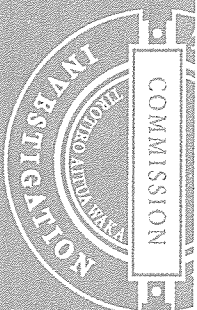


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AIRBRIFT ACCIDENT REPORT

No. 90-004T

**HUGHES 369D
ZK-HOP**

**4Km east of Lake Widgeon,
Fiordland National Park
1 November 1990**

**Transport Accident Investigation Commission
Wellington - New Zealand**

Transport Accident Investigation Commission
Wellington

Chief Commissioner
Transport Accident Investigation Commission

The attached report summarises the circumstances surrounding the accident involving a Hughes 369D aircraft ZK-HOP at 4km east of Lake Widgeon, Fiordland National Park on 1 November 1990 and includes suggested findings and safety recommendations.

This report is submitted pursuant to Section 8(2) of the Transport Accident Investigation Commission Act 1990 for the Commission to review the facts and endorse or amend the findings and recommendations as to the contributing factors and causes of the accident.

25 November 1991
R CHIPPINDALE
Acting Chief Executive

APPROVED FOR RELEASE AS A PUBLIC DOCUMENT

9 December 1991
M F DUNPHY
Chief Commissioner

AIRCRAFT:	Hughes 369D	OPERATOR:	Thompson Brothers
REGISTRATION:	ZK-HOP	PILOT:	Mr R.D. Nicholson
PLACE OF ACCIDENT:	4 km east of Lake Widgeon, Fiordland National Park	OTHER CREW:	One
DATE AND TIME:	1 November 1990, late afternoon or evening	PASSENGERS:	Nil

SYNOPSIS:
The Duty Inspector of Air Accidents was advised at 0730 hours on 2 November 1990 that a search was in progress for ZK-HOP which had failed to return to base from a deer hunting sortie the previous day. At 0810 hours advice was received that an accident had occurred. Mr D.G. Graham was appointed Investigator in Charge and commenced the investigation the same afternoon. The wreckage of ZK-HOP was located at the base line below a steep ussack and scrub covered slope. A prominent gouge mark had been made in the slope further up, by the main rotor blades. The shooter had been thrown from the helicopter as it descended. The pilot was found lying beside the helicopter. Both occupants had died from injuries received in the accident.

1.1 HISTORY OF THE FLIGHT: See page 4.	1.2 INJURIES TO PERSONS: Pilot: 1 Fatal Crew: 1 Fatal	1.3 DAMAGE TO AIRCRAFT: Substantial	1.4 OTHER DAMAGE: Nil
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1.5 PERSONNEL INFORMATION: See page 5.	<table border="1"> <tr> <th colspan="2">Flight Times (Approximate Only)</th> </tr> <tr> <td>Last</td> <td>Total</td> </tr> <tr> <td>90 days</td> <td></td> </tr> <tr> <td>All Types</td> <td>127</td> </tr> <tr> <td>On Type</td> <td>127</td> </tr> <tr> <td></td> <td>3035</td> </tr> </table>		Flight Times (Approximate Only)		Last	Total	90 days		All Types	127	On Type	127		3035
Flight Times (Approximate Only)														
Last	Total													
90 days														
All Types	127													
On Type	127													
	3035													

1.6 AIRCRAFT INFORMATION:
See page 7.

1.7 METEOROLOGICAL INFORMATION: See page 8.	1.8 AIDS TO NAVIGATION: Nil	1.9 COMMUNICATIONS: Nil
1.10 AERODROME INFORMATION: Not Applicable	1.11 FLIGHT RECORDERS: Not Applicable	1.12 WRECKAGE AND IMPACT INFORMATION: See page 9.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION: See page 11.	1.14 FIRE: Fire did not occur	1.15 SURVIVAL ASPECTS: See page 11.
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1.16 TESTS AND RESEARCH: See Page 12.	1.17 ADDITIONAL INFORMATION: See page 14.	1.18 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES: Nil
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2. ANALYSIS: See page 14.	3. FINDINGS: See page 17.
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4. SAFETY RECOMMENDATIONS: See Page 18.	5. APPENDICES:
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* All times in this report are NZDT (UTC + 13 hours)

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 On the day of the accident, 1 November 1990, the pilot and shooter left Te Anau in ZK-HOP at about first light (approximately 0550 hours) for an early morning deer shooting sortie in the Seaforth River area. The crew subsequently carried out a second hunting sortie, successfully recovering 23 deer to Te Anau during the morning's activity which involved some four to five hours flying. No reports or comments to suggest any malfunction or abnormality in the operation of ZK-HOP were made by the pilot or shooter concerning the two flights.

