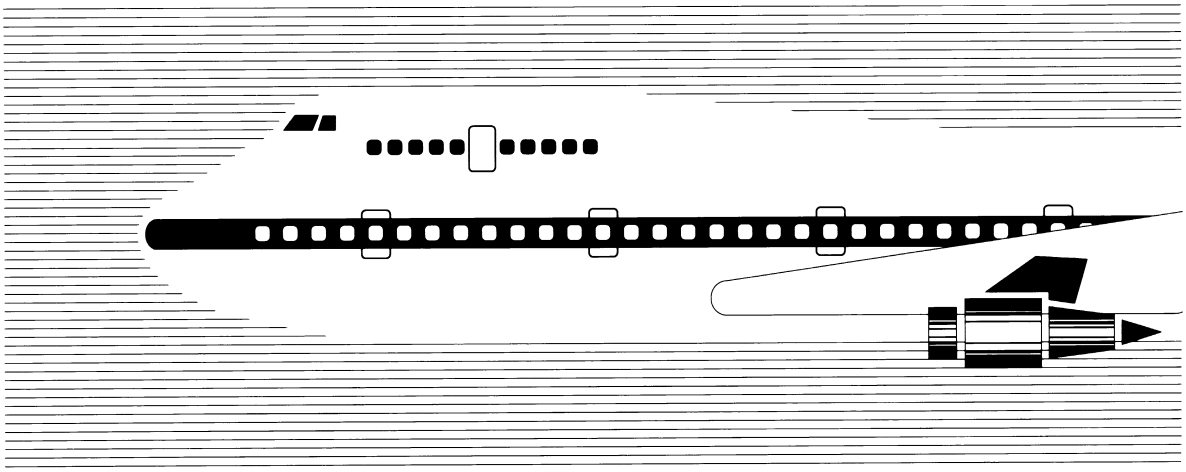
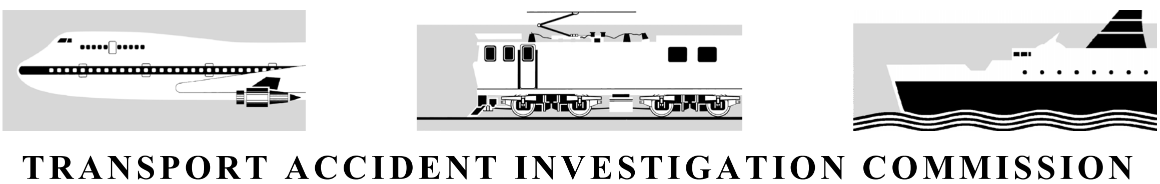


AVIATION OCCURRENCE REPORT

03-007	Hughes 369HS, ZK-HCC, in-flight power loss and emergency landing, Fox Glacier	30 November 2003



TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

Report 03-007

Hughes 369HS

ZK-HCC

in-flight power loss and emergency landing

Fox Glacier

30 November 2003

Abstract

On Sunday 30 November 2003 at about 1015, ZK-HCC, a Hughes 369HS helicopter, was on a scenic flight near the head of Fox Glacier at about 9500 feet when its engine power turbine and main rotor speed suddenly reduced. On board were 4 passengers and the pilot.

The pilot descended the helicopter to 6500 feet where power was restored. Several minutes later a second power loss occurred so he carried out an emergency landing at the base of Fox Glacier. The right rear skid broke when it struck a large rock during the landing, and the helicopter consequently rolled onto its right side. No one was seriously injured in the accident.

A power turbine governor underspeed condition resulted when electrical continuity to the governor switch on the collective lever was lost, thus reducing the power turbine speed to its minimum setting.

Safety issues identified were the need to ensure that governor switches were securely fastened to the collective lever, and to refresh pilots' knowledge about power turbine governor underspeeds. Safety recommendations were made to the Director of Civil Aviation addressing these issues.

ZK-HCC after the accident

Contents

Figures

Abbreviations

amsl	above mean sea level
CAA	Civil Aviation Authority
FCU	fuel control unit
IAS	indicated airspeed
kg	kilograms
N_2	power turbine speed
N_R	rotor speed
PTG	power turbine governor
RPM	revolutions per minute
UTC	coordinated universal time

Glossary

beep switch	an electrical switch on the collective lever that sets the power turbine governor to maintain the power turbine speed at a specific value.

