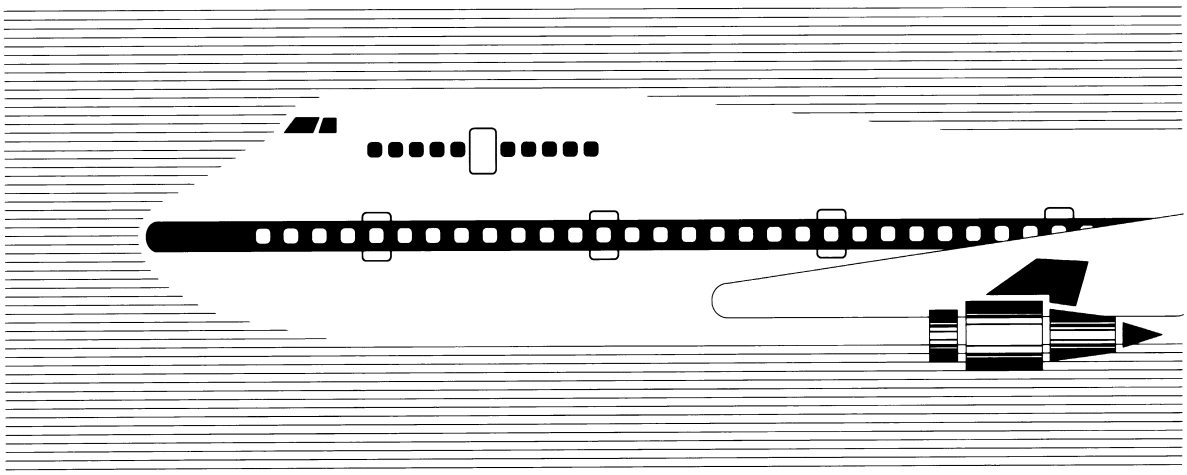
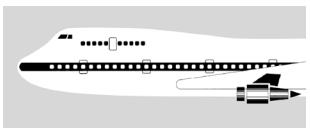
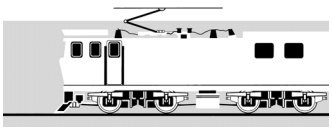


AVIATION OCCURRENCE REPORT

05-009 **Eurocopter AS350 BA Squirrel, ZK-HGI, roll over on landing, Franz Josef Glacier** **17 August 2005**


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 05-009

Eurocopter AS350 BA Squirrel

ZK-HGI

roll-over on landing

Franz Josef Glacier

17 August 2005

Abstract

On Wednesday 17 August 2005, at 1145, the pilot of ZK-HGI, a Eurocopter AS350 BA helicopter, flew a party of 4 adults and 3 children to a snowfield above Franz Josef Glacier, in South Westland. When approaching to land, the helicopter started to drift right, the skids caught in the soft snow and the helicopter rolled onto its right side. The pilot and passengers were able to vacate the helicopter and, other than some bruising, were not injured.

The accident was caused by the pilot unknowingly entering white-out conditions as he approached to land on the snow. Recent snow had obscured markers put in the snow to assist visual reference. Therefore, he did not detect the lateral movement of the helicopter as it was about to land. The pilot's selection of approach heading further compounded the loss of visual references.

The safety issues identified were the pilot's understanding of white-out conditions and the importance of approach heading selection. The operator and pilot addressed both these issues early in the investigation, so no safety recommendation was required.

Wreckage of ZK-HGI
Geikie Snowfield, Franz Josef Glacier

Contents

Figures

Abbreviations

CAA	Civil Aviation Authority (New Zealand)
cm	centimetre(s)
ELT	emergency locator transmitter
ft	feet
m	metre(s)
RCCNZ	Rescue Coordination Centre New Zealand
RPM	revolutions per minute
UTC	coordinated universal time
VHF	very high frequency

Data Summary

Aircraft registration:	ZK-HGI
Type and serial number:	Eurocopter AS350 BA Squirrel**,** 1614
Number and type of engines:	one Honeywell (Lycoming) LTS101-600A3A turboshaft
Year of manufacture:	1982
Operator:	The Helicopter Line Limited
Date and time:	17 August 2005, at about 1145[1]
Location:	Franz Josef Glacier**,** South Westland latitude: 43° 28.69´ south longitude: 170° 14.86´ east
Type of flight:	commercial transport, charter
Persons on board:	crew: 1 passengers: 7
Injuries:	nil
Nature of damage:	extensive
Pilot's licence:	Commercial Pilot Licence (Helicopter)
Pilot's age:	46
Pilot's total flying experience:	1644 hours total 1487 hours on helicopters (315 hours on type)
Investigator-in-charge:	I R McClelland

[1] All times in this report are in New Zealand Standard Time (UTC +12) and are expressed in the 24-hour mode.

