Report 00-003

Aerospatiale AS 350BA

ZK-HWK

collision with terrain

Mount Karioi, Waitomo

7 March 2000

Abstract

On Tuesday 7 March 2000, Aerospatiale AS 350BA helicopter ZK-HWK was on a local charter flight from Raglan to Mount Karioi, carrying technicians to service telecommunications equipment located on the summit. It was being flown in conditions of reduced visibility resulting from local cloud when it collided with trees and the ground, killing all 4 occupants.

The time of the accident and the detail of the flight path could not be conclusively established, but the pilot may have inadvertently lost visual reference with the surface in deteriorating visibility.

A safety issue identified was:

- The desirability of a less vulnerable ELT location in helicopters.

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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.

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Contents

List of Abbreviations

amsl	above mean sea level
CAA	Civil Aviation Authority of New Zealand
ELT	emergency locator transmitter
GPS	global positioning system
hPa	hectoPascal
kg	kilogram
m	metre
mHz	megaHerz
mm	millimetre
nm	nautical miles
NZDT	New Zealand daylight time
RNZAF	Royal New Zealand Air Force
SAR	search and rescue
SARSAT	search and rescue satellite
UTC	universal coordinated time
VHF	very high frequency

Data Summary

Aircraft type, serial number and registration:	Aerospatiale AS350BA, 2004, ZK-HWK
Number and type of engines:	one Turbomeca Arriel 1B
Year of manufacture:	1987
Date and Time:	7 March 2000, probably about 0930 hours[1]
Location:	on Mount Karioi, 4.7 nm south-west of Raglan aerodrome latitude: 37° 52.3´ south longitude: 174° 48.2´ east
Type of flight:	air transport, charter
Persons on board:	crew: 1 passengers: 3
Injuries:	crew: 1 fatal passengers: 3 fatal
Nature of damage:	aircraft destroyed
Pilot's licences:	Commercial Pilot Licence (Helicopter and Aeroplane)
Pilot's age:	39
Pilot's total flying experience:	2816 hours 2427 hours on helicopters
Investigator-in-Charge:	J J Goddard

[1] All times in this report are NZDT (UTC + 13 hours)

1. Factual information

1.1 History of the flight

1.1.1 On the morning of 7 March 2000 the pilot of New Zealand Heliwork's AS350BA Squirrel helicopter ZK-HWK had a charter flight booked, to take two telecommunications technicians to Mount Karioi to service equipment located on the summit. He began duty at his base at Hamilton aerodrome at about 0600 hours, with some hangar work and with preparing the helicopter for the day's flying.

1.1.2 At about 0730 hours he flew ZK-HWK across the aerodrome, to refuel with Jet A1 fuel at an installation on the eastern side of the aerodrome. He then repositioned the helicopter back to the company hangar, and had coffee with friends at an adjacent aircraft maintenance company.

1.1.3 The pilot boarded one of the two technicians, and also the pilot's flatmate and two friends onto the helicopter at about 0850 hours for the positioning flight from Hamilton to Raglan, 23 nm to the west, where the other technician was to be picked up.

1.1.4 ZK-HWK departed from Hamilton at 0858 hours in clear sunny weather, with light and variable winds and few clouds at 2500 feet. The flight conditions were clear and mostly smooth, but with increasing cloud and a moderate southwest wind producing minor turbulence on arrival at Raglan.

1.1.5 At Raglan the pilot's flatmate, who had some training in ground crew duties, supervised the deplaning of her two friends and the boarding of the second technician who was accompanied by his brother. After checking that all 3 passengers were properly strapped into their seats, she asked the pilot how he would get to Mount Karioi. This was because she had observed that the upper third of the mountain was obscured by cloud. The pilot's reply was non-committal, but to the effect that they would have a look.

1.1.6 ZK-HWK departed normally from Raglan at about 0920 hours, and was observed to head south, climbing towards the east side of Mount Karioi until lost to sight against the cloud. The helicopter was not seen again, although a witness southwest of Mount Karioi heard a helicopter fly over towards the west at between 0930 and 1000 hours.

1.1.7 At some undetermined time after leaving Raglan, ZK-HWK flew into the forest canopy on the south side of Mount Karioi, colliding with several trees before a final collision with the ground, at an elevation of 1850 feet amsl.

