Report 99-006

Hughes 269C

ZK-HYE

wire strike

near Kawerau

18 December 1999

Abstract

On Saturday 18 December 1999 at about 1524 hours, ZK-HYE, a Hughes 269C helicopter, was on a private local scenic flight about 3 nautical miles north of Kawerau. Approaching to land, the helicopter struck a power line and impacted the ground nearly inverted. The pilot and 2 passengers died as a result of the accident and the resulting fire destroyed most of the helicopter.

No new safety issues were identified during the investigation.

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.

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 Web site: www.taic.org.nz

Contents

Figures

List of abbreviations

agl	above ground level
C	Celsius
cm	centimetre(s)
km	kilometre(s)
kts	knots
m	metre(s)
nm	nautical mile(s)
NZDT	New Zealand Daylight Time

Data Summary

Aircraft type, serial number and registration:	Hughes 269C, 800027, ZK-HYE
Engine type:	Lycoming HIO-360-D1A
Year of manufacture:	1970
Date and time:	18 December 1999, 1524 hours[1]
Location:	3 nm northeast of Kawerau latitude: 38° 03′ south longitude: 176° 45′ east
Type of flight:	private
Persons on board:	crew: 1 passengers: 2
Injuries:	crew: 1 fatal passengers: 2 fatal
Nature of damage:	aircraft destroyed
Pilot's licences:	Private Pilot Licence (Helicopter and Aeroplane)
Pilot's age:	37
Pilot's total flying experience:	210 hours (68 helicopter) 50 hours on type
Investigator-in-Charge:	I R M^{c}Clelland