1 Factual Information

1.1 History of the flight

1.1.1 On the morning of Wednesday 17 August 2005, ZK-HGI, a Eurocopter AS350 BA helicopter was being used to carry helihikers onto the lower slopes of Franz Josef Glacier for guided walks on the glacier. On returning to the helipad near the Franz Josef Glacier township, the operator advised the pilot of ZK-HGI by radio that a group had booked to complete a scenic flight to the head of the glacier. The flight was to include a landing on the glacier to allow the passengers to complete a short walk in the snow before returning to the township. The pilot confirmed he had sufficient fuel, and agreed to undertake the flight.

1.1.2 The group consisted of 2 families, and totalled 4 adults and 3 children. The operator had given the passengers a safety briefing at the operator's base and led them to the helipad to board ZK-HGI. The helicopter was fitted with seating for 7, with the pilot's seat and a 2-seater bench in the front, and a 4-seater bench row in the rear. As permitted by Civil Aviation Rules[2], the youngest child, a 20-month-old, sat on her father's lap in the rear row and was secured by an additional lap belt attached to the aircraft's seat belt. After being secured in their seats, the passengers donned headsets and waited for lift-off.

1.1.3 At 1135, ZK-HGI lifted off from the helipad and started flying up Franz Josef Glacier. As the flight progressed, the pilot gave the passengers a commentary on the local area. The pilot's intention was to fly to Baumann Glacier for the snow landing but local cloud prevented this. At 1141, the pilot radioed his base and advised that he was diverting across the glacier to the Geikie Snowfield for the landing (see Figure 1).

1.1.4 Geikie Snowfield was the preferred alternative if Baumann Glacier was unsuitable, and the pilot had landed there many times before. Cane poles, with flags attached, had been previously placed there to mark the general landing area. The flags provided pilots with a visual reference for their approach and landing, to what was otherwise a totally white environment.

1.1.5 The pilot said he approached the landing area on a north-easterly heading but could not see the flags as they had been covered by snow during the previous day and evening. However, the pilot said he was comfortable to continue and believed he had sufficient visual references to land safely. According to the pilot, his intention at that stage was to land with a small amount of forward speed, termed a slow run-on landing.

1.1.6 The passengers reported that as the helicopter approached touchdown the helicopter became enveloped in light blowing snow. The pilot and passengers recalled the helicopter then suddenly and rapidly rolled onto its right side. After all helicopter motion had ceased, the pilot pulled the fuel shut-off lever and turned off the aircraft's electrical power.

1.1.7 The pilot and passengers immediately vacated the helicopter and moved about 50 m away and confirmed they had no injuries. After a few minutes the pilot returned to the helicopter and attempted to establish radio contact with his base, but was unsuccessful. He then recovered a survival bag and, together with the passengers, awaited rescue. The pilot was aware that the helicopter's emergency locator transmitter (ELT) had activated, and that they would soon be reported as overdue.

1.1.8 At 1205, the duty person at the operator's base in the township noted that ZK-HGI was overdue and so initiated search action in accordance with the operator's procedures. The operator contacted pilots flying in the local area, and asked a pilot of another helicopter operating on Franz Josef Glacier to check Geikie Snowfield. At 1214, the pilot of the second helicopter reported that he had sighted ZK-HGI. By 1233, rescue helicopters had removed the first of the passengers off the glacier, and by 1300 all of the passengers had been taken to the township.

[2] Civil Aviation Rules, Part 91.207 (d), dated 25 November 2004.