1.1.8 There were no witnesses to the accident.

1.1.9 The technicians' work on Mount Karioi was estimated to take about 45 minutes, so the helicopter's return was not expected until after 1000 hours. The pilot's flatmate, who was waiting at Raglan with her friends, was not initially concerned because the pilot had told her not to react too soon if he was late back, because he might be delayed on the ground and out of cell phone range. He had been up to 4 hours late on previous occasions.

1.1.10 She contacted the police at about 1330 hours, to advise her concern that the helicopter was overdue. After local enquiries, a class 3 search was initiated using helicopters and ground parties. The wreckage of ZK-HWK was located visually by helicopter at 1757 hours, and a rescue party was winched to the site, where they ascertained that no occupants of ZK-HWK had survived the accident.

1.2 Injuries to personnel

Injuries	Crew	Passengers	Others
Fatal	1	3	-
Serious	-	-	-
Minor/nil	-	-	

1.3 Damage to aircraft

1.3.1 ZK-HWK was destroyed by collision with trees and the terrain.

1.4 Other damage

1.4.1 Nil

1.5 Personnel information

1.5.1

Pilot:	Male, aged 39 years
Licences:	Commercial pilot licence (Helicopter) and (Aeroplane)
Ratings:	Agricultural, Chemical
Helicopter type ratings:	Hiller UH12, Enstrom F28, Bell 206, AS350, Hughes 369
Medical certificate:	Class 1, valid to 26 May 2000 (included waiver 020 and 051: excessive weight)
Last annual pilot competence and agricultural check:	30 June 1999
Last Biennial flight review:	20 June 1999
Flying experience:	Total, all types: 2816 hours Total, helicopter: 2417 hours Total, AS350 type: 288 hours Total, last 90 days: 94 hours (91 on ZK-HWK)
Duty time:	3 hours
Rest before duty:	12 hours

1.5.2 The pilot was the principal of New Zealand Heliwork (1988) Limited, which was essentially a one-man operation.

1.5.3 He had completed his Commercial Pilot Licence (Aeroplane) in 1982, followed by his Commercial Pilot Licence (Helicopter) in 1989. The majority of his helicopter flying had been on the Bell 206 type, but after completing AS 350 type conversion training in June 1998, he had mostly flown that type.

1.5.4 The restrictions had been placed on his Class 1 medical certificate after his routine medical examination in November 1998, when he was assessed as fit, but of excessive weight. A medical certificate was issued for a reduced period of 6 months. His last medical examination was in May 1999, when he was assessed as fit, with a normal 12-month currency period on his medical certificate. A weight reduction of 3.5 kg had been achieved since his previous examination.

1.5.5 He had last flown, in ZK-HWK, on 28 February. That was on private operations with the owner of the helicopter, for a total of 2.4 hours.

1.5.6 His pilot logbook recorded 8 previous jobs on Mount Karioi since 1991, but there were other non-specific local entries which could have also included Mount Karioi. The charterer advised that the pilot had done several flights for them to Mount Karioi during 1999.

1.5.7 He was reported to have had some previous experience of flying the helicopter up mountainsides in reduced visibility, including on Mount Karioi, but was known to be conservative in doing this, typically only through a thin layer of cloud, 100-200 feet thick.

1.5.8 People who saw the pilot at Hamilton before departure that morning reported that he was his normal cheerful self.

1.6 Aircraft information

1.6.1 ZK-HWK was an Aerospatiale (now Eurocopter) single-engine helicopter, serial number 2004, manufactured in 1987 as an AS 350B model. It was imported to New Zealand in 1995 and registered as ZK-HPV. Modifications were carried out in 1996 to upgrade the model to an AS 350BA. After some 800 hours of routine operations it was exported to Australia in April 1999, where major inspection work was done at Eurocopter Australia.

1.6.2 It was re-imported and re-registered ZK-HWK, and issued with an Airworthiness Certificate in the Standard category in October 1999. It was subsequently privately owned but operated solely by New Zealand Heliwork as the company's principal helicopter.

1.6.3 ZK-HWK was thereafter maintained by Eurocopter New Zealand in accordance with the New Zealand Heliwork (1988) Operator's Maintenance Manual. This manual had not been amended to reflect this maintenance contractor, but records indicated that appropriate maintenance had been carried out. The last scheduled maintenance, a 100-hour inspection, had been completed on 2 February 2000, at a total time in service of 1868 hours. The next scheduled inspection was due at 1968 hours, and the next maintenance review was due on 18 October 2000.

