditions over the route with cumulus and towering cumulus cells. The weather radar images showed northward-moving convective cells. Wellington hourly observations at 2100, 2200 and 2300 reported towering cumulus and an occasional shower. Winds at Mount Kaukau were southerly, around 30 kt. The Masterton automatic observations at 2000, 2200 and 2300 registered precipitation and relatively high humidity.
>
> A similar air mass covered the area, but given the southerly flow, cloud bases could be expected to be lower, visibility poorer and showers heavier about and to the east of the Rimutaka Range than on the western side. This is because of the orientation of the hills, which lie in a southwest to northeast direction. Wellington Airport is not sheltered by the Rimutaka Range in a southerly flow, but Hutt Valley should be fairly well sheltered. Along the route low visibility was likely in Wellington at times, low cloud and poor visibility probable about the main ridge and the eastern side of the Rimutaka Range, but relatively better visibility and higher cloud bases over Hutt Valley.

1.4.2 The general aviation weather forecast (GAWX), North Island, issued at 1335 and valid to 2400, included:

> Situation:
> A southerly flow covers the island, unstable in the east.
>
> Forecast weather:
> … Wellington, Wairarapa, Hawkes Bay, Gisborne: Rain showers, isolated rain and hail showers, with areas of broken stratus at 1200 feet and isolated cumulonimbus at 2500 feet, tops above 10 000 feet. Areas of broken cumulus and stratocumulus at 2500 feet, tops 9000 feet.
>
> Visibility:
> 30 km reducing to 10 km in light rain showers, 4000 m in rain and hail showers.
>
> Wind forecast:

	3000 feet	5000 feet
Gisborne	185°true (T)/25 kt	195°T/25 kt
New Plymouth	155°T/22 kt	165°T/24 kt

Paraparaumu	170°T/27 kt	175°T/29 kt

Comment:
Southerlies easing tonight.

1.4.3 The Wellington Aerodrome forecast (TAF) issued at 1403 and valid to 0700 15 January was:

> Surface wind 180°/220 kt, gusting 35 kt. Visibility 30 km. Light rain showers. Cloud scattered at 3500 feet, broken at 4000 feet.
> Temporarily between 1400 and 0100: visibility 6000 m in rain showers.
> Surface wind becoming between 1300 and 1600: 170°/12 kt.
> 2000 foot wind 170°/35 kt.

1.4.4 The Wellington Aerodrome routine weather reports (METAR) were:

> 2100: surface wind 190°/27 kt; showers in the vicinity; few clouds at 1800 feet, broken at 3500 feet, few towering cumulus at 3500 feet; temperature 12, dewpoint 6; QNH 1019; wind shear, runway 16; visibility temporarily 6000 m in rain showers. Mount Kaukau wind 180°/31 kt.
>
> 2200: surface wind 180°/20 kt; showers in the vicinity; few clouds at 1800 feet, broken at 3500 feet, few towering cumulus at 3500 feet; temperature 12. dewpoint 8; QNH 1020; wind shear, runway 16; visibility temporarily 6000 m in rain showers. Mount Kaukau wind 180°/34 kt.

1.4.5 The pilot had the GAWX NI and the Wellington TAF and METARs. Before departure she telephoned a helicopter operator in Masterton to ask for a local weather report, but got no reply. No routine weather report was available from Masterton.

1.5 Wreckage and impact information

1.5.1 ZK-III was examined at Masterton on 15 January. The fuselage had incurred substantial tree impact damage to the nose, belly and right side. Thepitot tube for the airspeed indicator, and the external floodlights were broken off. The chin windows were missing, and the right windscreen and both right side windows were broken but remained in place. The landing skids were off; the front cross tube, part of the rear cross tube and part of the right skid had been removed while the helicopter was hovered at Masterton, to enable it to land on its belly. The other skid parts were missing. The right horizontal and vertical stabilizers were missing, separated at the tail boom. The left horizontal stabilizer was damaged, but remained in place. One tail rotor blade showed minor damage, and one tail rotor pitch link was bent some 20°, but had continued to function, apparently without distress. The main rotors showed no obvious damage. Both engines had ingested minor tree debris, but had continued to run without abnormal symptoms.