1.1.2 During the afternoon the pilot and shooter flew in ZK-HOP from Te Anau to the Waitaurahiri River to pick up the shooter's brother and a friend, who had been whitebaiting. Seven deer were shot enroute to the Waitaurahiri River and these were picked up at Lake Hauroko on the return flight and brought back to Te Anau as a sling load. The shooter's brother, who had been a partner in the ownership of ZK-HOP for many years and was actively involved in the day to day operations of the helicopter, recalled that the aircraft's fuel tank was replenished with four "jerrycans" of fuel prior to their return flight. He reported that the flight proceeded uneventfully. The pilot flew the helicopter in his normal capable manner and the helicopter appeared to be performing to the pilot's satisfaction.

1.1.3 After arrival at Te Anau, the shooter and pilot arranged to fly a further hunting sortie during the late afternoon and evening. It was their usual custom to refuel ZK-HOP to capacity prior to each deer hunting flight and the available evidence indicated that this procedure was carried out. In addition, at least five 20 litre plastic "jerrycans" were filled with fuel and loaded aboard the helicopter, again in accordance with the crew's established practice. Both the pilot and shooter then returned to their respective homes before the proposed flight.

1.1.4 A Te Anau resident, familiar with the helicopter's operations, observed ZK-HOP depart towards the south-west at 1705 hours. No subsequent sightings of the helicopter were reported. The usual pattern of operation for such a flight involved a return to base before last light but by nightfall ZK-HOP had not arrived back at Te Anau. (The end of evening civil twilight for the area was promulgated as 2107 hours).

1.1.5 The helicopter's failure to return gave rise to concern for the safety of the pilot and shooter. However, on an earlier occasion starting difficulties had been encountered with ZK-HOP. This problem had not recurred since rectification of the battery's condition. The possibility existed that after hunting for a given period the pilot had landed and shut the helicopter down to conserve fuel before continuing operations later in the evening, and had subsequently been unable to restart. The night was fine, and the pilot and shooter were known to be suitably clothed and equipped to deal with such an emergency. Nevertheless at 2300 hours a helicopter search was commenced by a local operator over the route and area likely to have been flown by ZK-HOP, in recognition of the possibility that a more serious event had occurred. This search was unsuccessful.

1.1.6 At approximately 0130 hours on 2 November 1990 the Police were notified that ZK-HOP was missing. A further helicopter search commenced at about 0200 hours and was continued without success until 0415 hours. The Rescue Coordination Centre (RCC) in Wellington was informed and a subsequent high altitude search was carried out by RNZAF F27 aircraft, in conjunction with a low altitude search by helicopter. Signals from the emergency locator transmitter (ELT) of ZK-HOP were received by the F27 at 0640 hours and shortly afterwards by the helicopter, in the area of Long Sound. The signals were localised in nature. The wreckage of ZK-HOP was located by the searching helicopter at approximately 0730 hours.

1.1.7 The accident occurred during the late afternoon or evening of 1 November 1990. The accident site was some 75 m above the bushline of a spur of the Cameron Mountains at an elevation of 3250 feet amsl. The accident site was in Fiordland National Park, 4 km east of the northern end of Lake Widgeon and about 80 km south-west of Te Anau. National Grid Reference 152577 NZMS1 S166 "Cameron". Latitude 45°53'40"S, longitude 166°58'00"E.

1.5 Personnel information

1.5.1 The pilot in command, Ray David Nicholson, 36, had commenced flying training on fixed wing aircraft in March 1976 and had obtained a Private Pilot Licence — Aeroplane in March 1977.

1.5.2 He had commenced helicopter training in February 1978 and in August 1979 had been issued with Commercial Pilot Licence — Helicopter (CPL H) number 275. Between August 1979 and April 1981 he was engaged in venison recovery flying utilising a Hughes 269 aircraft.

