CIVIL AVIATION AUTHORITY
OF NEW ZEALAND

AIRCRAFT ACCIDENT REPORT

OCCURRENCE NUMBER 02/2468

HUGHES 269C

ZK-HFW

NEAR DANNEVIRKE

16 AUGUST 2002

Glossary of abbreviations used in this report:

agl	above ground level
CAA	Civil Aviation Authority
CAR	Civil Aviation Rules
E	east
ELT	emergency locator transmitter
m	metre(s)
°M	degrees magnetic
MCPA	2-Methyl-4-chlorophenoxyacetic acid
MHz	megahertz
NZST	New Zealand Standard Time
rpm	revolutions per minute
S	south
UTC	Coordinated Universal Time
WGS-84	World Geodetic System – 1984

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Aircraft type, serial number and registration:	Hughes 269C[1], 380669, ZK-HFW
Number and type of engines:	1 Lycoming HIO-360-DIA
Year of manufacture:	1978
Date and time:	16 August 2002, 1300 hours[2] (approx)
Location:	7.4 km south of Dannevirke Latitude[3]: S 40° 16.46' Longitude: E 176° 06.40'
Type of flight:	Agricultural - spraying
Persons on board:	Crew: 1
Injuries:	Crew: 1 fatal
Nature of damage:	Helicopter destroyed
Pilot-in-command's licence	Commercial Pilot Licence (Helicopter)
Pilot-in-command's age	37 years
Pilot-in-command's total flying experience:	1553.9 hours, 1442.7 on type
Information sources:	Civil Aviation Authority field investigation
Investigator in Charge:	Mr A M Moselen

[1] The Hughes 269 is popularly known as the "300". In mid-1983 production and product support was taken over by Schweizer; examples of the type subsequently produced are known as the Schweizer 269 or 300.

[2] Times are NZST (UTC + 12 hours)

[3] WGS 84 co-ordinates

Synopsis

The Civil Aviation Authority was notified of the accident at about 1330 hours on Friday 16 August 2002. The Transport Accident Investigation Commission was in turn notified shortly thereafter, but declined to investigate. A CAA site investigation was commenced the following day.

The helicopter was engaged in thistle spraying operations at a farm property. During the second spray run of the day, the loader driver lost visual and audible contact with the helicopter. In the meantime, a stock manager on an adjoining property had seen the helicopter descend towards a hillside and not reappear. He drove to the area to find the helicopter destroyed and the pilot fatally injured.

1. Factual information

1.1 History of the flight

1.1.1 The owner/pilot of ZK-HFW was contracted to carry out a thistle spraying operation using MCPA liquid chemical on a farm property near Dannevirke. He commenced the second spray run of the day by initially "spot" spraying various areas of the property. The helicopter was then observed by the loader-driver to proceed up the side of a ridge, at an estimated height of 50 feet agl and on an approximate heading of 325°M in anticipation of a spray run back down the ridge slope.

1.1.2 The loader driver explained that he watched the helicopter's progress until a point beyond the ridge and over an adjoining farm where the helicopter commenced a left turn. He then saw the helicopter disappear from view. After several unsuccessful attempts to contact the pilot by radio and cell phone, the loader driver went to investigate.

1.1.3 A stock manager from the adjoining farm property explained that he was alerted to the helicopter's presence by engine noise. He looked up and noticed the helicopter approximately two kilometres away, flying towards a row of trees atop a ridge with the motor revving ("engine screaming, as if the rotor had disconnected"). He then observed the helicopter in what appeared to be a nose down attitude, descending towards the ridge slope until it "struck the ground in a puff of smoke".

1.1.4 The stock manager arrived at the scene three to four minutes later to find the helicopter on its side with the spray pump engine still running but detached from the helicopter. He observed the pilot in the wreckage and extracted him from it. A check of the pilot's pulse appeared to indicate no sign of life. The stock manager then turned off the spray pump engine and contacted emergency services.

1.1.5 The accident occurred in daylight, at approximately 1300 hours, in rolling hill country, 7.4 km south of Dannervirke, at an elevation of 590 feet. Grid reference 260-U24-741989, latitude S 40º 16.46' longitude E 176º 06.40'.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Other*
Fatal	1	0	0
Serious	0	0	0
Minor/None	0	0	

1.3 Damage to aircraft

1.3.1 The helicopter was destroyed.

1.4 Other damage

1.4.1 Nil.

1.5 Personnel information

1.5.1 The pilot, aged 37, held a Commercial Pilot Licence (Helicopter) first issued in 1996, and a Class 1 medical certificate with no restrictions valid to 20 February 2003.

1.5.2 The pilot was type-rated on various helicopter types including the Hughes 269C. In addition, he held a grade 2 Agricultural Rating and a chemical rating.

1.5.3 Up until 13 August 2002, the pilot had flown a total of 1554 hours, including 1443 hours on Hughes 269 helicopters. His last biennial flight review and proficiency check were carried out on 30 July 2002.

1.5.4 The pilot was reportedly in apparent good health and spirits on the day of the accident.

1.6 Aircraft information

1.6.1 Hughes 269C, serial number 380669 was manufactured in 1978. The helicopter was registered in New Zealand on March 1992 as ZK-HFW.