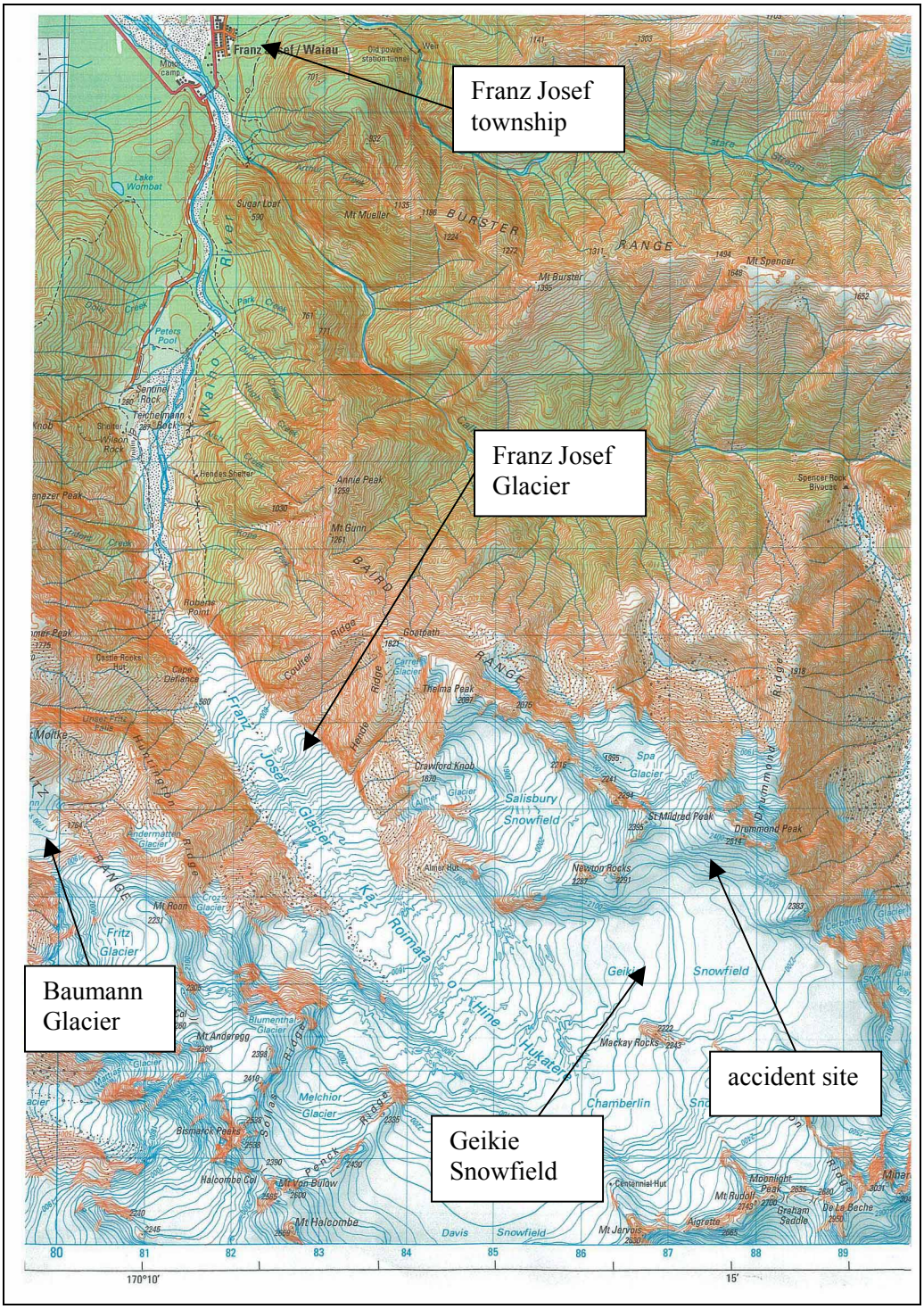


Figure 1
Map of Franz Josef Glacier Area

1.2 Injuries to persons

1.2.1 There were no serious injuries. The passengers later reported some minor bruising and soreness.

1.3 Damage to aircraft

1.3.1 There was extensive damage to the aft part of the fuselage, main rotor and tail rotor systems.

1.4 Personnel information

1.4.1

pilot:	aged 46	
licences:	Commercial Pilot Licence (Helicopter) Private Pilot Licence (Aeroplane)	
aircraft ratings:	Robinson R22, Bell 206, Hughes 269 and 369, Eurocopter AS350 and 355	
medical certificate:	Class 1, issued 20 February 2005 and valid until 19 August 2005	
last biennial flight review:	27 November 2004	
last competency assessment:	25 July 2005	
flying experience:	all types	1644 hours
	helicopter	1487 hours
	Eurocopter AS350	315 hours
	last 90 days	63 hours
	last 7 days	5 hours
duty time:	about one hour	
rest before duty:	over 36 hours	