1.5.3 Mr Nicholson had obtained a Type Rating on the Hughes 369 series aircraft in November 1980 and from May 1981 to September 1982 he flew in New Guinea, obtaining a Type Rating on the Bell 206 type while overseas. On return to New Zealand, he flew the Hughes 269 aircraft on venison recovery from October 1982 to May 1983.

1.5.4 He flew again in New Guinea between August 1983 and May 1984, on this occasion obtaining a Type Rating on the AS350 type. On his return he was engaged in venison recovery work, flying a Hughes 369HS until June 1985. He then undertook charter and scenic flying operations, until September 1986 when he recommenced venison recovery, initially in a Hughes 269 type but later, from 15 November 1986, operating Hughes 369D ZK-HOP. Apart from a short period of scenic flying in June 1987, Mr Nicholson continued to fly ZK-HOP on venison recovery operations until June 1988.

1.5.5 From July 1988 until August 1989, Mr Nicholson flew in New Guinea, briefly returning to New Zealand in June 1989 when he carried out some further flying in the Te Anau area. The majority of his venison recovery operations had been flown in Fiordland and from August 1989 until the date of the accident Mr Nicholson continued flying ZK-HOP on this type of work, on behalf of the aircraft's owners and operators.

1.5.6 Regular entries in Mr Nicholson's logbook ceased after 12 November 1989 but a brief period of flying was recorded in January 1990. Analysis of diary entries together with his logbook times indicated that Mr Nicholson had accumulated the following flight experience up to the date of the accident. (Further flying may have been carried out which was not recorded.)

Total fixed wing flying:	157 hours
Total helicopter flying:	5621 hours
Pilot in Command (helicopter):	5576 hours
Total hours flown on Hughes 369 type:	3035 hours
Total hours flown on ZK-HOP:	971 hours
Total hours flown on venison recovery (of which 1227 hours were on the Hughes 369 type, with 794 hours on ZK-HOP)	2556 hours

No night flying time was recorded.

1.5.7 Within the 90 days preceding the accident Mr Nicholson had flown at least 127 hours, all on the Hughes 369 type. Sixty hours of this total was on venison recovery operations in ZK-HOP all flown within Fiordland National Park. Within the last seven days, Mr Nicholson had flown approximately 12 hours in ZK-HOP (excluding the accident flight). This included venison recovery flights on 26 and 27 October 1990.

1.5.8 On the day of the accident Mr Nicholson had flown two deer hunting sorties in the morning, involving an early departure and some four to five hours flying. He had also carried out hunting activity during the afternoon flight which had comprised a further flight time of about two hours. It was likely that he had flown a total of between 8 to 10 hours at the time the accident occurred. All of the day's flying had involved operations in the south-west of Fiordland National Park and in the adjoining area.

1.5.9 Mr Nicholson's most recent medical examination for the renewal of his flight crew licence had been undertaken on 8 January 1990. He had been assessed fit in accordance with the standards required for the renewal of his CPL H. The Validity Certificate associated with his CPL H was valid until 29 January 1991.

1.5.10 One of the owner/operators of ZK-HOP, Nelson James Thompson (48) was acting as shooter at the time of the accident. He was very experienced in deer recovery operations in Fiordland National Park and had operated helicopters in the area for many years both in the capacity of shooter and as pilot. He and Mr Nicholson flew regularly together in ZK-HOP and were accustomed to working as a shooter and pilot team. Mr Thompson held Private Pilot Licence — Helicopter (PPL H) number 8023 which he had last renewed in November 1988 and which had remained valid until 13 October 1990. He had recorded a total of 2233 hours on helicopters at the time of the licence renewal. Mr Thompson was medically examined on 5 October 1988 and had been assessed fit to the standards required for his PPL H. This assessment covered the period up to 13 October 1990. Mr Thompson had previously held CPL H number 403 which he had renewed regularly between 1982 and 1985.

1.6 Aircraft information

1.6.1 Hughes 369D helicopter ZK-HOP, serial number 600738D was constructed in the United States of America during 1980 and imported new to New Zealand later the same year. It was registered to Messrs Thompson Bros of Te Anau in November 1980.