Data Summary

Aircraft registration:	ZK-HCC
Type and serial number:	Hughes 369HS, 410318S
Number and type of engines:	one Allison (Rolls Royce) 250-C20
Year of manufacture:	1971
Operator:	Mountain Helicopters Limited
Date and time:	30 November 2003, 1025[1]
Location:	Fox Glacier latitude: 43° 29´ south longitude: 170° 02´ east
Type of flight:	air transport, scenic
Persons on board:	crew: 1 passengers: 4
Injuries:	crew: nil passengers: 4 minor
Nature of damage:	substantial helicopter damage
Pilot's licence:	Commercial Pilot Licence (Helicopter)
Pilot's age:	27
Pilot's total flying experience:	956 hours (35 hours on type)
Investigator-in-charge:	K A Mathews

Acknowledgments

The Commission acknowledges the assistance provided by the Australian Transport Safety Bureau.

[1] Times in this report are New Zealand Daylight Time (UTC +13 hours) and are expressed in the 24-hour mode.

1 Factual Information

1.1 History of the flight

1.1.1 On Sunday 30 November 2003 at approximately 1002, ZK-HCC, a Hughes 369HS (or Hughes 500C) helicopter, took off from its base at Fox Glacier township for a standard 30-minute scenic flight. The intended flight was over Fox Glacier, around Mount Cook and Mount Tasman, and back past Fox Glacier to Fox Glacier township. On board were 4 passengers and the pilot.

1.1.2 The pilot had completed 3 earlier uneventful scenic flights in ZK-HCC that morning. Before the first flight of the day he had carried out a pre-flight inspection of the helicopter and completed the required checks, including checking for any fuel contamination. A mobile fuel bowser used for the helicopter fuelling was checked at the start of each day for any contamination. The pilot did not find any water or other contamination in the bowser or helicopter fuel.

1.1.3 Prior to the fourth flight the pilot fuelled the helicopter from the bowser to the standard fuel load of 250 pounds (113 kg), giving the helicopter a total endurance of about 1.5 hours. The pilot initially took off with 2 passengers seated in the front seats for a 20-minute flight, but returned to base a few minutes later to uplift 2 more passengers and to extend the flight to 30 minutes. Because the helicopter continued running, a ground assistant aided the 2 extra passengers and helped them into their seats.

1.1.4 The weather was sunny and suitable for scenic flying with good visibility, no rain, little wind and few clouds in some valleys and near some of the mountain peaks.

1.1.5 The helicopter departed normally and climbed to about 9500 feet above mean sea level (amsl). The pilot said that when the helicopter was in level forward flight about 10 minutes after departure, he noticed the engine power turbine speed (N_2) indicating needle reducing to at least 97%[2] and the superimposed rotor speed (N_R) indicating needle reducing to about 456 RPM[3] (revolutions per minute) on the dual tachometer (see Figure 1). The pilot said he checked that the throttle was in the full open position and simultaneously lowered the collective lever (reducing engine power) to prevent any further N_2 and N_R reduction and to maintain N_2, and the N_R in about its indicated mid green range. Because of the power reduction, the helicopter descended. At the same time he exercised the collective lever N_2 governor switch (beep switch)[4] to try and regain the N_2. He contacted the pilot of another helicopter flying in the area and expressed his concern. He also advised the passengers and said they might have to land. At about 6500 feet amsl ZK-HCC regained its usual N_2, so the pilot increased power and flew the helicopter in normal flight.

1.1.6 Because of the problem the pilot decided to abandon the flight. He advised his base that he was returning, and continued to give the passengers a scenic commentary. Several minutes later, when the helicopter was near the top of Fox Glacier and at about 6500 feet amsl, the problem recurred. The pilot exercised the beep switch but was unable to increase the N_2 above about 97%. When he raised the collective lever, the N_2 began to decay further, so he lowered the lever to maintain the N_2 and N_R and descended the helicopter for a probable emergency landing. Neither the pilot nor the passengers recalled seeing any instrument panel emergency lights illuminate or recalled hearing any alarms.

[2] Normal power-on operating range was 103% to 104% and was indicated by a green arc on the N_2 gauge.
[3] Normal power-on operating range was 484 to 489 RPM. The power-off range was 400 to 523 RPM and was indicated by a green arc on the N_R gauge.
[4] An electrical switch on the collective lever that sets the PTG to maintain N_2 at a specific speed between about 97% and 104%.