1.4.2 The pilot obtained his commercial helicopter licence on 31 January 1997, and in 2000 he joined another operator based in Fox Glacier, initially flying part-time. Although he gained experience in local operations, the pilot did little or no high alpine snow landing operations during that time.

1.4.3 The pilot joined the operator in early October 2003, and completed his rating on the Eurocopter AS350 on 29 October 2003. Included in his training was instruction on mountain flying and snow operations. Theoretical instruction was followed by a dedicated dual instruction flight of over 2 hours duration, covering such items as "flat light" approaches and emergencies. On completion of his training, the operator gave the pilot a C-category rating, approving him for flying operations, initially with a senior pilot.

1.4.4 The pilot was based in the Franz Josef Glacier area and, under the supervision of the senior base pilot, he was subsequently approved for single pilot operations. On 26 September 2004, the pilot was upgraded to B-category company pilot.

1.4.5 The pilot's last check flight, a 180-day competency check, was flown on 25 July 2005. His last annual competency check was on 27 November 2004 and involved an assessment of his flying in mountainous terrain. Part of the flight was conducted in blowing snow conditions.

1.5 Aircraft information

1.5.1 ZK-HGI was a Eurocopter (previously Aerospatiale) AS350 BA helicopter, serial number 1614, manufactured in 1982. It was fitted with a single Honeywell (Lycoming) LTS101-600A3A turboshaft engine, serial number LE43551CE.

1.5.2 ZK-HGI was issued with an Airworthiness Certificate in the standard category. The certificate was non-terminating provided the helicopter was maintained and operated in accordance with the approved maintenance and operations manuals.

1.5.3 The last recorded scheduled maintenance was a "500/A hourly"[3] inspection, completed at 5665.65 airframe hours on 9 April 2005. The last annual review of airworthiness was also completed on that date.

1.5.4 The helicopter was next scheduled for a 100-hour inspection at 5765.65 hours. As at 17 August 2005, ZK-HGI had accumulated 5715.65 hours, and had 50 hours to run to the inspection.

1.5.5 On 23 December 2004, the operator installed an LTS101 engine as part of an upgrade of ZK-HGI to a "BA" model. By 17 August 2005, the engine had accumulated 3820 hours since new, or 199 hours since installation, and also had 50 hours to run to the next scheduled inspection.

1.5.6 The last unscheduled maintenance undertaken on ZK-HGI was on 15 August, when a faulty engine oil pressure transmitter was replaced. No outstanding airworthiness defects were recorded or reported.

1.6 Meteorological information

1.6.1 The operator, pilot and passengers reported the weather to be calm with high overcast cloud. Photographs taken by one of the passengers immediately after the accident showed a grey, nearly overcast, sky with high cirrus cloud present. The photographs also showed that no shadows were being cast across the accident site from the surrounding terrain.

1.6.2 The operator reported fresh snow had fallen during the previous night. People in the photographs appeared to be standing in about 35 cm of soft snow.

1.6.3 The sun's bearing was later calculated to have been about north of the pilot as he approached to land, and about 32º above the horizon.

White-out

1.6.4 The term "white-out" refers to the loss of visual cues by which a person can make an assessment of their position and relative movement. It is often associated with, but not restricted to, high overcast skies over featureless snow terrain, that produced a "flat light" effect which reduced surface contrast and definition. The condition could be made worse by the presence of blowing or falling snow, where actual visibility may be reduced to very short distances.

1.6.5 The loss of adequate visual cues for landing in snow can also occur in bright light conditions. With a clear blue sky, for example, the sun may reflect off the snow and prevent a clear surface definition for a pilot to accurately assess depth perception. Pilots may, therefore, have a good horizon and unlimited visibility, but in looking into a particular area may lose all references by which they can assess their movement.