1.6.4 A review of maintenance documents showed that all scheduled maintenance had been recorded and all significant defects rectified. No outstanding airworthiness directives were found. The component service record cards showed that all finite-life components were within their appropriate lives.

1.6.5 The helicopter had accumulated a total of 1905 hours time in service.

1.6.6 The Turbomeca Arriel 1B engine, serial number 972, had run a total of 1905 hours. It had been installed in this helicopter since new.

1.6.7 The weight and balance of the helicopter was calculated using an estimated fuel quantity of 60%, and an estimated baggage weight of 40 kg. This gave a total weight of 1887 kg, with the centre of gravity located 3.23 m aft of the datum.

1.6.8 The maximum permitted weight of the helicopter was 1950 kg, with the permitted centre of gravity range between 3.17 and 3.43 m aft of the datum.

1.7 Meteorological information

1.7.1 A slow-moving ridge of high pressure extended towards the north of New Zealand from an anticyclone in the Tasman Sea, giving a moderate south-westerly airflow over North Island with generally settled weather and clear skies inland. A weak front in this southwest flow passed over North Island during the day. Near the west coast stratiform cloud formed where the moist onshore flow was lifted by high ground. The extent of this coastal low cloud increased and the height of its base lowered during the morning with the approach of the front.

1.7.2 The aerodrome weather at Hamilton on the morning of 7 March, broadcast on the automatic terminal information service, included:

> Information Echo, at 0903 hours: wind variable at 3knots, visibility 30 km, cloud; few at 2500 feet, temperature 18°, dewpoint 16°.
>
> Information Foxtrot, at 0955 hours: similar, but with broken cloud at 2500 feet.
>
> Information Golf, at 1052: wind 230° at 10 knots, visibility 30 km, cloud; few at 2500 feet, broken at 2800 feet, temperature 22°, dewpoint 14°.
>
> Information Juliet, at 1251 hours: wind 260° at 10 knots, varying between 220° and 310°, visibility 15 km, cloud; scattered at 1500 feet, broken at 2500 feet, temperature 22°, dewpoint 17°.

1.7.3 Observations from the Metservice automatic weather station at Port Taharoa (19 nm south of Mount Karioi) were:

> 0900 hours: wind 220° at 14 knots, temperature 19°, dewpoint 16°, pressure 1015hPa
> 1000 hours: wind 210° at 13 knots, temperature 20°, dewpoint 17°, pressure 1016hPa
> 1100 hours: wind 220° at 11 knots, temperature 21°, dewpoint 16°, pressure 1016hPa
> 1200 hours: wind 210° at 10 knots, temperature 20°, dewpoint 16°, pressure 1015hPa

1.7.4 The weather at Raglan when the helicopter arrived was reported as a moderate southwest wind which increased during the morning, good visibility, and broken cloud which was not low. The upper part of Mount Karioi was obscured by cloud.

1.7.5 Another helicopter pilot was flying on the western side of Mount Karioi until about 0900 hours, mustering cattle. He reported that the wind was westerly at about 30 knots, visibility was okay with no rain, and cloud was broken away from the mountain but closed in on Mount Karioi with a local base of about 500 feet. The top of Mount Karioi had been obscured by cloud from about 0700 hours.

1.7.6 The crew of an RNZAF helicopter that flew southbound along the coast past the western side of Mount Karioi at about 0845 hours reported that they could have passed either side of the mountain. The local cloud base was pretty solid at 1500 feet and no shower activity was noted. There was some localised weather on the mountain, with the southwest wind. On their return at about 1615 hours the weather had deteriorated with a cloud base of about 1000 feet and increased wind.

1.7.7 A video recording made by a passenger in ZK-HWK on the flight from Hamilton to Raglan showed clear sunny conditions on departure, with good visibility but increasing cloud above during the flight. The recorded view from Raglan Aerodrome of the departure of ZK-HWK, looking towards the north side of Mount Karioi, showed local continuous cloud obscuring the upper third of the mountain, with a base estimated at about 1500 feet, but with some breaks in the cloud to the east and west.

1.8 Aids to Navigation

1.8.1 Not applicable.

1.9 Communications

1.9.1 ZK-HWK was equipped with normal aircraft VHF radios, and a cellphone.

1.9.2 Normal communications with Hamilton Tower on 122.9 mHz were reported on the helicopter's departure from Hamilton. No other communications were heard.