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

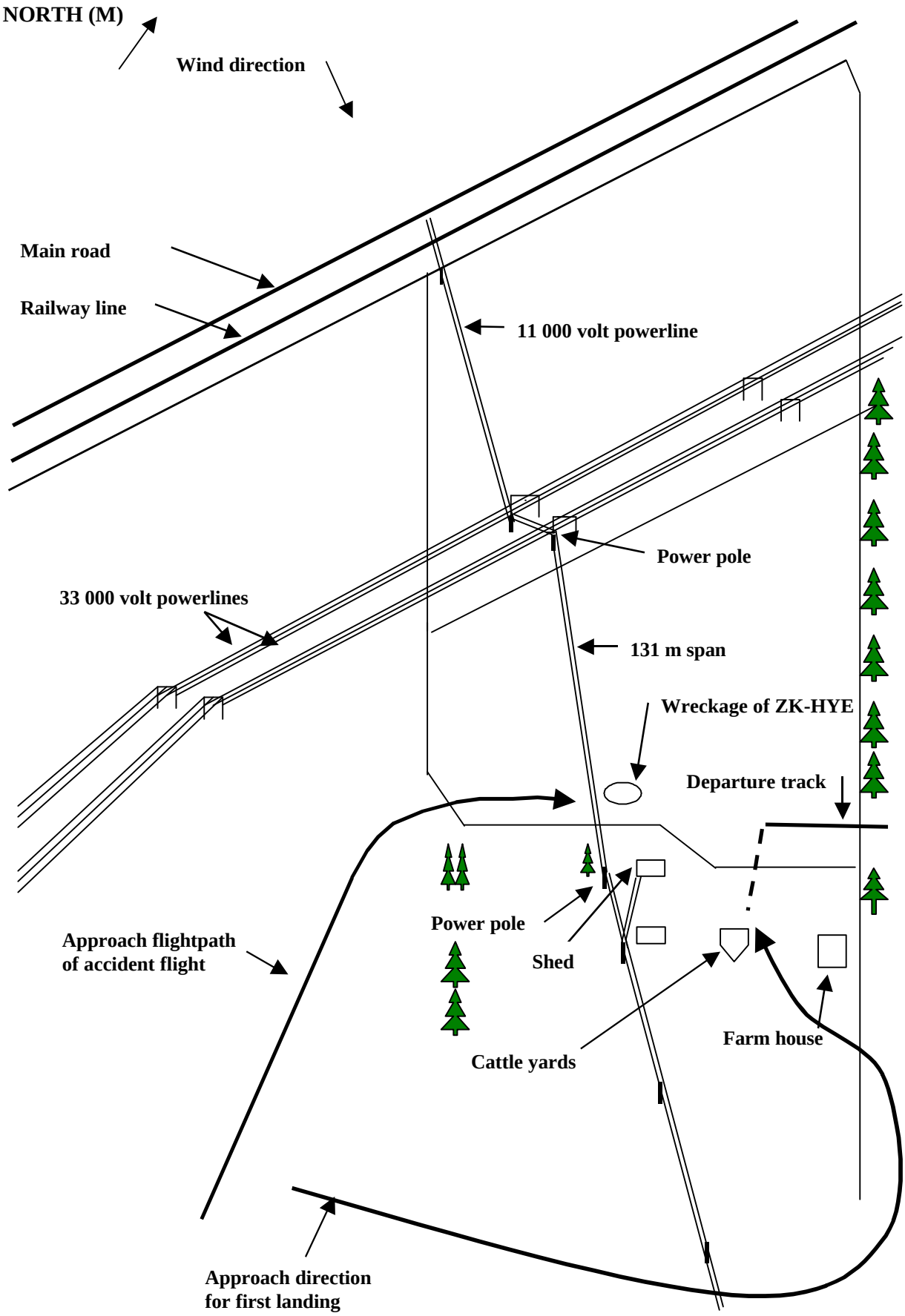

Figure 1
Accident Site
(Not to Scale)

1. Factual Information

1.1 History of the flight

1.1.1 On about 15 December 1999, the pilot contacted the operator to arrange the hire of ZK-HYE, a Hughes 269C helicopter, for Saturday 18 December. The helicopter was based at the operator's Ngongotaha site, on the western side of Lake Rotorua. The helicopter was primarily used for local charter work and training but was available for private hire. Since the pilot was unknown to the operator's flying instructor, the pilot and instructor agreed that they would complete a short check flight in ZK-HYE before the pilot commenced the private hire.

1.1.2 On 18 December, the pilot arrived at the operator's base at about 1030 hours, accompanied by his wife. The instructor examined the pilot's flying log book and noted that the pilot had flown about 60 to 80 hours on helicopters, mostly on the Hughes 269C. The last flight was recorded as being flown 2 weeks earlier, on 4 December 1999, when the pilot had completed a biennial flight review[2] with another instructor.

1.1.3 The instructor and pilot discussed the intended flight. The instructor fitted the dual flight controls to ZK-HYE while the pilot "pre-flighted" the helicopter. About 20 litres of fuel were added at this time. The pilot started ZK-HYE and completed the engine "run-up" checks before lifting from the helicopter pad and departing to Rotorua Aerodrome. The pilot then flew a series of exercises including into wind and down wind landings, autorotations to the hover and quickstops. The instructor considered the pilot to be "a little rusty" at first but improved during the flight to demonstrate a good standard.

1.1.4 The pilot flew the return leg to the operator's base and while enroute he and the instructor discussed the intended private flight. The pilot advised the instructor that he was going to fly to his parents' farm about 3 nautical miles (nm) north of Kawerau and that he knew the area well despite not having flown there before. The instructor then questioned the pilot about any wires on the farm. The pilot replied that there were "heaps" but plenty of room to land. The check flight took about 30 minutes.

1.1.5 The dual flight controls were removed from ZK-HYE after landing and a centre seat fitted. The helicopter was then refuelled to full, giving about 113 litres of fuel. The instructor saw the pilot load the helicopter, and accompanied by his wife, start it and depart normally.