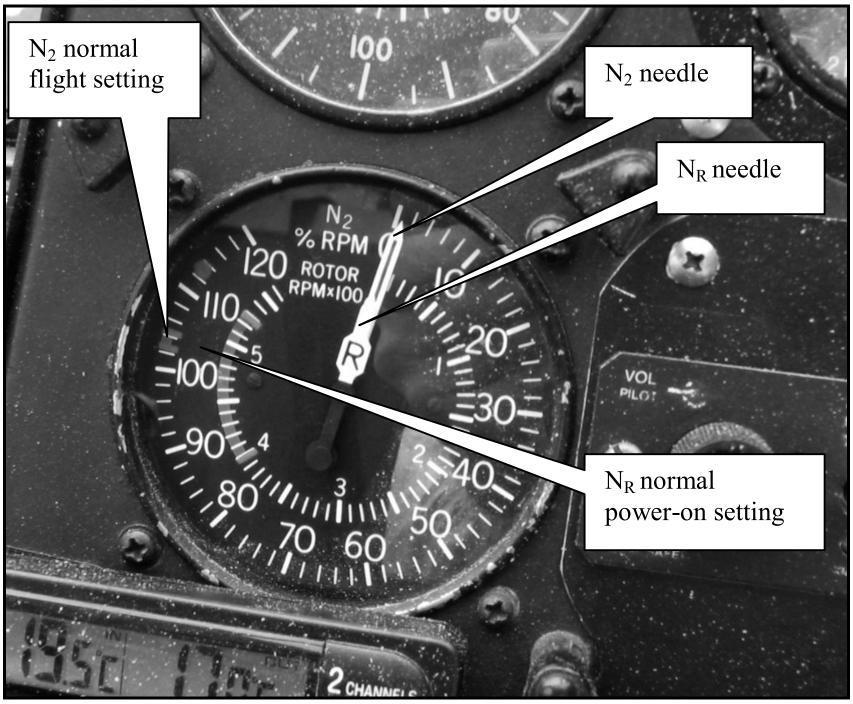


Figure 1
Dual N_2 N_R tachometer

1.1.7 The pilot advised the passengers and his base, then concentrated on descending the helicopter and manoeuvring it away from the icefall and crevasses toward a suitable landing area at the base of Fox Glacier. The pilot said that during the descent he raised the collective lever to check the power but saw the N_R decay to the lower end of its power-off green range, so he lowered the lever again and committed himself to carrying out an emergency landing at the base of the glacier.

1.1.8 As the helicopter neared the ground the pilot flared it to reduce its forward speed and to help arrest its rate of descent, and applied collective control for an emergency landing. The helicopter levelled and sank quickly, striking a large rock with the heel of its right skid, breaking the skid. The helicopter then rolled onto its right side and came to rest with the engine still running. The pilot shut off the fuel to the engine and then assisted the front seat passengers out of the helicopter. Meanwhile the 2 rear seat passengers had escaped from the helicopter themselves. No fire occurred.

1.1.9 Some alpine guides in the area witnessed the accident and went to the scene, with 2 nurses from their tour party. A helicopter pilot flying in the local area landed nearby a short time later to offer assistance.

1.2 Injuries to persons

1.2.1 The helicopter passengers suffered some minor injuries, but a rear seat passenger was taken to hospital for observation and then discharged. The pilot was uninjured.

1.3 Pilot information

1.3.1 The pilot was aged 27. He held a Commercial Pilot Licence (Helicopter) and Class 1 Medical Certificate valid until 23 November 2004. He held a B category flying instructor rating.

1.3.2 At the time of the accident the pilot had flown some 956 hours in helicopters, including 35 hours in the Hughes 369C. He had completed his Hughes 369 rating in March 2002 on an "E" model, which was fitted with a Bendix fuel control unit (FCU) and power turbine governor (PTG). His only other turbine helicopter experience comprised some 5 hours on the

Aerospatiale AS350. Most of his helicopter experience had been gained instructing on piston engine Robinson R22 or Hughes 269 helicopters.

1.3.3 The pilot began working for the operator the second week of November 2003. He started his training on 11 November 2003, and completed a competency check and a biennial flight review with a flight examiner in ZK-HCC that day. The checks included a written examination. On 19 November 2003 he completed his flight route qualifications and was then authorised for line operations. For scenic flights, the pilot was permitted to depart from the Fox Glacier township base, complete the flight and then return to base.