1.7 Communication

1.7.1 The operator required company pilots operating from Franz Josef to be in very high frequency (VHF) radio communication with the operator's office staff during local flights. Pilots were to report at specific locations during a flight and keep the office informed of their progress, passenger numbers, fuel endurance and any significant weather conditions.

1.7.2 Pilots would occasionally lose VHF radio coverage, depending on altitude and location, for example, when landing on the Geikie Snowfield. Should a pilot not report within 10 minutes of the next scheduled call, the staff at the operator's base would initiate search action in accordance with the company emergency plan.

[3] A maintenance inspection completed every 500 flying hours.

1.8 Wreckage and impact information

1.8.1 The accident site was on the northern section of Geikie Snowfield, below Drummond Peak, at an elevation of about 7000 feet (2135 m).

1.8.2 The area around the site was generally flat, but the slope fell away gradually to the southwest as the snowfield fed into the top of the glacier. Immediately to the north of the site, the ground rose sharply towards a range of peaks that rose about 1200 feet (380 m) above the site. On the day after the accident, the peaks cast a shadow over the site until about 1045, after which it remained exposed to the sun for most of the day. The area was snow-covered but some rocky faces were exposed near the top of the peaks (see Figure 2).

1.8.3 ZK-HGI was lying on its right side in about 40 cm of soft snow, on a heading of about 030º (see Figure 3). All of the helicopter was accounted for at the site. Debris, including sections of tail rotor drive shaft and pieces of fuselage, had been thrown up to 80 m from the helicopter. The tail boom had been severed and lay near the fuselage. The marks on the boom and main rotor blades were consistent with the blades striking the boom causing the separation. The main transmission had been partly torn from its mounting.

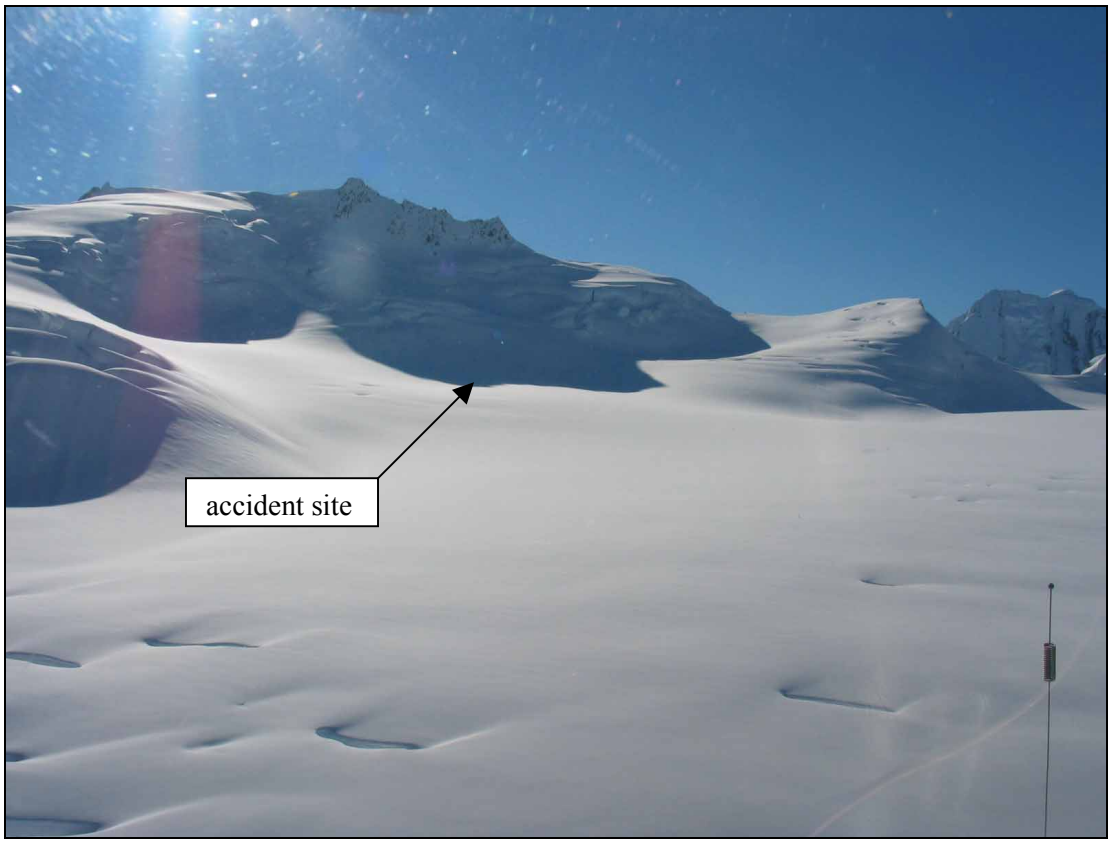


Figure 2
Geikie Snowfield looking north
(taken at 1030 on 18 August 2005)