1.5.2 Tree debris was wedged around the pedal controls and pushrods, apparently without impeding or disrupting the pilot's control of the helicopter. A large amount of tree debris had entered the cabin, probably through the missing chin windows.

1.5.3 The accident site on the spur southwest of Mount Tauherenikau was examined by helicopter, not from the ground. Broken beech tree branches and foliage extending from an estimated 30 feet below the ridge towards the top marked the collision point. Several pieces of red and yellow wreckage, probably the right stabilizers and skid pieces, lay below the broken trees. There was no evidence that the helicopter had struck the ground at the site. The line of tree damage was to the southeast, at an elevation of about 2850 feet.

1.6 Organisational and management information

1.6.1 The helicopter was operated by Helilink Limited, a subsidiary of Airwork (NZ) Limited, and provided on a wet lease to the Life Flight Trust as an air ambulance and rescue helicopter. The pilots were employed by Airwork, while the helicopter crews were employed by the Life Flight

Trust. The doctor and nurse were from Wellington Hospital, and were trained as medical crew on air ambulance work.

1.6.2 The operation was under the Airwork Air Operator's Certificate, in accordance with Civil Aviation Rules (CAR) Part 135 (Air Operations – Helicopters and Small Aeroplanes). The Airwork Operations Manual specified the minima for night VFR helicopter air transport operations, which were similar to those in CAR Parts 91 and 135.

1.6.3 The VFR table in CAR Part 91.301 prescribed the minimum distance from cloud, and flight visibility. For flight in uncontrolled (class G) airspace, at or below 3000 feet above mean sea level, or 1000 feet above terrain, whichever is higher, this was: clear of cloud and in sight of the surface, with a flight visibility of 5 km. A proviso allowed helicopters, flown at suitable speed, to operate with less than 5 km visibility.

1.6.4 CAR Part 135.155 "Meteorological conditions – VFR flight" stated:

> (a) Each person performing an air operation shall ensure a VFR flight is not commenced unless current meteorological information indicates VFR minima prescribed in Part 91 and in paragraphs (b), (c), (d), and (e) can be complied with along the route, or that part of the route to be flown under VFR.
> (b) …
> (c) Each pilot-in-command performing a VFR air transport operation in a helicopter outside controlled airspace shall fly in meteorological conditions-
> (1) …
> (2) if the use is at night, of not less than a ceiling of 2000 feet above ground level and visibility of not less than 5 km.

1.6.5 The Airwork Operations Manual did not expand on these basic rules, either in general, or in relation to frequently used routes. No other Airwork document provided guidance information for pilots on night VFR operations.

1.6.6 The Helicopter Flight Guide part of the Airwork Operations Manual had a section titled "GPS Flight Plans – Wellington", with details of some common routes which were pre-programmed into the helicopter GPS. The plan used on the accident flight appeared twice, with the same waypoints, as "FPL 3 Low level route via Kiwi Ranch to Masterton", and as "FPL 13 NZMH Masterton Hospital via Kiwi Ranch DAY VFR 1500 feet". The route was not normally used at night.

1.6.7 The New Zealand Aeronautical Information Publication (AIP), was published for the Civil Aviation Authority of New Zealand (CAA) by Airways Corporation. Neither the Visual Flight Guide (VFG) nor the Planning Manual parts of the AIP contained any information about enroute night VFR operations. By comparison, the Australian VFR Flight Guide, published by the Civil Aviation Safety Authority of Australia, contained a 22-page section on the topic.

1.7 Other information

1.7.1 The pilot advised that before departure she planned the flight at 2500 feet, using FPL 13 for route guidance, because she had flown that route several times by day at 2000 feet, and had observed that there was ample height above terrain at that altitude. The highest point on the route was 1500 feet, at Puffer Saddle. She considered that 2500 feet would provide an extra margin above terrain at night, and would be clear of the forecast broken cloud layer at 3500 feet. She had considered but decided not to climb to 5000 feet on a direct track, because she did not have advice on the amount of cloud cover at Masterton, and did not want to arrive above a substantial layer of cloud. Similarly, she had considered the low-level southern route via Tirakirae Head, but decided to use it as a diversionary route if, while flying up Hutt Valley, she had doubts about the height of cloud over the Rimutaka Range.