1.3.4 The instructor who gave the pilot his Hughes 369 rating said his training included discussion about PTG failures. He said a governor underspeed condition was not demonstrated in flight because this unduly stressed the rotor head. The flight examiner who had last checked the pilot said he discussed governor failures with the pilot but had not demonstrated an underspeed condition. A governor overspeed could not be demonstrated, and any underspeed demonstration could involve beeping the N_2 to its lowest setting of about 97% (455 RPM N_R), which was outside the Flight Manual limits for powered flight. On the bottom of the pilot's competency check sheet the examiner had written, "… has limited experience on type and needs to be supervised."

1.3.5 In the 7-day period before the accident the pilot had flown 18.3 hours. In the 30-day period he had flown 60.9 hours. In the 7-day period before the accident he had been on duty about 43 hours.

1.4 Helicopter information

1.4.1 ZK-HCC was a Hughes 369HS (referred to as a Hughes 500C) single-engine helicopter, serial number 410318S, constructed in the United States in 1971. The helicopter was fitted with an Allison (Rolls-Royce) 250-C20 engine, serial number CAE 822677.

1.4.2 In October 1994 the helicopter was imported to New Zealand, inspected and issued a non-terminating Certificate of Airworthiness in the standard category.

1.4.3 The maintenance records showed ZK-HCC was maintained in accordance with the manufacturer's maintenance manual. At the time of the accident the helicopter had amassed 8578.65 airframe hours and its engine 12 591.6 hours since it was new. The last inspection was a 100-hour check on 12 September 2003 at 8494.35 airframe hours. The next inspection due was a 100-hour check at 8594.35 airframe hours or on 12 September 2004, whichever occurred first.

1.4.4 There were no outstanding defect or maintenance-required entries in the Aircraft Technical Log that was carried in the helicopter.

1.4.5 The helicopter was not equipped with engine auto ignition or a low N_2 or N_R warning system, nor was it required to be.

1.4.6 According to the helicopter Flight Manual the normal power-on maximum N_R was 489 RPM (104% N_2) and the minimum N_R was 484 RPM (103% N_2). Before flight the N_2 normal operating range of 104% or more, to 100% or less, was to be checked using the beep switch, and then set at between 103% and 104%.

1.4.7 On 6 October 2003 the helicopter engine was refitted with its Ceco FCU, serial number 3AAC1691, following servicing. The engine was fitted with a Ceco PTG, serial number 2AAD1001. In New Zealand the Ceco system was not common on the Allison (Rolls-Royce) 250-C20 series engine, with most engines being fitted with a Bendix system. The operator and the pilot advised that until the accident flight they had not experienced any problems with the helicopter or its engine after the Ceco system had been refitted.

1.4.8 Several other experienced helicopter operators advised that the Ceco fuel control system was not as precise at maintaining the N_2 at selected values as the Bendix system, and that it usually required constant pilot monitoring and use of the beep switch. During large or rapid collective control applications the Ceco system could allow some transient N_2 droop, especially if the PTG had been beeped back and set for minimum N_2. The operators advised also that operating a helicopter near its gross weight, especially at higher altitudes, could exacerbate the above situation.

1.4.9 A weight and balance computation showed that ZK-HCC took off on the accident flight at about its maximum permitted gross weight of 2550 pounds (1157 kg), with its centre of gravity at about the forward limit.

1.4.10 Some other experienced Hughes 369HS operators advised that the helicopter was capable of being flown safely with the PTG beeped back and the N_2 set to minimum.

1.4.11 One operator said he had once flown his Hughes 369HS near its maximum permitted gross weight with the N_2 set at about 95%, at sea level with an ambient temperature of about 26 degrees Celsius. He said the helicopter maintained an out-of-ground-effect hover[5] and operated satisfactorily.

1.4.12 The helicopter Flight Manual contained a section on engine fuel control or PTG malfunctions and said failure was indicated by instrument needle fluctuation. A failure producing an underspeed was indicated by a decaying N_2 and N_R. The recovery procedure was to:

- Lower collective to maintain rotor RPM [N_R] in the green and attempt level flight at 60 knots IAS [indicated airspeed]
- If power is insufficient for level flight or a power-on decent, make an autorotational landing.

1.4.13 The helicopter Flight Manual also contained a section on low rotor speeds. The manual said a low N_R would most commonly be associated with:

- Engine failure
- Transient rotor droop during large, rapid increases in power
- Governor failure producing an underspeed.