Figure 3
Accident site looking north-north-west
(taken at 1045 on 18 August 2005)

1.8.4 The main rotor head and blades were severely damaged. The starflex arms on the rotor head displayed 45º fractures, the orientation of which were consistent with the initial rotor strikes occurring while under power, followed by some residual inertia before rotation ceased. The collective lever control was found at about half the collective pitch setting.

1.8.5 The fuel remaining was estimated to be equivalent to about 28% on the fuel quantity gauge, or about 160 litres. That was sufficient for about another 45 minutes of flying. The fuel lever had been pulled through to the shut-off position.

1.9 Survival aspects

1.9.1 At 1205, about 15 minutes after the accident, the duty person at the operator's base in the township initiated search action in accordance with the operator's procedures. The duty person broadcast an alert to pilots flying in the local area, and at 1214 the pilot of another helicopter reported sighting ZK-HGI. This helicopter needed to return to the township to offload its passengers before being able to assist further. At the same time, the operator was preparing a second helicopter to take emergency medical staff to the site.

1.9.2 Between 1219 and 1221, the 2 rescue helicopters referred to above departed the township for Geikie Snowfield. At 1229, the pilot of one of the rescue helicopters reported that the pilot and passengers of ZK-HGI were safe and well. At 1233, the first of the passengers were being lifted off the site and by about 1300 the last person was flown to the township where they were checked by waiting medical personnel.

1.9.3 Pilots flying at high altitude in the general area at the time of the accident reported receiving an ELT signal. This information was passed to the Rescue Coordination Centre New Zealand (RCCNZ) at about the same time the operator reported to RCCNZ that ZK-HGI was overdue.

1.9.4 The pilot and passengers were dressed in light clothing only, that they considered adequate for the prevailing conditions. Some protective equipment was available in the helicopter's survival packs.

1.9.5 The operator required all pilots to undertake regular first aid and mountain survival training. Mountain survival training included a practical exercise every 3 years, with refresher training every intervening year. The pilot of ZK-HGI met the operator's currency requirements for his first aid and mountain survival training at the time of the accident.

1.10 Organisational and management information

1.10.1 The operator primarily conducted commercial aerial charter and tourist sightseeing flights using 11 helicopters, mainly the AS350 and its twin-engine variant the AS355. Additional helicopters were leased during peak tourist operations. The operator's primary base was in Queenstown, with line stations in Glentanner and Franz Josef Glacier. Operations were also flown from Wanaka, Methven, Twizel and Fox Glacier.

1.10.2 Company flying operations were under the supervision of a Chief Pilot, supported by a Standards Pilot. As the name suggests, the Standards Pilot was responsible for the maintenance of standards in accordance with the company's Operations Manual, the parent document from which all other manuals flowed. Under the Standards Pilot were company instructor pilots who developed, coordinated and delivered the training. At each line station, a lead pilot was appointed, who was responsible for managing the station's operations and ongoing pilot training requirements.

1.10.3 Initial conversion and role training, for example mountain and night flying, was usually done from Glentanner. On completion of their initial training, pilots were given a C-category rating. C-category pilots were "authorised to act as pilot-in-command on air transport and commercial transport flights only when under the direct supervision of an A- or B-category pilot".

1.10.4 B-category pilots were "authorised to act as pilot-in-command on air transport and commercial transport flights, and when acting under the supervision of a A-category pilot, may take line responsibility for operational aspects of the operation including marking and selection of snow landing sites and provide direct supervision for other pilots".

1.10.5 A-category pilots were "authorised to act as pilot-in-command on any air transport and commercial transport operations and have line responsibility for such operations including marking and selection of snow landing sites and the supervision of other pilots. A-category pilots may act as pilot-in-command on other missions including external load and search and rescue flights".