1.6.2 The CAA issued a non-terminating Airworthiness Certificate in the Standard Category on 1 May 1996. The helicopter had accrued 3949.10 hours time in service up to the last recorded entry in the Aircraft Maintenance Log on 17 July 2002.

1.6.3 The last scheduled maintenance was a 50 hour check performed on 18 July 2002 and an annual review of airworthiness had been completed on 5 November 2001.

1.6.4 The engine, a Lycoming HIO-360-DIA serial number L24333-51A had run 1434 hours since overhaul. The most recent maintenance was a 50-hour inspection on 18 July 2002. In addition, all the spark plugs were replaced due to a reported magneto drop.

1.6.5 The modification status of the helicopter included provision for an agricultural spraying system. The equipment was fitted at the time of the accident and whilst severely disrupted by impact forces it was established that the system complied with specifications.

1.6.6 Although the all-up weight of the helicopter prior to the accident was not calculated, there was nothing found which would suggest that it had been laden beyond its permitted maximum or that the centre of gravity was outside the normal range.

1.6.7 The manufacturer's data plate was not located in the wreckage during the site examination. Later, inspection of the Aircraft Maintenance Log revealed an entry recorded in 1997, declaring the manufacturers data plate missing.

1.7 Meteorological information

1.7.1 The Meteorological Service General Aviation North Island weather for Friday 16 August 2002 forecast an unstable north-west flow. People spoken to in the Dannevirke area remarked that overcast conditions existed at about 1300 hours with no rain and light northerly winds.

1.7.2 Weather was not a factor in this accident.

1.8 Aids to navigation

1.8.1 Not applicable.

1.9 Communications.

1.9.1 Although the pilot was able to communicate with the loader driver, there were no transmissions heard from the pilot during the accident sequence.

1.10 Aerodrome information

1.10.1 Not applicable.

1.11 Flight recorders

1.11.1 Not applicable.

1.12 Wreckage and impact information

1.12.1 The helicopter struck the face of a moderately steep ridge at an elevation of approximately 590 feet on an impact heading of 227°M. The complete helicopter was accounted for at the site.

1.12.2 Ground scarring and debris at the initial impact point indicated that the helicopter had descended more or less vertically, at low forward airspeed, and in a straight and level attitude. Ground strike marks also showed that prior to impact, the helicopter had appeared to have turned left from the north-easterly track flown over the ridge top, through approximately 100° (a left turn was also observed by the loader driver). After the initial impact, the helicopter had bounced and rolled

over to the right, finally coming to rest in a shallow crevice some 8 m further down the slope.

1.12.3 Impact forces were initially absorbed by the forward left hand side of the helicopter. The left skid, left front section of canopy and support structure were all severely crushed; the left spray boom and tank had torn away from their respective attachment points. The right-hand spray boom and the spray pump motor and tank had detached during the rollover. The dump release mechanism for the spray tanks was found in the release position and the tanks were completely dry.

1.12.4 There were three main rotor ground strikes evident above and to the left of the point of impact. Damage patterns on the three blades indicated low rotor rpm and all the blades had remained attached to the rotor mast.

1.12.5 The tail rotor assembly was found largely intact. One tail rotor blade had contacted the tail boom assembly where a crease and paint mark corresponded with the shape of the leading edge of the blade. Material transfer had also occurred. The entire tail boom assembly had detached at impact. The tail rotor drive coupling had failed in torsional overload with minimal forces being present at the time of failure. The tail rotor assembly damage was consistent with low tail rotor energy prior to impact.

1.12.6 Although the airframe structure had significant impact damage, pre-impact integrity of the flight and engine controls was established. Cockpit instruments considered potentially helpful to the investigation were removed for further analysis.

1.12.7 At the main wreckage site, a scorch mark was found where hot exhaust gases had impinged on the ground a short distance away from the engine exhaust pipe outlet. Although the engine was inverted, it was determined that it had continued to run in an unloaded condition. While it was not possible to determine with any certainty how long the engine was running post impact, with the fuel tank supply disrupted, what little fuel was contained in the filter bowl and fuel lines could have provided the engine with sufficient fuel to run for a short time.

1.12.8 The transmission drive clutch assembly was found in the engaged position and all the transmission drive belts were found intact with no signs of having slipped during operation.

1.12.9 The engine lower drive coupling and shaft were found detached and damaged. The front male drive spline and engine mounted female spline coupling appeared to have an inadequate amount of lubrication. In contrast, the rear end of the assembly was intact and with ample grease evident. The engine mounted female spline coupling had ruptured on one side and the internal splines were damaged and misaligned. Both items were removed for further analysis.

1.12.10 The engine and some accessories were later removed from the helicopter for inspection by a CAR Part 145 certified engineering organisation.

1.12.11 During the site investigation, it was noted that a level area of ground at the base of the ridge provided a suitable place for a helicopter to land if required. The area would have been approximately in the pilot's 10 o'clock position as he crossed the ridge.