1.1.6 The flight to the family farm took about 25 minutes with ZK-HYE initially approaching from the west. The helicopter then descended on a wide left base flying between a cattle yard and the farmhouse. The helicopter landed in an open grassed yard near an implement shed. (see Figure 1). The arrival of the helicopter was a surprise to the other members of the family who had gathered for a lunchtime get-together. The pilot shut down the helicopter, unloaded some items and joined the other family members for lunch.

1.1.7 During lunch the pilot arranged to take some members of the family for a short flight before returning to Rotorua. The pilot's father and mother agreed to go first. The pilot carried out a pre-flight inspection of ZK-HYE before helping to strap in the 2 passengers. The pilot's father was seated on the right of the helicopter while his mother occupied the centre seat. The 3 occupants were wearing headsets. The weather at the time was overcast with a high cloud base and a light breeze from the north-west.

[2] A flying assessment by a Category A or B flying instructor, to be completed at no more than 2 yearly intervals.

1.1.8 The pilot's intention was to fly around the farm and return to take a second group of 2 for a flight. However, no arrangements were made with the second group as to where the helicopter would land or if the engine and rotors were to be kept running or stopped. The observers believed that, knowing the pilot's meticulous manner, he would most likely shut down the helicopter before offloading the first group and boarding the second.

1.1.9 The pilot had some difficulty starting ZK-HYE but was successful on about the fourth attempt. The helicopter was then hover-taxied forward over a fence to a large paddock next to the yard and implement shed. The paddock was covered in flowering clover about 20 cm high. A power line ran across the paddock, about 100 m south-west of where the pilot entered. The pilot completed some hovering manoeuvres before lifting the helicopter off on an easterly heading and climbing over some trees.

1.1.10 The farm had 3 power lines that ran across it. Two prominent 33 000 volt power lines ran on a north-easterly heading parallel to the main road and railway line boundary of the farm, and across an adjacent paddock to where ZK-HYE had lifted off. The 2 power lines were about 100 m north of where ZK-HYE had departed. Each line consisted of 3 conductors or wires supported by wooden cross-arms attached to 2 wooden poles. The sets of poles were at about 130 m intervals. Passing underneath the 33 000 volt power lines was a less prominent 11 000 volt power line running from the main road across the farm in a south-easterly direction, feeding the farmhouse and other buildings. The 11 000 volt power line crossed the paddock about 50 m in from the southern fence line, or about 100 m to the south of where ZK-HYE had departed on the flight around the farm. The 11 000 volt power line consisted of 3 wires supported on wooden cross-arms and single poles. No poles were located in the paddock. Instead the 131 m span was supported by a pole near the implement shed and a second pole close to 2 of the 33 000 volt power line support poles in an adjacent paddock. The minimum ground clearance for the 11 000 volt power line across the 131 m span was 21.3 feet (6.5 m) with a pole height of about 26.2 feet (8 m).

1.1.11 After lifting off, ZK-HYE was observed by witnesses, including several people on neighbouring properties, to climb to about 500 feet and fly around the outside of the farm in a clockwise direction. The helicopter then crossed the railway line and road to the south-west of the farm, turned left through about 270° to approach the paddock, from where it departed, from the south.

1.1.12 ZK-HYE then flew a "slow steady approach, gradually descending" and turning right as it passed some tall trees near the southern corner of the paddock. As the helicopter approached abeam the implement shed it had descended to about 15 feet above ground level (agl). The observers were aware of the power line crossing in front of the helicopter. One person believed the helicopter would pass underneath the wires while others thought it would fly over them. As the helicopter moved forward several bright flashes were seen as it contacted the wires. Several loud "cracks" were also heard at the same time as the bright flashes. The helicopter was then observed to roll and tumble forward, impacting the ground nearly inverted. On impact a loud explosion was heard followed by an intense fire. The fire quickly enveloped the cabin area.

1.1.13 The wire strike and explosion were heard by several neighbours who raced quickly to the accident scene and attempted to help extract the occupants. The fire, however, prevented any rescue. Local fire and rescue services arrived on the scene within about 15 minutes of the accident and extinguished the remaining fire. The duration of the flight was about 6 minutes.