1.10.6 The Chief Pilot, in conjunction with the Standards Pilot and applicable lead pilot, determined a pilot's category according to experience, ability and qualifications. The lead pilot at each station was to consider a pilot's operational category and any limitations they were under when allocating a flight task. In addition to annual pilot competency checks performed by the instructor pilots, line pilots completed regular 180-day checks that included recurrent and general training where needed.

1.10.7 In 2003 the operator came under new management, and the Civil Aviation Authority (CAA) completed a compliance inspection before issuing a new Air Operator Certificate. The inspection report recorded "a very positive feeling about the state of Company morale and the obvious ownership and involvement of the staff in safety and standards". The CAA inspectors noted stable competent staff at all levels. The Air Operators Certificate was duly issued.

1.10.8 The last CAA audit of the operator was a regular audit of the Glentanner and Twizel stations completed on 23 November 2004. The audit report echoed many comments of the previous audit of the Queenstown operation. Comments included the company "to be operating in conformance with its documented procedures which continue to improve". There was noted to be good stability of key staff, helping to ensure that standards were maintained. There were no Finding Notices as a result of the audit.

2 Analysis

The flight

2.1 The flight was a routine scenic flight. The pilot was familiar with the area and had flown the same scenic flight many times during his 22 months with the operator. The passengers were appropriately briefed for the flight and all were secured into the helicopter before lifting off.

2.2 ZK-HGI was fully serviceable and no pre-existing defects that could have affected the safe conduct of the flight were recorded or found post-accident.

2.3 Despite the cloud in the Baumann Glacier area, the weather was suitable for the flight to proceed, and the pilot's decision to change the landing area was appropriate. However, the high overcast did cause a flat light effect that probably would have made judging the surface definition difficult in the absence of other visual references.

2.4 The approach heading flown by the pilot, took the helicopter directly towards the sun and the steep rising terrain to the north of the landing site. Although the sun was high enough not to affect the pilot's view or cast a shadow across the landing site, the angle of approach did mean that the helicopter's shadow remained behind the pilot, and therefore could not be used to aid height judgement.

2.5 A secondary effect of the approach heading was to cause the pilot to lose sight of the skyline and horizon as he got closer to the landing area. He also lost sight of the exposed rocky outcrops, which were then nearly 1000 ft above him.

2.6 The pilot intended a slow run-on landing to keep any blowing snow behind the helicopter for as long as possible. However, for that to have succeeded the pilot needed to be able to assess his forward speed over the final stages of the approach, and to ensure there was no lateral helicopter movement. The passengers' reports that blowing snow started to envelop the helicopter suggested that the pilot had been unable to accurately judge his approach speed and was nearly in a hover. The blowing snow affected the pilot's visibility, which further reduced his visual references.

2.7 The helicopter touched down while it was moving laterally to the right, and caught the skids as they sank into the soft snow. The lateral movement was sufficient to roll the helicopter onto its right side before the pilot was able to recognise the situation and recover control.

White-out

2.8 The phenomenon of white-out was well known and understood by the operator and pilot. However, its onset can be very insidious and, as in this accident, a pilot may not realise a loss of essential visual references until too late.

2.9 The selection of an approach track to a landing area is critical, especially in mountainous and snow-covered terrain. The chosen track should provide a pilot with the safest route to fly, and include escape options should the approach need to be discontinued at any time. In snow conditions, the pilot should have had some easily identifiable marker on the ground to confirm the landing area and assist in assessing the speed and angle of approach of the final stages.

2.10 By electing to approach the landing area on a north-easterly heading, the pilot of ZK-HGI was approaching a flat area with steep rising terrain behind, both covered in snow. This deprived the pilot of visual references to help assess the conduct of his approach. With the site markers covered in snow, the pilot was solely reliant on good surface definition. However, the high overcast and its effect on the lighting conditions meant that the surface definition was likely to be degraded.

2.11 The pilot probably chose the north-easterly approach heading because it was the most direct and expeditious. A straight-in approach avoided having to extend his flighpath further to the east and approach on a more westerly heading. Approaching on a westerly heading would have been the better option, as it assured a clear escape path left towards the head of the glacier and more defined geographic features would have remained in sight to help the pilot assess the approach. There was plenty of fuel remaining for this to be achieved.