1.6.2 The last entry in the airframe logbook was dated 20 July 1990 and the total hours at this time were recorded as 3925 hours. Allison 250-C20B engine, serial number 832958, had also run a recorded total of 3925 hours, as of this date and 395 hours since complete overhaul. From pilot records it was estimated that ZK-HOP had flown some 65 hours from 31 July to the date of the accident, resulting in an airframe and engine total time of approximately 3990 hours.

1.6.3 A non-terminating Certificate of Airworthiness (C of A) in the Standard Category had been issued on 3 December 1984. Its validity was dependent on the aircraft being maintained in accordance with the appropriate sections of the Hughes Handbook of Maintenance Instructions (HMI). The aircraft had been so maintained.

1.6.4 The last Maintenance Inspection prior to the accident was a 50 hour inspection completed on 30 July 1990. At the time of the inspection one of the five main rotor blades (the white blade) was replaced and all main rotor dampers were re-phased. A subsequent main rotor track and balance adjustment was carried out. Other work included replacement of the transparencies in both forward doors and replacement of faulty cells and deep cycling of the aircraft battery, together with replacement of the tail rotor hub assembly.

1.6.5 Maintenance Release number 320226 was issued following the inspection and remained in force until 27 October 1990 or the attainment of 3970 hours in service, whichever occurred earlier. This Maintenance Release bore the instruction:

"All pilots must operate and daily pre-flight inspect the aircraft in accordance with aircraft flight manual and attached M/R sheets detailing inspections on the M/R head straps and lead/lag links".

1.6.6 ZK-HOP had been grounded for a five day period from 20 October 1990 as the pilot had observed delamination in one of the tail rotor blades during his daily pre-flight inspection. The blade had been forwarded to an approved repair facility and had been re-installed and the tail rotor assembly tracked and balanced, by a Licenced Aircraft Maintenance Engineer. ZK-HOP was returned to service on 26 October 1990 and at the time of the accident had flown approximately 12 hours with no reported defect, since the work on the tail rotor was carried out.

1.6.7 The owner/operators had made arrangements with the maintenance organisation for the next scheduled inspection to be carried out on or about the day of the accident. In the event, probably due to an oversight, ZK-HOP had continued in operation on this occasion beyond the calendar time and airframe hours specified in the Maintenance Release.

1.6.8 The owner/operator had owned ZK-HOP for ten years and records indicated that no expense had been spared in terms of regular and required maintenance by an approved maintenance organisation to ensure that the helicopter remained in first class condition.

1.6.8 The gross mass of the helicopter at the time of the accident was estimated to have been approximately 911 kg. The maximum authorised mass was 1363 kg. The longitudinal CG with the shooter seated in the helicopter was likely to have been approximately 2618 mm aft of the datum. (The datum was defined as 100 inches (2540 mm) forward of the rotor centreline). At a mass of 911 kg the longitudinal CG limits were 2515 mm and 2692 mm aft of the datum. The lateral limits at this mass were 76 mm either side of the centreline. (If the shooter was alighting from the helicopter, or embarking at the time of the accident, attendant longitudinal and lateral CG changes could increase the pilot's difficulty in maintaining a precise hover close to a slope, or result in an initially undetected drift towards an adjacent slope).

1.7 Meteorological information

1.7.1 On the day of the accident an anticyclone centred to the west of North Island extended a strong ridge southwards and both were spreading east onto the country. By midnight the axis of the ridge had passed over the accident area and during the early hours of the following day, north-westerlies became established.

1.7.2 Local weather reports and analysis of the overall situation indicated that during the day a south-westerly airstream flowed onto the south of the country bringing a few showers and areas of cloud to southern Fiordland and Southland. However during the afternoon and evening the winds died away quickly and the cloud dissipated as the air subsided under the influence of the ridge.

1.7.3 The General Manager of the New Zealand Meteorological Service reported:

"Because of the uncertainty concerning the time of the accident and the lack of observations it is difficult to be specific about weather conditions. However it seems most likely that after about 1800 NZDT there would have been little or no cloud in the crash area and consequently no precipitation.