1.2 Injuries to persons

1.2.1 The occupants received significant traumatic injuries during the accident, but were observed to have survived the impact with the ground. However, all occupants died from burns in the resulting fire.

1.3 Damage to aircraft

1.3.1 The helicopter was destroyed.

1.4 Pilot information

1.4.1 The pilot, male, aged 37, was a licenced aircraft maintenance engineer and had commenced flying aeroplanes as a recreation in 1994 and helicopters in 1996. He held valid Private Pilot Licences for both helicopter and aeroplane, and was rated on the Hughes 269. At the time of the accident the pilot had accrued about 210 hours of flying experience, comprising about 142 hours on aeroplanes and 68 hours on helicopters. In the year leading up to the day of the accident the pilot had flown 7.3 hours on helicopters, including 1.1 hours on the Hughes 269C during his biennial flight review on 4 December 1999. He had previously flown the Hughes 269 on 14 November 1998.

1.4.2 The pilot held a Civil Aviation Authority Class 2 Medical Certificate endorsed with medical and operational restrictions for flight with severe colour perception defect (deuteranomaly) and short-sightedness (myopia) as required by Civil Aviation Rule Part 67. These restrictions were related to the wearing of spectacle lenses and carrying a spare pair available for use in flight if required, and a prohibition from flying at night. Reasons for this were related to the recognition that unaided visual acuity did not permit safe flight without glasses and that the colour perception defect was associated with reduced detection of targets under low intensity light levels.

1.4.3 In early 1996 the pilot completed several practical assessments of his colour vision, including flying with an instructor at night. The pilot was reported as having no difficulty correctly interpreting the various aerodrome lights at Auckland and Ardmore. However, a request by the pilot in June 1996 that the licence restrictions associated with the colour vision be removed was declined. On the day of the accident the pilot was observed to be wearing dark glasses, later confirmed by his wife to be prescription lenses.

1.4.4 The pilot was held in high regard by his associates and peers. He was known to be conscientious and competent in his work and flying. He would take time to ensure passengers were correctly strapped in and briefed before a flight.

1.5 Aircraft information

1.5.1 ZK-HYE was a Hughes 269C, serial number 800027, single-engine helicopter manufactured in the United States in 1970. The helicopter had been issued with a non-terminating Certificate of Airworthiness in the standard category. The helicopter had accumulated about 5460 hours and had 17 hours to run to the next "50 hour" check servicing. The helicopter was powered by a Lycoming HIO-360-D1A engine, serial number L-24321-51A, that required standard aviation avgas fuel. The helicopter had 3 seats.

1.5.2 According to the operator's records ZK-HYE was being maintained in accordance with the approved inspection schedule. All lifed components were recorded as being within their service life.

1.5.3 The all-up weight for ZK-HYE on the accident flight was calculated to be about 80 kg below the maximum allowed. The helicopter was calculated to be within its centre of gravity limits at the time of the accident.

1.5.4 ZK-HYE was fitted with a single fuel tank, capable of holding about 113 litres of avgas. The fuel tank was mounted above the engine on the right-hand side of the helicopter, immediately behind the cabin.

1.6 Meteorological information

1.6.1 The weather on the day of the accident was described by eye witnesses as fine, with an overcast sky and some shower activity on the distant hill tops. The temperature was mild with a light north-westerly breeze. At the time of the accident the sun was obscured by cloud but would have been high and well to the left of the pilot as he approached to land.

1.6.2 The weather conditions at Rotorua Aerodrome, 20 nm west of the accident site, at about the time of the accident were reported as a surface wind of 350° magnetic at 15 to 20 knots (kts), scattered[3] cloud at 3000 and 5000 feet, temperature 18° C, visibility 30 km with a QNH[4] of 1015 hectoPascals. Showers were observed in the vicinity of the aerodrome. Tauranga Aerodrome reported similar conditions.