1.7.2 The distance between waypoints at Kiwi Lodge and Puffer Saddle was 0.7 nm, and between Puffer Saddle and Tauherenikau River was 2.0 nm. Other waypoints on FPL 13 were further apart.

1.7.3 The pilot advised that she did not feel under pressure to fly in adverse weather conditions. She had found the Life Flight Trust supportive of pilot decisions not to fly. The request for the flight had been from the Life Flight Trust, via her crew, asking her opinion on whether to use the helicopter or the aeroplane, and she made the decision to use the helicopter.

1.7.4 After this accident the Aviation Industry Association of New Zealand Incorporated (AIA), started to develop standards and requirements for helicopter VFR air ambulance and search and rescue night operations. Helicopter operators around New Zealand who were members of AIA were contributing to the production of industry operational guidelines.

2 Analysis

2.1 This accident involved an experienced pilot flying a suitably equipped twin-engine helicopter for a well-established air ambulance operator over a short route which was frequently used by day but not normally at night between Wellington and Masterton hospitals. The flight was being conducted under night VFR, which was normal for the Helilink operation.

2.2 The weather was obviously a factor, because the collision with the trees occurred while the pilot was climbing the helicopter through cloud as a result of a deliberate emergency decision. Her decision followed the realisation that she had inadvertently overflown a waypoint by an unknown distance or time, and that they were heading into an area of higher terrain, instead of tracking to the next waypoint at Tauherenikau Gorge. The overflying of the waypoint probably resulted from a number of factors. These included:

- the local weather had deteriorated since the previous waypoint, with increased and lower cloud, and probably reduced visibility
- the pilot had some difficulty reading the GPS information at that particular time, because of some vibration on the display, and because her attention was increasingly directed to her flight instruments as well as looking outside
- there were no ground lights in that sector, and the terrain was naturally indistinct at night. The missed waypoint was almost certainly not visible, even in clear night conditions, since it comprised a minor river junction in a bush-clad valley, so the GPS was the only practical way to identify passing the waypoint
- the successive waypoints were close together on that part of the route; only about 30 seconds, and about 60 seconds flying time apart respectively
- the assistance she had called for from her crew with reading the GPS at that time. This was a good idea, and appropriate crew resource management, but it may have been called for too late for her crew to become accustomed to the task, because misunderstanding about the distance to run to the waypoint resulted. The reading she heard of "3" could not have been correct, because the distance from the previous waypoint was only 2 nm, but recognising and resolving the error would have been unlikely with the pilot's work load at the time. The misunderstanding may have led the pilot to expect some 90 seconds to elapse before reaching the next waypoint
- the approach to the waypoint was on a northerly, rather than a northeast heading, after the small deviation she had made from the direct track after Puffer Saddle. This meant that the required right turn to the next waypoint was through about 100° instead of about 60°, and any visual cues (such as ground lights seen through the Tauherenikau Gorge) would have been slightly behind, rather than in her two o'clock position.

2.3 The pilot's pre-flight assessment of the weather information, and her flight planning in relation to it, were significant factors in the accident. The GAWX did not specifically predict lower cloud with poor visibility on the eastern side of the ranges compared with Hutt Valley and Wellington,

but some appreciation of orographic weather with the southerly airflow might have alerted her to that probability. If she had been able to anticipate the weather deterioration across the ranges, she may well have decided that the low-level southerly route was a preferred option. While the majority of her flying experience was overseas, in countries of large landmass with fewer local small-scale weather variations, she had been flying from Wellington for over a year, and should have gained some appreciation of the local weather in different wind directions.

2.4 The pilot's choice of route up Hutt Valley was probably made with her selection of a cruising altitude of 2500 feet in mind. There was some logic in this selection, because it was 500 feet higher than she had comfortably flown the route by day (and 1000 feet higher than the highest point on the route). The route also appeared to accommodate her expectation of the limitations the cloud would place on the flight.