Organisation and training

2.12 The pilot's training and supervision were of a high standard. The operator had a structured qualification process by which pilots were able to gain experience and responsibility consistent with their performance and capability. The pilot of ZK-HGI had demonstrated the appropriate skills and been upgraded to B-category pilot about 10 months before the accident. He had performed according to the required standards during this time, and the operator's ongoing training had reinforced the standard.

2.13 However, despite the pilot's training, he elected to approach straight into the landing site, which meant that his approach path took him directly towards steep rising ground. The pilot later identified that his selection of approach heading was not appropriate for the circumstances and that this contributed to the accident. He also confirmed that he was not under any pressure to save time.

2.14 The use of cane poles with flags had proved a very effective method to help identify a landing area and provide essential visual information for pilots to assess their approach and landing. As snow levels increased during the winter, the poles were raised or additional poles inserted as old ones became obscured. In the spring the reverse applied. In this case the recent snowfall was of such depth that flags became totally covered before they could be raised or replaced. In such a situation, it was appropriate that only A- or B-category pilots were authorised to land and re-mark areas.

2.15 Alternative methods of providing approach references had been considered by the operator, but were either not approved by the management of the National Parks, were uneconomical or were impracticable for single-pilot operations with passengers. The other methods included the use of smoke grenades and the throwing of re-usable streamers, or the like, from a helicopter as it made an initial pass over a landing area. However, the operator preferred to continue with the use of the marker poles and flags, and to more closely manage the first flight of the day, especially after a heavy snowfall.

Survival

2.16 The accident was a slow-speed roll-over event and, provided the occupants were well restrained, should have been survivable, as was the case. The cabin of ZK-HGI maintained its integrity and therefore offered the occupants a survivable space protecting them from items that were thrown about when the main and tail rotor blades struck the snow and other helicopter parts.

2.17 The pilot acted promptly in selecting the electrical power and fuel off, and helping get the passengers out of the helicopter. Once all movement had ceased, the occupants were wise to promptly vacate the wreckage and move a safe distance away.

2.18 The pilot and passengers were not clothed to endure a long period on the glacier waiting to be rescued. However, the contents of the survival bags carried on board the helicopter would probably have provided sufficient protection and food to see the party through to the next day had rescue been delayed.

2.19 The operator's emergency plan worked well with the overdue status of the flight promptly recognised and a search initiated. The recovery of the passengers and pilot back to the township and the availability of medical personnel were efficiently handled. The ELT signal and RCCNZ activation provided a final back-up should the operator's procedures not have been initiated as quickly as they were.

3 Findings

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

3.1 The pilot was appropriately licensed and rated for the flight.

3.2 The helicopter had a valid Airworthiness Certificate and was recorded as being serviceable for the flight.

3.3 The pilot was experienced in mountainous operations and was familiar with the landing area.

3.4 The weather was suitable for the flight, but a high overcast resulted in poor surface definition.

3.5 The pilot did not see that the landing site marker poles had been covered by recent snow, until shortly before landing.

3.6 The pilot's choice of approach heading deprived him of adequate visual references for a snow landing.

3.7 The pilot was not aware he had lost all visual references until after the helicopter rolled onto its side.

3.8 The helicopter was functioning normally until it started to roll onto its right side.

3.9 The pilot's actions after the helicopter had rolled onto its side were appropriate.

3.10 The operator's normal procedures and emergency plan were effective in recognising ZK-HGI was overdue and in initiating search and rescue action.

4. Safety Action

4.1 The operator and pilot readily identified the factors contributing to the accident, and the investigation found no individual or systemic issues that needed to be corrected. Nevertheless, the accident was to be used by the operator as a test case to revalidate their risk management strategies. As part of this process, other local operators were to be included with the objective "to minimise the risk of reoccurrence for all operators".

Approved on 17 February 2006 for publication

Hon W P Jeffries
Chief Commissioner

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05-009	Eurocopter AS350 BA Squirrel, ZK-HGI, roll over on landing, Franz Josef Glacier, 17 August 2005
05-001	Gulfstream G-IV ZK-KFB and Piper PA 28 ZK-FTR , loss of separation, near Taupo 7 January 2005
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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

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