The pilot was to respond immediately to the low N_R by adjusting collective to maintain N_R within limits.

1.5 Wreckage and impact information

1.5.1 The helicopter touched down close to the base of Fox Glacier on a level shingle area interspersed with rocks.

1.5.2 The helicopter was damaged substantially during its touchdown and subsequent roll onto its right side.

1.5.3 The helicopter analogue clock had stopped at 1025.

1.5.4 The right rear skid broke when it struck a large rock during the landing. The skid oleo and its attachment also broke. When the helicopter rolled onto its side each of the 4 main rotor blades struck the ground and were sheared off at their respective doublers near the rotor hub, indicating that there was significant power driving them. The tail boom, tail rotor drive and control linkages were severed by one of the main rotor blades. The stabilisers, tail rotor gearbox and tail rotor were largely undamaged.

[5] Where there is no ground air cushion available to reduce the power required for a hover.

1.5.5 The engine was undamaged, except for a broken throttle bell crank and push-pull linkage in the engine bay on the engine firewall.

1.6 Tests and research

1.6.1 The helicopter was recovered back to Fox Glacier township for examination, and was later transported to an independent maintenance facility at Christchurch for further examination.

1.6.2 Fuel samples from the operator's fuel bowser and the helicopter were examined. The fuel was the correct type and was not contaminated

1.6.3 The engine manufacturer sent a representative to be involved in the examination.

1.6.4 Examination of the helicopter fuel system did not reveal any deficiencies or fuel contamination. There was adequate fuel available to the engine. All filters and screens were clean. Fuel was present throughout the system to the fuel nozzle. There were no fuel leaks. The fuel venting system was not blocked. A check of the fuel delivery system lines and components showed there were no disruptions or air leaks.

Engine examination and testing

1.6.5 Examination of the PTG showed it was in the fully beeped back position, or set for about 97% N_2. Further examination showed that 2 of the 3 electrical wires to the beep switch on the collective lever were detached. The wires were soldered to terminals on the switch and covered with shrink-sleeving insulation, but 2 terminals were broken. Visual examination of the terminals indicated they had broken from fatigue. There was no evidence indicating that the terminals broke during the accident. One broken terminal was for the power supply and the other broken terminal was for the beep up (increase N_2) connection. A panel nut under the beep switch that secured the switch to the collective lever was somewhat loose, allowing some clockwise and anticlockwise rotation of the switch, and some fore and aft movement also. However, a locating slot on the beep switch that fitted into a tab on its attachment plate prevented any significant rotation of the switch. A lock-washer under the panel nut was used to prevent the panel nut loosening.

1.6.6 The operator and the pilot later advised that they had not noticed any insecurity with the beep switch. The operator said that had he been aware of the loose panel nut he would have recorded the defect and had it rectified.

1.6.7 The electrical connections of the beep switch were not subject to routine maintenance inspections and there was no record of the switch having been serviced or replaced. The beep switch was the correct switch for the helicopter. The helicopter manufacturer advised that standard practice was to apply shrink-sleeving insulation over the beep switch soldered terminals. Although the basic helicopter maintenance instructions referred to potting compound being used around the beep switch connections, the manufacturer advised that shrink-sleeving was an acceptable alternative.

1.6.8 The wiring loom inside the collective lever was not subject to any unusual twisting or pulling. Several operators experienced with the helicopter type said they had not known the beep switch wires or terminals to break. A database check of Hughes 369 occurrences in New Zealand revealed no similar instances of broken terminals. The helicopter manufacturer reported no similar events and no systemic problems associated with the switch wiring. An experienced maintenance engineer said the wires under the beep switch were usually a tight fit, and any excess movement of the beep switch itself could cause the wires or terminals to flex and possibly break.

1.6.9 All fittings to the engine were secure. The collective control linkage was intact and rigged appropriately for its operating system. The throttle linkage bell crank on the right side of the engine firewall had broken during impact, along with the push-pull linkage. The engine turned freely and no mechanical defects were evident. The drive to the main rotor gearbox was intact and undamaged. The main rotor and tail rotor gearboxes rotated freely.

1.6.10 The engine was removed from the helicopter and shipped in a secure container to Melbourne to run on a test stand at an independent engine overhaul facility under the Commission's supervision. The manufacturer had a representative present for the testing. Visual inspection of the engine did not reveal any accident impact damage. A pneumatic air pressure leak test showed there were no leakages in the pneumatic system. A vacuum test showed there were no air leaks in the fuel delivery system. The engine had ingested some debris resulting in some minor damage to the leading edge tips on several first stage compressor blades. This damage was not considered to be a concern for engine testing. Both engine chip plugs were clean. The fuel and oil filters showed no abnormal contamination.