Winds in the area would have been decreasing south-westerlies but stronger than gradient winds due to funneling along Long Sound. At 1800 NZDT winds at about 3000 feet may still have been about 15 knots but by 2100 NZDT they would probably have dropped to 5 to 10 knots with the direction veering westerly. I do not expect that there would have been any significant turbulence.

The free air temperature at the height of the crash would have been about plus 1.5 degrees celsius. Radiative cooling may have dropped this just below zero for a time at about midnight but temperatures would probably have increased during the early hours of the 2nd as the north-westerlies freshened to reach an estimated plus 5 degrees by 0600 NZDT."

1.7.4 The accident site was on an exposed west-facing slope and was surrounded by mountainous terrain with numerous gaps in the ranges to the south and west. Wind strength probably decreased toward evening but occasional gusts and local variations in wind strength were likely to be encountered in the accident area in the veering westerly conditions.

1.7.5 The pilot of the helicopter which commenced an aerial search for ZK-HOP at 2300 hours on 1 November 1990 reported that it was a moonlit night and very clear. He stated that the flight was reasonably calm but at 8000 to 9000 feet there was some light buffeting in the developing north-westerly situation.

1.12 Wreckage and impact information

1.12.1 The accident to ZK-HOP occurred on the side of a spur of the Cameron Mountains located about 5 km north-east of Cascade Basin at the head of Long Sound. The fuselage was lodged amongst stunted mountain beech at the edge of the bush below a steep tussock and scrub covered slope with numerous rocky outcrops. The rear right skid support and the skid itself had been torn away and the front and rear of the left skid were broken off. The fuselage lay semi-inverted on its right side with the front cockpit area completely exposed. The lower forward structure and cockpit floor had been severely compressed rearwards and upwards.

The crush angle indicated that when it first struck the slope the fuselage was pitched markedly nose down. The extent of damage suggested that the helicopter tumbled and rolled as it descended the slope.

1.12.2 The aft section of ZK-HOP's tailboom, complete with vertical fin, horizontal tailplane and tail rotor assembly was lying on a tussock ledge 55 m up slope from the fuselage. The tailboom was oriented on a heading of 180°M. The horizontal tailplane and upper part of the fin had been skewed 20° to the left in relation to the tailboom and was liberally spattered with fresh earth. The tail rotor gearbox and both tail rotor blades were intact. The tailboom had broken off downwards and to the right (viewed from above) at about the mid-boom position (1470 mm forward of the tail rotor gearbox) after being weakened by deformation and main rotor blade strike while the helicopter was still in flight.

1.12.3 The carcasses of eight deer were spread down the slope 5 m to the north of the tailboom/tail rotor assembly and had evidently been released from the helicopter's lifting hook. Six deer had already been gutted and decapitated and formed an existing slingload on a 10 foot doubled nylon strap. The two other deer had apparently been shot recently and had been lifted out on individual short nylon straps, to be gutted and prepared for addition to the sling load at a later stage. The manner in which the deer were lying and the steep nature of the slope on which they had come to rest, suggested that their release from the hook in this location occurred as a matter of some urgency. About 25 m further upslope there was a small hollow which would have served as a more suitable site for release of the load and preparation of a final sling load prior to returning to base.

1.12.4 Approximately 7 m upslope, directly above the spread of deer carcasses, there was a prominent gouge mark in the tussock covered slope, clearly made by the helicopter's main rotors. The gouging of the soft soil extended over a length of some 9 m, up to 250 mm deep and 350 to 400 mm wide. The main rotor strikes had traversed the slope in a south to north direction and were angled upwards towards the north by 10° to 15°. The slope faced west. There were cuts in low shrub and flax and a trapped "pocket" of

riblets (internal spacers from within the outer section of the main rotor blades) at the south end of the gouge marks, while a predominance of small portions of main rotor blade tip skin was scattered towards the north. Paint flecks and fiberglass pieces including part of the "static port" panel, from the air intake "doghouse" were also found in this area.