1.9.3 In remote area operations the company policy was to have a person on the ground delegated to provide flight-following, and alerting should a flight become overdue. This was either by using radio communications, if practicable, or by having an expected return time to base overdue action upon. For this flight, radio or cellphone communications were not anticipated, and the pilot's flatmate was expected to act as the appropriate person.

1.10 Aerodrome information

1.10.1 Not applicable.

1.11 Flight recorders

1.11.1 No flight recorders were installed or required to be installed in ZK-HWK.

1.11.2 No GPS (global positioning system) equipment was installed in ZK-HWK. GPS equipment has proved to be of significant value in recording recoverable track and time data in several recent investigations.

1.11.3 The Airways Corporation air traffic control primary and secondary radar recordings for the appropriate area and time were examined for any evidence of the helicopter's flight path. No recorded data was found which correlated with the flights of ZK-HWK from Hamilton to Raglan or from Raglan to Mount Karioi.

1.12 Wreckage and impact information

1.12.1 The fuselage of ZK-HWK was lying inverted on a southerly heading on forested terrain which locally sloped down to the east at 23°. The accident site was on the east side of a broad spur running from the summit of Mount Karioi down to the south, at about 1850 feet above sea level and about 150 feet below the crest of the spur. The mountain was covered with regenerated native forest of moderate density.

1.12.2 The main transmission and rotors, tail boom, right skid, 4 doors and all detachable panels were separated from the helicopter fuselage, and distributed along the wreckage trail through the forest. The engine was out of its mounts, but approximately in position underneath the fuselage. The cabin floor had collapsed upwards with most damage on the left front. This was consistent with a severe ground collision while in forward flight, probably nose down and banked left. All 4 occupants had been ejected; the pilot and front passenger with their seats which had separated from the floor mountings, while the rear passengers had been released by the overload failure of

their lap belts. One occupant was trapped beneath the fuselage while the others had been thrown clear.

1.12.3 The most distant trees with obvious helicopter collision and main rotor slash damage were about 30 feet tall and 27 m from the accident site. The track from these trees to the site was 220° magnetic, with a vertical angle of 8° down from the slash marks. The pattern of slash marks suggested that the helicopter was banked 10° to the left. The length of the wreckage trail and the ground impact damage was consistent with a moderate speed at impact.

1.12.4 Along the wreckage trail the first major item, 4.5 m from the damaged trees was the rear of the tail boom, which included the tail rotor and gearbox, and horizontal and vertical stabilizers. This was followed by the left skid, the doors, panels and main transmission and rotors. All major components of the helicopter were accounted for in the vicinity.

1.12.5 The main rotor blade damage was severe and similar on all 3 blades, consistent with multiple tree strikes while rotating under power and at normal rotational speed. The starflex arms in the main rotor head had characteristic 45° fractures. The orientation of these fractures indicated that the blue and yellow blades were being driven by engine torque, while the red starflex arm fracture was consistent with inertia forces from the red blade. Both tail rotor blades showed severe damage from tree strikes, both rotational and sideways. The tail boom and horizontal and vertical stabilisers also showed evidence of collision with trees, which had resulted in the tail boom separation.

1.12.6 The pre-impact integrity of engine controls and flight control systems was confirmed by examination. The dual collective and cyclic controls had been installed in the front passenger position, in addition to the pilot's controls. There was no evidence of whether or not these controls were obstructed or operated by the passenger. The main rotor and tail rotor gearboxes rotated normally. The drive shaft separations were consistent with the accident break-up.

1.12.7 The fuel tank was punctured and almost empty, but there was evidence of substantial fuel spill at the site.

1.12.8 The instrument panel showed little significant evidence, except for the altimeter reading of 1800 feet and the hourmeter reading of 1135.6. Neither the aircraft clock nor the watches worn by the occupants had captured the time of the accident.

1.12.9 The Pointer emergency locator transmitter (ELT) was ejected from its mounting in the severely crushed fuselage nose section, breaking its aerial connection and fracturing its printed circuit board. The ELT was found with the master switch in the "OFF" position. A second 406 mHz manually operated personal ELT, probably the property of the front passenger, was also found. It was switched "OFF".