1.7 Wreckage and impact information

1.7.1 The wreckage of ZK-HYE was lying nearly inverted on its right side about 6 m past the 11 000 volt power line in the direction of flight and about 22 m in from the fence near the shed. All major components of the helicopter were accounted for at the site. The cabin area had been destroyed as a result of the fire. The engine, mounted below the cabin, had suffered significant fire and heat damage. The helicopter's skids were still attached to the frame and showed no signs of having contacted the ground during the accident. The helicopter's main rotor system, including the mast, was lying next to the main wreckage, as was the tail boom and tail rotor. Neither the main rotor nor tail rotor had suffered any significant fire damage.

1.7.2 The separation and damage to the main and tail rotor systems were consistent with the helicopter having struck the ground inverted with high rotor revolutions. Witness marks on the leading edges of the 3 main rotor blades, between 1.28 and 1.86 m in from the tips, were characteristic of a wire strike. There were no other indications of wire strike on the helicopter.

1.7.3 Examination of the engine disclosed no pre-impact abnormalities, with the drive belts and actuator both correctly positioned. The over-running clutch operated normally. Rotational damage to the cooling fan blades indicated that the engine was running at the time the helicopter struck the ground. All 3 occupant harness buckles were found latched together with the harness strapping having burnt through.

1.7.4 The local power authority had repaired the broken 11 000 volt power line by the time the Commission had arrived at the accident site. The damaged cross-arms and insulator had been repaired and the damaged sections of wire had been replaced. The new wire was distinguishable by its shinier appearance, compared to the original duller coloured wire.

1.7.5 Examination of the 11 000 volt power line showed one span of wire broken and the remaining 2 spans twisted, with only the steel core remaining intact where it had been struck. The wire had broken about 28 m in from the pole at the eastern end of the span. The 2 cross-arms on the poles at the ends of the span were damaged and wire under the connector in the vicinity of the pole near the road had also "blown". This additional damage was considered by the electrical faultman who attended the site to be a result of the initial failure.

[3] 3 to 4 eighths of cloud cover.
[4] An altimeter subscale setting to obtain altitude above mean sea level.

1.8 Medical and pathological information

1.8.1 Post-mortem examinations of the occupants indicated they died as a result of the fire. Examination of the pilot did not reveal anything that would have affected his ability to control the helicopter. There was no medical or pathological evidence of pilot incapacitation or impairment.

1.8.2 The pilot's most recent medical assessment was on 17 January 1995 when he was issued a Class 2 medical certificate valid until 30 January 2000. The pilot was observed to be in good health and behaving normally in the days preceding the accident.

1.9 Fire

1.9.1 The fire was described by observers as very intense and centred about the helicopter's fuel tank. The source of the fire would have been fuel vapours generated by the compression and rupturing of the fuel tank coming into contact with one of the many ignition sources on the helicopter, possibly engine, exhaust or a spark. Scorch marks on the ground indicate the flames were directed in an easterly direction from the site while the smoke drifted more to the south-east.

1.9.2 Neighbours and witnesses to the accident were eventually able to control the fire using 2 small fire extinguishers and a water hose. The local fire service extinguished the residual fire on arrival at the site, between 10 and 15 minutes after the accident.

1.10 Survival aspects

1.10.1 The location of the fuel tank on the Hughes 269C, behind the right-hand passenger, meant that after impacting the ground the occupants of the helicopter were directly above the centre of the fire. Had they been able to, the occupants of the helicopter would have had little time to safely evacuate the wreckage.

1.11 Additional information

1.11.1 The pilot was familiar with the farm, having been raised there from about the age of 11 years. A photograph of the farm taken in the early 1970's showed that the 3 sets of power lines were present at that time. A more recent survey photograph taken in 1987 showed that several trees had since become established to the south of the shed. The tallest of these trees was about 75 feet (21 m) in height but most were 45 to 50 feet (14 to 15 m) high. One of the trees was located about 10 m from the pole supporting the 11 000 volt power line.