1.12.5 The average slope from the detached tailboom assembly to the fuselage at the bushline was about 45°. However in the vicinity of the main rotor strike marks and the deer carcasses the terrain was steeper, varying from 55° to 65° in slope. Wreckage from the helicopter formed a trail down the slope on a heading of 255°M. Localised distribution of items from the cockpit including a rifle and ammunition, the first aid kit (un-opened), spent cartridge cases and broken pieces of perspex from the cockpit, indicated that the fuselage had struck the slope heavily in a nose down attitude in an area of rocks and scrub about 30 m below the level of the main rotor strike marks.

1.12.6 A total of five 20 litre plastic "jerry cans", used for carrying additional fuel, were located. Of these at least three were probably full at the time of the accident, providing a reserve of some 30 minutes flying in addition to the quantity of fuel which remained in the helicopter's fuel tank. (35 litres was later recovered from the fuel tank, without allowance for any spillage or loss which may have occurred during the accident sequence or in subsequent recovery of the aircraft).

1.12.7 Fragmented and separated portions of the main rotor blades were recovered from various parts of the slope in an arc to the north of the fuselage descent path and up to 100 m from the gouge marks. The rotor head of ZK-HOP had sustained severe damage to all components consistent with continued rotation under considerable power. Four of the five main rotor blades were shorn off adjacent to the blade grips. Almost the entire blade grip and inner portion of one blade (yellow blade) was missing and was not recovered, but the mode of failure of the internal tension/torsion straps was similar to that of the other four blades, indicative of high rotational energy in the rotor head when the main rotor blade strike occurred.

1.12.8 Portions of the tip sections of all five main rotor blades were recovered. Each blade had sustained similar damage, curved rearwards and upwards. Each of the tips had split open at the trailing edge and contained earth and debris consistent with repeated strikes against the slope. Paint smears confirmed that the main rotor blades had flapped downwards sufficiently to strike the "doghouse" and tailboom at this time.

1.12.9 On site examination showed that a long rope strop spliced to a chain was very tightly wrapped around the mast of ZK-HOP, the rope section having been wound on first. Some of the rope was "doublet". Subsequent disentanglement indicated that the chain was about 6.3 m long and the strop about 12 m long. A 1400 mm length of solid metal leading edge strip had peeled from one blade (commencing 1240 mm inboard from the tip) and was tightly intertwined with the rope strop about the mast. Clear chain marks were evident on the underside of the same blade, located between 650 mm and 820 mm inboard from the tip. The rope was approximately 14 mm in diameter and the chain was comprised of welded steel links about 6 mm nominal diameter and 32 mm in length. The long chain and strop was normally coiled neatly on the floor of the right side of the cockpit at the shooter's feet, suitably accessible for attachment to the cargo hook and the load to be lifted out.

1.12.10 The cargo hook of ZK-HOP was found in the fully closed position with no evidence of distress on the hook itself or its attachments. Instrument readings and other observations included the following:

The airspeed indicator read 24 knots

The altimeter was set to a QNH of 1016 hPa

The fuel selector was fully "TN"

Oil pressure read 70 psi/turbine outlet temperature read 40°

The start pump was "OFF"

The key had been broken off with the Master Switch in the "ON" position

The emergency locator transmitter (ELT) had remained in its mounting attached to the bulkhead behind the pilot's seat. It was in the manually selected "ON" position when recovered.

1.13 Medical and pathological information

1.13.1 Post mortem and toxicological examinations revealed no pre-existing condition likely to have affected the ability of the pilot to control the helicopter.

1.13.2 The pilot was reported to have been in normal health and good spirits on the day of the accident.

1.13.3 Pathological examination showed that in addition to severe bruising and laceration of various parts of his body and head, the pilot had sustained multiple rib fractures on both sides of the chest. Chest wall and lung damage resulted in death due to respiratory failure.

1.15 Survival aspects

1.15.1 The pilot was wearing a full safety harness with the shoulder straps operating on an inertia reel. The front right seat of the helicopter — normally occupied by the shooter — was equipped similarly with a fully safety harness installation. However, the left and right sections of the lap belt assembly for this seat were found tucked into the rear of the seat cushion and the shoulder strap assembly remained wound on the inertia reel indicating that, at the time of the accident, no part of the safety harness was in use. It was Mr Thompson's normal practice to wear the safety harness but he was known to stow the lapbelts carefully in this manner before disembarking from the helicopter.