1.6.11 On the test stand the engine started normally, and was then run through a series of operating performance tests specified in the engine overhaul manual, including rapid acceleration and deceleration tests. No anomalies were found and the engine met its performance specifications, despite the damage to some of its compressor blades. The FCU maximum fuel flow stop was found set at the correct minimum (-) setting for the helicopter. The setting was changed to the maximum (+) setting and the engine retested. Again, no anomalies were found and the engine met its performance specifications. The PTG was replaced, with no change to the engine performance. The original PTG was refitted, and the engine again met its performance specifications. N_2 adjustments by throttle lever application were made from 97% to 103% to check PTG range and functionality, with no anomalies being found.

1.7 Additional information

1.7.1 The passenger in the left rear seat was operating a video camera continually throughout much of the flight, including the time when the pilot reported the initial N_2 droop and during the emergency landing. A copy of the video provided some useful information including good engine noise audio recordings. The Australian Transport Safety Bureau conducted a sound spectrum analysis of the video sound track to provide N_2 speeds for the Commission.

1.7.2 The results showed that the tape was not a continuous recording of the entire flight, but on the portions analysed the N_2 decreased 3 separate times to 98%. The first N_2 reduction occurred after about 7 minutes of video recording at a time when a lake across the main divide of the Southern Alps could be seen. This corresponded to a photograph taken by a passenger in the centre front seat showing the time on the helicopter clock as 1015, and the airspeed indicator reading about 30 miles per hour (about 25 knots).

1.7.3 The first recorded N_2 reduction to 98% (460 RPM N_R) was followed later by momentary N_2 increases to 107%, and 104.5%. Another recording showed an N_2 speed reduction again to 98%, followed by a momentary increase to106%, then a reduction again to 98%.

2 Analysis

2.1 The flight began as a routine scenic flight in suitable weather conditions with a qualified pilot, and with sufficient fuel to safely complete the planned trip. The helicopter departed normally and the pilot did not experience any problems during the departure and climb to 9500 feet. Neither had the pilot experienced any problems during the earlier flights that morning.

2.2 After the pilot had levelled the helicopter he would have continued to use the beep switch to periodically adjust the N_2, because of the fuel control system on the engine. A short time later it is possible that either the beep switch power wire detached but made intermittent contact and shorted against the beep down connection, or the beep up terminal detached but made intermittent contact thus allowing only a reduction in N_2 at that time. Either of these 2 terminals becoming detached in flight could explain the problem as described by the pilot. The 2 terminals could also have detached at the same time, but this is unlikely. Consequently, the N_2

was inadvertently set to the minimum speed of about 97%. The pilot would not have expected to see this, and if he had demanded an increase in power at about the same time by raising collective, say in response to some normal sink or by having slowed the helicopter, then it could have temporarily exacerbated the N_2 loss.

2.3 A video recording and photograph showed the helicopter was probably at about 9500 feet amsl and at a slower than normal airspeed when the power loss first occurred, about 13 minutes after departure. Although the video recording was not continuous, it covered much of the flight and the minimum recorded N_2 was 98%. This was consistent with the pilot's recollection of the initial N_2 reduction, the elapsed time to the power loss and the altitude. About 10 minutes elapsed from the first power loss to the emergency landing.

2.4 The pilot responded correctly by lowering the collective lever to maintain N_2 and N_R because of the power loss, and by exercising the beep switch to try and regain the lost N_2. The pilot would have been concerned at that point about the inhospitable terrain beneath the helicopter and the need to position the helicopter during descent to a more suitable area, if possible, for a potential emergency landing. When the helicopter had descended to about 6500 feet, which would have taken some minutes, the engine recovered its normal N_2, probably because of an intermittent electrical contact on the beep switch.

2.5 Several minutes later the problem recurred and the pilot once more exercised the beep switch in an attempt to regain the lost N_2. In doing so he might have again set the PTG to provide minimum N_2 or caused the power terminal and beep down connection to short, or have caused the second terminal to break. The pilot elected to descend the helicopter to a suitable area at the base of Fox Glacier, with a near sea level elevation, and carry out an emergency landing. During the descent he raised the collective lever for a power check but was concerned when he saw the N_R decay to the lower end of its indicated green range. He then lowered the collective in order to maintain N_R, and to provide the best range.