1.11.2 A badly damaged video camera was retrieved from the wreckage. The damaged videotape was extracted and the recoverable information transferred to a useable tape. The recovered recording showed some of the accident flight and had been taken by the passenger in the right-hand seat of ZK-HYE.

1.11.3 The relevant video sequence commenced shortly after the arrival of ZK-HYE at the farm and finished about 2 minutes before the accident. The video showed the pilot pre-flighting the helicopter and helping strap in the passengers before starting. After starting, the helicopter was recorded moving forward into the large paddock and then carry out several sidewards, rearwards and turning manoeuvres before departing to the east.

1.11.4 The video recording showed ZK-HYE climbing to a height of about 500 feet agl and flying around the farm in a clockwise direction. The helicopter was then flown past the main road and then turned left through a series of turns onto a northerly heading, to approach the paddock from where it had departed. The recording finished as the helicopter was about one nm from where the observers and second group of passengers were waiting. The video recording indicated that the helicopter was performing normally with no unusual noises or manoeuvres. Speed during the flight around the farm was constant at about 70 kts. The cabin windscreen was noted to be clean and clear of any obstacle that might have affected the pilot's vision.

2. Analysis

2.1 The accident flight was the first of 2 planned short flights around the farm of the pilot's parents. The pilot was familiar with the farm having been raised there from an early age. He therefore should have been aware of the obstacles that might affect the safety of the flights.

2.2 Although the arrival of the helicopter was a surprise to the people gathered at the farm, the pilot had planned the trip for some time. The pilot was aware of his experience levels and continued to remain cautious in his approach to flying. He had, therefore, readily agreed to complete the check flight with the instructor before commencing the hire. The pilot was able to demonstrate to the instructor that he had acceptable handling skills and knew about the power lines that ran across the farm.

2.3 The weather enroute to the farm and during the afternoon should have posed no problems to the pilot. The overcast sky meant that the sun was unlikely to affect the pilot's vision but was still bright enough for him to wear his darkened prescription glasses.

2.4 ZK-HYE would have been well above the 11 000 volt power line when it descended to land near the cattle yard in the morning. Nevertheless, by approaching over the power line and then turning left back towards the north-west, the pilot should have been able to see the clearly visible poles and been reminded of the existence of the wires.

2.5 In preparation for the first flight around the farm the pilot completed a pre-flight inspection of the helicopter, then helped strap in and brief the passengers. The pilot did not, however, brief the second group of passengers about their flight, including where he would land and if he would keep the rotors turning or shut down before loading the passengers. With the number of observers watching the flight, including one child, the pilot most likely intended to return to the same area in the large paddock from where he had lifted off, and shut down.

2.6 The pilot moved ZK-HYE forward into the adjacent large paddock probably to give himself more space to complete the hovering manoeuvres and to provide a clearer take-off path to the east towards a row of trees. The flight around the farm proceeded normally at about 500 feet agl and 70 kts. The video recording indicated nothing unusual for the duration of the flight.

2.7 Returning to land the pilot approached the paddock on a northerly heading, about 200 m west of the approach path flown on arrival that morning. This heading gave a slight headwind component for the approach. After ZK-HYE had passed some tall trees near the southern corner of the paddock the pilot turned the helicopter about 60° right to fly towards his probable landing spot. The breeze was sufficiently light that the small downwind component should have posed no problems for the final stages of the approach.

2.8 As ZK-HYE approached abeam the shed it would have been at about the same height as the 11 000 volt power line. The pilot probably did not see the wires and continued moving forward towards them eventually causing the rotors to come in contact with the wires. The effect of the rotors striking the wires resulted in the helicopter rolling and tumbling forward, impacting the ground at about a 50° angle from the wires. The force of the helicopter impacting the ground inverted caused the fuel tank to rupture, resulting in an intense fuel fed fire.