1.15.2 During the impact sequence, the pilot's shoulder harness failed at the point where it emerged from the inertia reel as a single strap. The left and right sections of the pilot's lap belt were found still buckled together with the slotted tangs of the shoulder harness securely located on the buckle assembly. The aperture of the metal shroud of the pilot's inertia reel had become worn to a feathered edge by the action of the shoulder strap continually rubbing against it during the service life of the reel. Under the impact loading in the accident this sharp edge had cut into the strap resulting in its consequent failure. The inertia reel assembly for the right front seat shoulder harness, although installed in the same manner, exhibited little wear on the edge of the shroud aperture. The shoulder harness of this seat was used to a significantly lesser extent than that fitted to the pilot's seat, consistent with the freedom of upper body movement required by the shooter.

1.15.3 The circumstances of the accident resulted in ZK-HOP commencing to rotate while still in flight above the steep tussock, scrub and rock strewn slope. Mr Thompson (the shooter), had received unsurvivable injuries as a result of falling onto rocks, possibly being flung from the skid during the initial descent and impact, consistent with the likelihood that he was external to the helicopter when the accident occurred.

1.15.4 Despite the wearing of a full safety harness the pilot was likely to have received significant injury in the severe nose-down impact which resulted in the destruction and deformation of the frontal sections of the helicopter. In addition he would have been left in an exposed position as the fuselage subsequently tumbled and fell down the slope. It was not practicable to establish precisely when in the impact sequence the shoulder harness failed. Its failure, however, rendered the pilot liable to greater injury than would otherwise have been the case. Whether, in this accident, the failure affected the pilot's injuries to the extent that his survival was compromised, was not established.

1.15.5 It was evident that the pilot had vacated the helicopter after it had come to rest and had moved to a location beside it, but there was no evidence that he had attempted to utilise any of the contents of the first aid kit which lay nearby, or to recover any equipment, such as the rifle or ammunition, from the scattered items on the slope. It was likely however that he had manually selected the ELT to the "ON" position. Medical opinion suggested that he had survived for 1 to 2 hours, but the extensive chest injuries he had received, required prompt medical intervention to sustain life prior to definitive treatment. The remoteness of the site and the fact that the accident occurred late in the day militated against the pilot's survival.

1.15.6 The ELT operated satisfactorily and transmitted a signal which enabled the wreckage of ZK-HOP to be located early on the day following the accident. (Although the night search proved unsuccessful, this did not affect the pilot's opportunity for survival as the circumstances indicated that he was likely to have succumbed to his injuries before the commencement of this search).

1.16 Tests and research

1.16.1 An Airworthiness Directive (AD) issued by the Air Transport Division of the Ministry of Transport on 26 November 1990 required inspection and testing of a number of specific main rotor blades and tail rotor blades fitted to various models of Hughes 369 and Hughes 269 helicopters. The main rotor blades and tail rotor blades which were installed on ZK-HOP were included in the requirements of the AD. Although the AD was published several weeks after the accident to ZK-HOP (and was not prompted in any way by this particular accident), the recovered portions of the main and tail rotor blades from the helicopter were examined as far as was practicable in terms of the AD for leading edge abrasion strip attachment integrity and for void or bond separation. No evidence of pre-impact abnormality or damage, or suspect bonding was found.

1.16.2 Microscopic examination of the filaments of the light bulbs in the relevant "warning" and "system status" indicators mounted in the instrument panel disclosed the following information:

The "ENGINE OUT" light may have been illuminated by the time severe impact occurred

The "TRANSMISSION OIL PRESSURE" light may have been illuminated at impact

The "AUTO REIGNITION" light was probably "ON"

The "ARMED" light in the auto reignition circuit was probably "ON"

1.16.3 The wreckage of ZK-HOP was transported to an approved maintenance and overhaul organisation. Detailed examination and tests carried out included the following:

All access panels removed as required, also lower control rod panel, fuel bay panel, and forward control rod curtain. Fuel system vacuum checked carried out in accordance with paragraph 3-69B in Allison 250-C20 Operation and Maintenance Manual.

Fuel filter by-pass switch removed and serviceability inspection carried out in accordance with Hughes Notice N185 Part 1.