2.6 During the emergency landing, with the PTG set at minimum and with a heavy helicopter, the N_2 would have drooped during the large, rapid application of collective control that was necessary to arrest the descent after the flare. Consequently, there would have been little immediate power assistance to recover the helicopter to a hover so it sank quickly to the ground, striking a rock with the right rear skid. Had the skid not broken, it is possible the helicopter would have remained upright and significantly lessened its damage.

2.7 The power loss experienced was the same as what the Flight Manual described as a PTG failure producing an underspeed. This should not normally cause the loss of a helicopter. The recovery procedure was to lower the collective lever to maintain N_R in the green and to attempt level flight at the minimum power speed of 60 knots. If there was insufficient power for level flight or a power-on descent, then an autorotational landing was to be made.

2.8 When the helicopter first had the power loss it might not have been able to maintain level flight because of the altitude and its heavy weight and low airspeed. However, during the second descent as the helicopter descended to a lower altitude it should have been possible for the pilot to recover from the descent if he had progressively applied collective control, maintaining N_R in the green range, and allowed the N_2 to stabilise around its minimum setting of about 97%. At the minimum N_2 the helicopter should have been able to be flown to base or Fox Glacier Aerodrome at the minimum power speed for a reduced power landing.

2.9 The pilot, though, was unsure of the exact nature of the power loss and believed the power loss was such that the best course of action was to commit to an emergency landing at the nearest suitable area away from the glacier. This decision was understandable in the circumstances. During the second descent when he raised the collective lever to check the power he saw the N_R decay to the bottom end of its indicated green range. This could have occurred if he applied collective control too rapidly and thus caused the N_2 to droop transiently to below its minimum setting, with a corresponding reduction in N_R.

2.10 The N_R range was 400 to 523 RPM, and normally sat around 484 RPM during powered flight. Hence, any N_R droop to about 456 RPM (97% N_2), or even lower to say 422 RPM (90% N_2), would have appeared significant to the pilot giving him the appearance of a substantial decrease in power. His concern would have been to maintain N_R in the green range by lowering the collective lever, rather than holding the lever to see if the power and hence the N_R would stabilize at about the mid-green range.

2.11 The N_2 operating range was checked at least on the first flight of each day, and normal use of the beep switch during each flight would show if it functioned normally. What is likely is that because the securing nut under the beep switch had loosened, it allowed some clockwise and anti-clockwise and fore and aft movement of the beep switch during normal use. The abnormal movement probably flexed the beep switch wire terminals and eventually caused 2 of them to break. When the terminal (or terminals) first broke, probably partially, it might have provided an early intermittent connection during the accident flight. Because of the particular type of fuel control system fitted to the engine, it required frequent beep switch use to maintain a constant N_2. This would have increased the amount of beep switch wire terminal flexing compared to a different system. The fuel control system fitted to the engine in ZK-HCC was not common in New Zealand, with most operators using a different system of fuel control.

2.12 The loose beep switch was not normal, but neither the pilot nor the operator noticed that it was loose. Had they done so, the operator should have had it rectified. Had the beep switch been securely fixed to its plate on the collective lever, it is likely the terminals would not have flexed and eventually broken.

2.13 The pilot's Hughes 369 rating training and last competency check covered PTG failures. These were not demonstrated in flight because of the inability to show an overspeed condition and because of the helicopter operating limitations. An underspeed (low power-on N_R) condition could also impose undue stress on the rotor head. An underspeed would also reduce the tail rotor rotation speed making it less effective with the potential to lose directional control, especially at heavy weights or higher altitudes at low airspeeds. The training the pilot received about PTG failures was probably adequate, even though he did not get a practical demonstration.

2.14 The pilot was not experienced on turbine engine helicopters, having flown some 40 hours with about 35 hours on the Hughes 369. His initial 369 rating was on the "E" model that had a different fuel control system to ZK-HCC. However, his competency check on ZK-HCC covered the differences between the helicopters, and the flight examiner considered him to be competent. Nevertheless, because of the pilot's lack of experience the examiner considered that he needed to be supervised and wrote this on the bottom of the pilot's competency check sheet.