2.9 The force and angle of the helicopter impacting the ground would have disorientated but possibly not incapacitated or rendered the occupants unconscious. The location and intensity of the fire would have made any escape nearly impossible.

2.10 The flightpath taken by the pilot when he approached the paddock from the south, meant that the power pole on the eastern end of the 131 m span was obscured by the trees near the implement shed. The pole at the western end of the span was some distance away and would have blended in with the poles supporting the 33 000 volt power lines in the next paddock.

2.11 Wires are very difficult to detect from the air. Pilots would normally see a supporting pole first and then try to determine the direction in which the wires ran. This would be confirmed by locating the next pole along the power line. Pilots operating at low-level will normally cross a power line at a pole to ensure a safe separation above the wires.

2.12 The eastern pole of the 131 m span would have become visible as ZK-HYE moved abeam of the shrouding tree, about 25 m before the wires. However, the pilot's view of the pole may have continued to be obscured by the passengers seated to his right. Because the pilot was not able to clearly see either pole he was deprived of a reminder of the presence of the wires across his view.

2.13 As ZK-HYE approached the wires, the height of the helicopter would have meant that the wires would have been cast against the background of the trees at the far end of the paddock. The weathering of the wires had resulted in a dulling of their colour. This may have made the wires less conspicuous against the trees and therefore harder to detect.

2.14 As the pilot prepared to land he would have been aware of the group of observers waiting by the paddock fence. The pilot was now probably looking forward and down, with his attention focused on flying the helicopter towards the landing spot. Maintaining a hover-taxi height of about 15 feet, the wires would have slowly moved above the pilot's field of view, reducing the possibility of detection.

2.15 As ZK-HYE slowly approached the wires there was ample opportunity for the pilot to take avoiding action before striking the wires, had he seen them. There was no evidence that the pilot had taken any avoiding action before the helicopter struck the wires. Further, there was no evidence to indicate that the passengers either saw the wires or warned the pilot of their proximity.

2.16 The flightpath flown by ZK-HYE would suggest that the pilot did not remember the existence of the power line, despite having flown over them on the approach that morning. However, the track flown on arrival that morning was well to the south of the accident site, and the pilot may not have been concerned about the power line at that time.

2.17 The pilot was observed to be wearing dark prescription glasses on the day of the flight, which would have provided adequate visual correction. The lighting environment was such that visual recognition of obstacles would have been no different from any person without myopia or deuteranomaly.

2.18 The addition of high visibility devices to the power line struck by ZK-HYE may have increased the likelihood of the pilot detecting the wires before impact. At the time of the investigation, the Civil Aviation Authority were leading a working party studying the feasibility of wire marking.

3. Findings

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

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

3.2 The pilot had little experience in operating a helicopter away from an aerodrome environment.

3.3 The helicopter was appropriate for the type of operation being conducted.

3.4 The helicopter had a valid Certificate of Airworthiness, and its records indicated that it was serviceable at the time of the accident.

3.5 There was no evidence of a mechanical failure or loss of control, prior to the wire strike, that would have contributed to the accident.

3.6 The helicopter weight and balance were within limits and appropriate for the flight.

3.7 The weather conditions were suitable for the flight.

3.8 The direction of approach meant that the poles supporting the power line were either obscured or blended in with other structures.

3.9 The pilot probably did not see the power line during his approach and this was the probable cause of the accident.

3.10 The pilot's vision impairments would not have affected his ability to detect the power line.

3.11 The pilot's darkened prescription glasses were unlikely to have reduced his ability to detect the power line.

3.12 The pilot flew directly towards the power line causing the rotors to strike the wires.

3.13 After striking the wires the pilot was unable to control the helicopter.

3.14 The impact with the ground was probably survivable, but the intensity of the post impact fire made survivability unlikely.

Approved for publication 13 June 2000

Hon. W P Jeffries
Chief Commissioner