2.5 The selection of an altitude of 2500 feet for the route, however, did not take into account the location of higher terrain close to the route, and the need to fly safely above it to allow for any navigational inaccuracies on the way. A consideration of high terrain within, say, 5 nm either side of the track might have led to a conclusion that a minimum safe altitude for this route under night VFR was probably close to 5000 feet.

2.6 The indication from the Skymaster log was that the pilot had overflown the Tauherenikau River waypoint by about 20 seconds, or about 0.4 nm, because that was where the turn to the east started. This small navigational overshoot effectively put the flight into danger. Such a small margin may be acceptable by day, with good light and visibility, but was insufficient on this night, with the prevailing low illumination and decreased visibility.

2.7 The major practical differences between night and day VFR operations arise because, while in each case the pilot is required to maintain visual contact with the ground, at night in undeveloped areas there may be insufficient surface definition for continuous visual navigation or for terrain avoidance, even though visibility is clear. A further difference is that at night it may often not be possible to see cloud ahead until the aircraft has entered it. One outcome of these considerations is that at night a minimum safe altitude for the route must be determined beforehand, rather than just knowing the height of the route. Another need is for instrument flying ability, so that inadvertent flight into cloud can be managed without difficulty or danger.

2.8 The determination of minimum safe altitudes for night VFR routes in common use is a task which is probably best done by the operator, rather than by each pilot before the flight. This is because suitable margins need to be set according to the type of route, aircraft and navigation facilities, before application to the route, as well as for standardisation and quality control purposes. Airwork had not developed any such guidance material for routes in its Helicopter Flight Guide, and relied on individual pilot judgement instead. While this was inevitable for remote routes which could not be anticipated, it represented a shortcoming in operational management for night VFR routes regularly used in its operation.

2.9 The pilot's action, in deciding to climb as soon as she realised that they were standing into danger after overflying the waypoint was appropriate and, along with her reaction to the radio altimeter alert of pitching the helicopter nose-up, was fortuitous in allowing the helicopter to avoid a major impact with the ground. The Skymaster log indicated that the climb may not have been as positively started as possible, however, because the helicopter did not slow to optimum climb speed, or develop a high rate of climb. Any such terrain avoidance manoeuvre should be assertively flown to achieve maximum climb angle, for best effect. The alternative, of making a 180° turn to backtrack, may not have been a safe option, given her unknown position in relation to high terrain.

2.10 The pilot's actions after the collision were appropriate and successful. They consisted of a recovery, on instruments, to normal flight from an unusual attitude and very low airspeed; continuing to climb the helicopter on a suitable heading until visual contact was regained; flying to Masterton Aerodrome; devising a plan; and hovering for nearly 1½ hours until she could land

the helicopter on the bed of tyres. Her flying the damaged helicopter to a successful emergency landing, with her injured hand, was a significant achievement.

2.11 The action of the AIA in developing standards and requirements for helicopter VFR air ambulance and search and rescue night operations was a positive initiative, and indicates a general industry realisation that night VFR operations need prescriptions and guidelines, in addition to the Civil Aviation Rules, to be reliable and safe. Standards developed by experienced pilots and operational managers are likely to be practical and relevant, so should be encouraged to facilitate widespread adoption.

2.12 CAA could do more to ensure that air operators providing night VFR flights set and apply appropriate operational standards. While the regulatory minima are necessary, operators should also have guidance material in their operations manuals, and pilot training and checking to ensure that their methods are consistent and appropriate to what they do. A recommendation was made to the Director of Civil Aviation that he ensures operators include in their expositions relevant operational material for their night VFR flights.

2.13 The investigation of this accident indicated that private aircraft operations of all kinds, not just air transport or commercial operations, may need guidance for night VFR cross-country flying. The Australian VFG section indicated that other regulatory authorities saw the need to address this lack of guidance for pilots. A recommendation was made to the Director of Civil Aviation that guidance material for all night VFR flying be published.

3 Findings

Findings and safety recommendations are listed in order of development and not in order of priority.