2.15 Even though the operator supervised the pilot's activities he could not accompany him on each flight. A more experienced turbine engine helicopter pilot might have quickly recognised the problem with ZK-HCC as a PTG underspeed failure and then flown the helicopter to a suitable area for a reduced power landing. However, given the pilot's limited exposure to turbine helicopters and any such problems, he probably reacted prudently to what he considered to be a significant power loss over hostile terrain. His initial actions in response to the power loss to preserve the lost N_2 and N_R were correct. Had the failure occurred under different circumstances, say at a lower altitude over better terrain, the pilot might have recovered the situation and landed the helicopter safely.

3 Findings

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

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

3.2 The weather was suitable for the flight.

3.3 The helicopter was suitable for the operation and its records showed it had been maintained appropriately.

3.4 The beep switch should have been securely tightened to the collective lever to prevent any beep switch movement.

3.5 Some unusual beep switch movement over time probably resulted in excessive flexing of the switch wire terminals that caused them to eventually break.

3.6 A PTG underspeed condition resulted when beep switch electrical continuity was lost, which resulted in a decrease of N_2 and N_R.

3.7 A PTG underspeed condition should not normally have prevented the helicopter from landing safely with reduced power.

3.8 The pilot responded appropriately to an unexpected significant power reduction by reducing collective control to preserve N_2 and N_R.

3.9 The pilot might have been able to fly the helicopter in descent to a more suitable area for a reduced power landing had he recognised the power loss was a PTG underspeed condition.

3.10 The pilot's limited experience with turbine engine helicopters and exposure to PTG underspeeds, and some transient N_2 droop, probably hindered his ability to quickly analyse the degree and nature of the power loss.

3.11 Given the circumstances that the pilot was faced with and his inexperience, he probably chose the best course of action by carrying out an emergency landing at the nearest most suitable area.

3.12 The emergency landing might have been successful had the skid not struck a large rock.

4 Safety Recommendations

4.1 On 17 June 2004 the Commission recommended to the Director of Civil Aviation that he:

4.1.1 advise all Hughes 369 operators to ensure that N_2 governor (beep) switches, and other toggle switches, are securely fastened to prevent any abnormal movement. (025/04)

4.1.2 after the Commission publishes its final report, use this accident scenario in CAA educational material to refresh helicopter pilots, instructors and examiners knowledge about PTG underspeeds. (026/04)

4.2 On 9 June 2004 the Civil Aviation Authority (CAA) replied on behalf of the Director of Civil Aviation to the preliminary safety recommendations, accepting them as worded. The CAA replied, in part:

4.2.1 With regard to recommendation (025/04). The Director will accept this recommendation and send a letter to all registered owners and operators advising them of the problem.

4.2.2 With regard to recommendation (026/04). The Director will accept this recommendation and publish an article in the Vector magazine relating to this subject.

Approved on 30 July 2004 for publication

Hon W P Jeffries
Chief Commissioner

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03-003	Boeing 747-412 9V-SMT, flight SQ286, tail strike during take-off, Auckland International Airport, , 12 March 2003
03-002	Cessna U206G ZK-EJG, engine failure after take-off, Ardmore Aerodrome, 2 February 2003
03-001	Kawasaki BK-117 helicopter ZK-III, collision with tree tops at night, Tararua Range, 14 January 2003
02-015	Piper PA31-325 Navajo ZK-TZC, loss of control and collision with the ground during a one-engine-inoperative landing approach by Feilding Aerodrome, 17 December 2002
02-013	Piper PA 34-200T ZK-FMW, undercarriage collapsed after landing, Ardmore Aerodrome, 12 November 2002
02-011	Bell 206B JetRanger III ZK-HRC, forced landing following reported power loss on approach Huka Falls, 3 km north of Taupo, 2 October 2002
02-010	Boeing 747-419 ZK-NBS flight NZ 2, in-flight flap separation over Manukau Harbour by Auckland International Airport, 30 August 2002
02-006	Partenavia P68B ZK-ZSP, engine power loss and off-field landing, 5 km southwest of Wairoa, 15 May 2002
02-005	Hughes 369D helicopter ZK-HRV, engine failure and forced landing, near Tarawera, 30 April 2002
02-003	Schweizer 269C helicopter, ZK-HIC, loss of tail rotor authority and emergency landing, Karaka Downs South Auckland, 15 March 2002
02-004	Cessna 210N Centurion ZK-TWA, collision with terrain, Conical Peak area 34 km southwest of Oamaru, 10 April 2002

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