1.12.10 The engine was lifted out by helicopter for detailed examination. The engine module 5 input pinion matched markings showed a relative movement of 2.5 mm, indicating the delivery of engine torque when the main rotor strike occurred. This was also confirmed by twisting distortion of the forward engine liaison cone.

1.12.11 Light bulbs from the caption panel were examined for evidence of filament hot stretch, which would indicate that they were illuminated at impact. No bulbs with hot stretch were found: all were normal, except for "PITOT" and "BLEED VALVE", which were broken. No bulbs from the switch panel were recovered.

1.13 Medical and pathological information

1.13.1 The post-mortem and toxicological examinations of the pilot did not disclose any abnormalities that might have affected his ability to conduct the flight.

1.13.2 The post-mortem examinations of the occupants showed that they all received multiple severe injuries at ground impact, which would have resulted in immediate death.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 The severe impact forces involved in the final collision of the helicopter with the ground were clearly beyond the design requirements of the occupant restraints. The accident was unsurvivable.

1.15.2 The delay of some 3 hours between the helicopter's expected time of return and overdue action being taken was a result of the pilot telling his flatmate not to react too soon, and having been up to 4 hours late previously.

1.15.3 The absence of an ELT signal removed the possibility of an earlier alert from overflying aircraft or from the SARSAT system, as well as preventing any location by an electronic search once the official search had begun. The failure of the ELT mounting resulted from the severity of the damage to the nose section of the fuselage, which generated forces well beyond the ELT's design parameters. The broken aerial connection and internal damage were direct consequences. The "OFF" position of the master switch could have occurred during the ejection of the ELT from the helicopter, or it could have been inadvertently left in that position. The second ELT, being manually operated, could not have produced a signal without action by a survivor.

1.15.4 Recent model AS 350 helicopters are manufactured with the ELT in the rear locker, while some AS 350 helicopters in New Zealand have been modified to relocate the ELT to the forward section of the tail boom. This has proved beneficial to the survival and functioning of the ELT in some previous accidents.

1.16 Tests and research

1.16.1 Nil.

1.17 Organisational and management information

1.17.1 NZ Heliwork (1988) Limited was formed in 1988 by the pilot, and was based at Hamilton aerodrome. It was essentially a one-man business, although the pilot's father assisted with some administrative tasks. The company's first ten years of operations were with a Bell 206 helicopter, principally on agricultural work to start with; this gave way progressively to general helicopter aerial work and passenger operations by 1997. The Bell 206 was supplemented from 1998 with leased AS 350 D and Hughes 369 helicopters, before being replaced by ZK-HWK in October 1999. ZK-HWK was privately owned, but leased to the company and registered in the company's name. The pilot flew the helicopter on private operations for the owner as well as on the company's commercial operations.

1.17.2 The company's flight crew training and checking was carried out by a training organisation at Hamilton, while the aircraft maintenance was carried out by Eurocopter New Zealand, at Ardmore.

1.17.3 The company held Transitional Air Operator Certificate, number 19773, valid to February 2003 and Agricultural Air Operator Certificate, number 19773, valid to January 2004, issued by the Civil Aviation Authority (CAA).

1.17.4 The CAA carried out audits of the company in March 1997, March 1998, and July 1999. The last audit found 8 deficiencies, which the audit report stated, "…show that more attention to detail is required in maintaining and completing required documentation both for operations and maintenance".

1.17.5 CAA records showed no previous operational incidents or accidents for the company or the pilot.

1.17.6 The company had become a well-regarded helicopter operator in the district, and was the operator of choice for a number of regional customers.

1.17.7 After the accident the company office and hangar premises, records and equipment appeared to be comprehensive and scrupulously maintained, giving the impression of a carefully managed business.

1.18 Additional information

1.18.1 The pilot did, on occasion, fit the dual controls to the helicopter to allow the owner to handle the controls while en-route on private flights. The pilot's flatmate had similarly flown the helicopter on positioning flights. It was normal practice for the dual controls to be removed for all other operations. The previous flight had been a private flight for the owner.

1.18.2 The pilot's diary, on the 7 March page, recorded the hour meter reading before flight of 1135.1. No other information was recorded in the diary for that day.

1.18.3 The task the two technicians were to do on Mount Karioi was non-urgent and mostly routine. It involved doing checks and maintenance on the repeater station equipment, and also planning and costing work to be done to improve the durability and security of the installation.