1.13 Medical and pathological information

1.13.1 Post-mortem examination of the pilot determined that the pilot had died of injuries sustained from impact forces.

1.13.2 The chemical used for the spray operation was MCPA, a common herbicide. It has moderately high oral toxicity. From the post-mortem, no MCPA was present in the blood samples nor were other medically incapacitating conditions found that might have contributed to the accident.

1.14 Fire

1.14.1 Fire did not occur.

1.15 Survival aspects

1.15.1 The accident was not survivable, owing to the high decelerative forces.

1.15.2 The helicopter was fitted with a Pointer 3000 ELT. Overflying aircraft heard and reported the ELT transmissions on 121.5 MHz.

1.16 Tests and research

1.16.1 The engine lower coupling and drive shaft were recorded in the Aircraft Maintenance Log as having been fitted new on the helicopter during a routine scheduled maintenance inspection some 80 hours prior to the accident due to in-service wear. These two items and an undamaged time-expired driveshaft from a maintenance facility were examined in detail.

1.16.2 Analysis showed that the grease used on both ends of the drive shaft splines was similar and corresponded to the correct specification. There was no sign of overheating of the splines, which would have occurred if the splines had failed due to excessive wear from a lack of lubrication. The wear marks on all of the splines when compared with the time expired drive shaft, were considered not to be heavily worn. The damaged and ruptured coupling sections had failed by a single overload event due to impact forces.

1.16.3 The engine strip and inspection examination revealed that partial seizure had occurred. The seizure and associated damage was considered to have occurred after impact, where high rpm and a lack of oil supply from post-impact events would quickly have raised the internal engine temperature to extreme levels. The inspection also revealed that the engine had several significant events during its operational history prior to the transfer of ownership to the pilot, and as a result extensive repairs had been carried out. The overhaul facility conducting the strip and inspection commented that these events were possibly due to operating the engine outside the manufacturer's specifications and/or the total hours recorded in the Engine Logbook were not a true reflection of the hours achieved.

1.16.4 Apart from the damage and general wear, the basic engine core showed no pre-existing defect that would have prevented it delivering power during normal operation. However, one of the ignition leads for the number two cylinder was not serviceable when tested.

1.16.5 No pre-existing defects were evident with the helicopter airframe or components.

1.16.6 Three cockpit warning light bulbs were inspected and found serviceable, consistent with their not being illuminated prior to the accident.

1.16.7 Inspection of the combined engine /rotor rpm indicator internal drive mechanisms showed they had failed on impact and verification of "trapped" readings was not possible.

1.17 Organisational and management information

1.17.1 The owner/pilot did not hold an Air Operator Certificate and was operating the helicopter under the certificate of another organisation.

1.18 Additional information

1.18.1 Nil.

1.19 Useful or effective investigation techniques

1.19.1 Nil.

2. Analysis

2.1 There was no evidence found during the course of this investigation that would explain the witness's description of "the engine screaming as if the rotor had disconnected", in flight. The witness, approximately two kilometres away, may have first heard the helicopter passing over the ridge top. On looking up he would then have observed the helicopter in a different position. It is likely that the witness heard the engine "screaming" post impact. There was evidence found during the investigation to indicate that the engine continued to run on unloaded after impact.

2.2 Experienced pilots of the same helicopter type have indicated that engine rpm increases extremely quickly after loss of load, increasing up to between 3800 and 4000 rpm immediately. The engine manufacturer states in the Flight Manual that the engine should not be operated above 1600 rpm unloaded as catastrophic engine damage can occur.

2.3 The helicopter's left turn into wind was probably an intentional manoeuvre made by the pilot to commence a spray run. While a right turn would have lost less rotor energy, an into-wind turn reduces the possibility of the helicopter being enveloped by spray outflow.

2.4 One engine ignition lead did not test satisfactorily. The replacement of spark plugs for a magneto drop (rough running) at previous maintenance may not have cured the problem. Ignition faults can be of an intermittent nature and while the serviceability of the other leads could not be positively determined, due to accident damage, there remains the possibility that faulty ignition leads initiated a rough running condition at a critical time in the flight sequence.

2.5 A rough running engine would have compromised the ability of the helicopter to maintain altitude, particularly in a left turn. This may have initiated the descent towards rising terrain. Once the situation was recognised, the pilot instinctively jettisoned the spray load, seen as the "puff of smoke" reported by the witness.

2.6 Additional methods to arrest the descent may have led to an "over-pitching" condition. Raising the collective pitch lever will, up to a point, increase engine power to maintain rotor rpm. This is achieved by mechanical linkage between the collective pitch lever and the fuel control unit. When no further power is available, perhaps limited by an under performing engine condition, an increase in collective pitch will result in a loss of rpm (over-pitching), which if not corrected immediately, can rapidly become irrecoverable.

2.7 The cause of the low rotor rpm at the time of the accident could not conclusively be determined.

2.8 No safety actions or recommendations could be formulated from the investigation.

3. Conclusions

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

3.2 The helicopter had a valid Airworthiness Certificate and had been maintained in accordance with current requirements.

3.3 The helicopter engine internal damage was due to post impact events.

3.4 The cause of the accident could not be positively established.

3.5 The accident was not survivable.

Report written by:

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8 July 2003

Authorised by

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8 July 2003