3.1 The pilot was appropriately licensed, experienced and fit to conduct the flight.

3.2 The helicopter had a valid Airworthiness Certificate, and had been appropriately maintained.

3.3 The helicopter was being flown on a Company route not normally used at night, at an altitude which provided an insufficient safety margin above terrain for night VFR operations.

3.4 A small navigational error resulted in the pilot making an appropriate emergency climb through cloud, during which the helicopter collided with trees but continued flying.

3.5 The pilot's actions after the collision were appropriate, and resulted in a safe emergency landing.

3.6 The operator did not provide additional relevant guidance for its pilot on night VFR operations.

3.7 CAA could do more to ensure that air operators providing night VFR flights set and apply appropriate operational standards.

3.8 There was a lack of guidance material for private cross-country operations under night VFR.

4 Safety Actions

4.1 Airwork (NZ) Limited advised that they have developed a Wellington Base Operations Guide. The additional document includes standard operating procedures for: Hospital transfers; paramedic pick-up points; off-shore operations; tasking checklist, especially for night tasks; route planning and GPS flight plans; promulgating MSA for Wellington Base operations.

5 Safety Recommendations

5.1 On 03 June 2003 the Commission recommended to the Director of Civil Aviation that he:

5.1.1 ensure that operators include in their expositions relevant operational material for night VFR flights. (030/03)

5.1.2 publish guidance material for all night VFR flying. (031/03)

5.2 On 18 August 2003 the Director of Civil Aviation replied in part:

> I accept this recommendation and will, when assessing operator's expositions, ensure that relevant operational material for night VFR flights is included. General Aviation Group Checklists will be amended to include this requirement. This will be completed by 1/9/2003. (030/03)
>
> I accept this recommendation and will publish a Good Aviation Practice (GAP) booklet containing guidance material for night VFR flying. This will be completed by 1/7/2004. (031/03)

Approved for publication 30 July 2003

Hon W P Jeffries
Chief Commissioner

Recent Aviation Occurrence Reports published by the Transport Accident Investigation Commission (most recent at top of list)

03-001 Report 03-001, Kawasaki BK-117 helicopter ZK-III, collision with tree tops at night, Tararua Range, 14 January 2003

02-015 Report 02-015, Piper PA31-325 Navajo ZK-TZC, loss of control and collision with the ground during a one-engine-inoperative landing approach by Feilding Aerodrome, 17 December 2002

02-013 Report 02-013, Piper PA 34-200T ZK-FMW, undercarriage collapsed after landing, Ardmore Aerodrome, 12 November 2002

02-011 Report 02-011, Bell 206B JetRanger III ZK-HRC, forced landing following reported power loss on approach Huka Falls, 3 km north of Taupo, 2 October 2002

02-010 Report 02-010, Boeing 747-419 ZK-NBS flight NZ 2, in-flight flap separation over Manukau Harbour by Auckland International Airport, 30 August 2002

02-006 Report 02-006, Partenavia P68B ZK-ZSP, engine power loss and off-field landing, 5 km southwest of Wairoa, 15 May 2002

02-005 Report 02-005, Hughes 369D helicopter ZK-HRV, engine failure and forced landing, near Tarawera, 30 April 2002

02-003 Report 02-003, Schweizer 269C helicopter, ZK-HIC, loss of tail rotor authority and emergency landing, Karaka Downs South Auckland, 15 March 2002

02-004 Report 02-004, Cessna 210N Centurion ZK-TWA, collision with terrain, Conical Peak area 34 km southwest of Oamaru, 10 April 2002

02-002 Piper PA34-200T Seneca SK-SFC, undercarriage failure and subsequent wheels-up landing, Gisborne and Hastings Aerodromes, 25 January 2002

01-012 Robinson R44 Astro, ZK-HTK, collision with terrain, Urewera National Park, 3 December 2001

02-001 Cessna 207, ZK-SEV, collision with terrain, Gertrude Saddle area 11 km southeast of Milford Sound, 19 January 2002

Transport Accident Investigation Commission
P O Box 10-323, Wellington, New Zealand
Phone +64 4 473 3112 Fax +64 4 499 1510
E-mail: reports@taic.org.nz Website: www.taic.org.nz

Price $ 22.00 ISSN 0112-696