1.18.4 The charterer advised that there was no evidence, such as a logbook entry or work done, found at the repeater station to indicate that the technicians had visited the station on the day of the accident.

2. Analysis

2.1 In the investigation of this accident it was not possible to conclusively determine either the time of its occurrence or the detail of the final flight path because of the absence of relevant evidence from the accident site or from witnesses.

2.2 However, the total flight time from before departure from Hamilton to the accident was indicated by the aircraft hour meter readings of 1135.1 and 1135.6. This gave an elapsed time of 0.5 ±0.1 hours, which would have included the brief flights across Hamilton aerodrome for refuelling (about 0.1), the flight from Hamilton to Raglan (about 0.3), and the accident flight from Raglan to Mount Karioi.

2.3 The inference is that the final flight duration was about 0.1 hours, with a possible maximum of 0.2 hours. A flight time of 0.1 (6 minutes) would have been sufficient to fly from Raglan around the east flank of Mount Karioi to the accident site, with some of the flight at less than normal cruising speed.

2.4 Other possibilities for the detail of the final flight include flying to the destination on Mount Karioi, with the accident occurring on the return leg; and interrupting the flight to the mountain, perhaps because of the weather, with an intermediate landing for an unknown length of time before resuming the flight.

2.5 Either of these alternative propositions would have been just possible within the maximum flight duration of 0.2 (12 minutes), if carried out expeditiously. The first proposition, of the accident occurring on the return from the destination was not likely because there was no evidence found at the repeater station that the technicians had visited it to perform their task. The second proposition was also not likely because of the close proximity of Raglan aerodrome. If the pilot had wanted to make an intermediate landing because of weather, or for any other unplanned reason, a return to Raglan would have been simpler and probably as expeditious as reconnoitring and landing at a new location.

2.6 Because of these considerations, the balance of probability is that the accident occurred on an uninterrupted final flight some 6 to 12 minutes after leaving Raglan, at about 0930 hours.

2.7 The details of the flight path could not be deduced after the initial departure from Raglan, which was witnessed and recorded on video. The helicopter had departed normally, heading south and climbing towards the east side of Mount Karioi until lost to sight against the cloud layer.

2.8 The base of this cloud layer in that vicinity, north-east of the mountain, was estimated to have been at about 1500 feet, similar to that reported by the RNZAF helicopter crew to the west of the mountain. The base of the cloud on the west side of the mountain, however, was reported as locally down to about 500 feet, by the other helicopter pilot mustering cattle in that area.

2.9 This variation in the reported cloud base around the mountain is consistent with the nature of orographic cloud, which is typically lower on the weather side of a mountain, where it forms, than on the lee side. Because of this the pilot of ZK-HWK, having approached the mountain from the northeast, if he then flew around the eastern flank to arrive at the accident site on the southern side, probably encountered thickening cloud with a lowering base on the way. In any event, the height of the accident site, 1850 feet amsl, was almost certainly well above the local cloud base on that side of the mountain. The probability is that the helicopter was being flown in reduced visibility in cloud, when the accident occurred.

2.10 The pilot's intended strategy for flying to the repeater station on the mountaintop, with the upper part of the mountain shrouded in cloud, is not known. His flatmate, before the departure from Raglan, had specifically asked about this but had received a non-committal reply.

2.11 A helicopter can be flown in reduced visibility, such as in cloud, up or down a mountainside, either hover-taxying or just above translation speed, at a few feet above the surface so that continuous visual reference can be maintained. Some conspicuous search and rescue flights have been so achieved. Maintaining visual contact with ground features is vital for navigation and for spatial orientation, as well as to avoid collision with the surface, so a low speed commensurate with the available visibility is essential. The ability of a pilot to so fly a helicopter is an acquired skill, and which requires mature judgement to decide when the additional risks are justified.

2.12 While the pilot of ZK-HWK had some experience of this type of flying, it is not known whether he decided to adopt it as the means to fly to the top of Mount Karioi when he saw the cloud around the top of the mountain. However, hover-taxying was probably the only way of flying to the top at that time.

2.13 If the pilot had elected to fly up the mountainside in this way, he would have needed a procedure in mind in order to navigate to the top and locate the destination helipad. His previous experience of at least 8 jobs on Mount Karioi probably had shown him that he could reach the top by following a spur or ridgeline from the south east, and that he could recognize the destination helipad.

2.14 The location of the accident site, on the east side of a southern spur, and the orientation of the wreckage trail of 220° magnetic, suggested that the helicopter had crossed a small valley between two spurs before colliding with the trees. If the final flight path was thus, it is possible that the pilot was following a southeast spur up the mountain, and inadvertently flew off the side of it over the adjacent valley where he lost sight of the ground as it fell away beneath the helicopter.

2.15 In such an eventuality, the pilot would be faced with having to temporarily continue in forward flight by reference to his instruments, and with two alternative courses of action: either to climb, hoping to avoid terrain, until clear of cloud; or to descend ahead at a low rate, hoping to regain sight of the ground in time to re-establish flight above the surface by visual reference.

2.16 The circumstances of this accident suggest that the pilot may have attempted the second alternative, but was unsuccessful in regaining sight of the ground before flying into the forest canopy on the far side of the valley. There was no indication that the helicopter was not under control when the accident occurred. It was either in level flight, or in a slight descent, and banked some 10° to the left as it struck the trees.

2.17 This hypothesis of the pilot's actions in the weather prevailing at the time of the flight is not substantiated by evidence, but represents a possible scenario given the circumstances of the accident. If the pilot did in fact decide to attempt the flight in this way, it would indicate an uncharacteristic lapse in his judgement making. There was no particular pressure to complete the flight, other than standard commercial considerations relating to unproductive flying. It is probable that on the flight from Hamilton to Raglan in good weather, the pilot had no expectation of encountering difficulty resulting from local weather on the mountain. Having arrived at Raglan, and observed the cloud on Mount Karioi less than 5 nm away, he was probably reluctant to abandon the intended short flight without exploring the actual conditions, and with an intention of turning back if necessary. In the event the weather conditions, in particular the visibility, probably worsened as the flight proceeded around the mountain. As a result the pilot may have encountered conditions beyond his personal minima before he was able to turn back, or it may have been an attempt to turn back which led to the helicopter flying across the valley towards the accident site.

2.18 The possibility of some control interference from the front seat passenger could not be eliminated, but there was no evidence to either support or disprove this. Both the dual cyclic and collective controls were fitted, unusually, making the helicopter susceptible to extraneous control inputs from the passenger.

2.19 This accident illustrated the vulnerability of the ELT location in the helicopter's nose section, compared with the modified location in some AS 350s. Such a modified location in ZK-HWK probably would have enabled the ELT to function in this accident. Although in this case a functioning ELT probably would not have assisted in rescuing any survivors, it would have expedited and simplified the search. In a less severe accident a functioning ELT could enable a timely rescue to save life. Regulatory action to require, where possible, the relocation of ELTs away from the nose section of all helicopters would have a positive flight safety potential. A safety recommendation to CAA was made to this effect.

3. Findings

3.1 The pilot was appropriately licensed and experienced for the operation and the helicopter type.

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

3.3 The helicopter was loaded within normal limits.

3.4 The helicopter was on a routine charter flight to a helipad on the top of Mount Karioi at a time when local cloud covered the top part of the mountain.

3.5 The helicopter was probably being flown up the mountain when it collided with the forest canopy.

3.6 The helicopter was probably being flown in reduced visibility, in cloud, before the collision with the trees.

3.7 The helicopter was functioning normally before the collision with the trees.

3.8 The helicopter was under control when it collided with the trees.

3.9 The pilot may have inadvertently lost visual reference with the surface while flying up the mountain at low level in deteriorating visibility.

3.10 There was no pressing reason for the pilot to continue the flight in the prevailing local weather conditions.

3.11 The failure of the ELT to function because of its vulnerable location had the potential to compromise the effectiveness of the search and rescue if this accident had been survivable.

4. Safety Recommendation

4.1 On 23 August 2000 it was recommended to the Director of Civil Aviation that he:

4.1.1 initiates appropriate regulatory action, such as an airworthiness directive, to require where possible the relocation of ELTs to a less vulnerable location than the nose section, on all helicopters. (051/00)

4.2 On 30 August 2000 the Director of Civil Aviation replied:

4.2.1 I accept this recommendation as worded and will initiate appropriate regulatory action, such as an airworthiness directive, to require where possible the relocation of ELTs to a less vulnerable location than the nose section, on all helicopters. This will be implemented by Thursday 28 September 2000.

Approved for publication 2 August 2000

Hon. W P Jeffries
Chief Commissioner