Engine fuel filter removed and inspected for contamination, carried out and found satisfactory. Fuel control filter removed and inspected also. Engine start pump assembly removed from tank assembly and inspected for blockage.

Helicopter fuel tanks drained of all remaining fuel and quantity measured. Found to contain 35 litres (approximately 62 lbs) of uncontaminated Jet A1 turbine fuel.

Oil filter inspected for contamination, nil evident, both chip detectors removed and nil contamination found.

Compressor bleed valve and associated tubing removed, one case half removed damage and debris found to continue back to impeller assembly.

Turbine can and discharge tubes removed, contaminants found burnt onto first stage nozzle and also on nozzle shield.

Main rotor transmission chip detectors inspected for contaminants, nil found.

Main rotor driveshaft removed, magnetic particle inspection and visual inspection of main rotor driveshaft carried out and no defects found.

Overrunning clutch removed and inspected, load check carried out in accordance with Appendix C of HMI found satisfactory. Magnetic particle inspection of inner and outer races carried out, no cracking evident, sprag inspected for impact damage, none evident.

Bendix driveshaft (engine to transmission) inspected and no defects evident.

A subsequent engine strip confirmed the ingestion of a large amount of foreign material in the first and second stage turbine wheels, as well as throughout the compressor. The material melted and burnt onto the first stage nozzle and wheel was from the composite structure of the air intake "dog-house" assembly which was demolished during the accident sequence.

1.17 Additional information

1.17.1 The operator (Thompson Bros) held Wild Animal Recovery Service licence number 87/110 issued by the Department of Conservation. This licence had been renewed on 1 July 1990 and was valid for one year. The operator also held Game Recovery Permit Number SL/009 issued on 8 October 1990 which was valid for a three year period. The Licence and Permit held were appropriate for deer hunting operations using ZK-HOP in Fiordland National Park and other Crown owned land within Southland Conservancy.

1.17.2 It was established practice for Mr Thompson, the owner/operator of ZK-HOP, to return to Te Anau by nightfall following a late afternoon or evening hunting sortie. It was also his practice to depart with the aircraft's fuel tank filled to capacity (providing an endurance of some two hours), and to carry an appropriate quantity of additional fuel in plastic "jerry cans", or uplift fuel from stocks enroute, according to the duration of the proposed operation. Mr Thompson would normally replenish the helicopter's fuel supply when the indicated quantity had reduced to 100 lbs (approximately 63 litres). The helicopter would be landed and shut down as required to conserve fuel during the course of a sortie. It was common practice for Mr Thompson to depart relatively early (e.g. at 1700 hours as on the day of the accident) and shut down ZK-HOP after some 30 minutes, dependent on the progress of the hunting, commencing operations again about an hour and a half before dark.

1.17.3 The pilot and shooter were both familiar with the locality and the features of the terrain in the area where the accident occurred and had hunted deer in this area on many previous occasions. They were both wearing suitable heavy clothing and footwear for the conditions and appropriate first aid and survival equipment, including rifle and ammunition, was carried on board ZK-HOP.

2. ANALYSIS

2.1 The pilot and shooter on board ZK-HOP were both experienced in deer recovery work and in conducting such operations in the varied and rugged terrain of Fiordland National Park. They were accustomed to working as a team, and were in current practice, having flown successful deer hunting sorties earlier on the day of the accident.

2.2 There were no witnesses to the accident to ZK-HOP, which occurred in a remote area. No details of the flight path followed or any events prior to the occurrence itself, could be established. There had been no reported indications, however, during the earlier flights on the day of the accident, of any airframe or engine malfunction or any problem associated with the performance or control of ZK-HOP. The pilot and shooter were apparently both in good health and spirits. No evidence was found to suggest that any medical factor contributed to the accident. It was likely, however, that the pilot had flown between 8 and 10 hours in ZK-HOP, mainly engaged in hunting activity and may have been fatigued at the time of the accident.

2.3 The precise time at which the accident occurred was not determined. The normal pattern of operations during a late afternoon and evening hunting sortie rendered it likely that the crew intended to return to Te Anau in ZK-HOP before last light. Their departure shortly after 1700 hours allowed some four hours of daylight for completion of the sortie.

2.4 The probable quantity of fuel on board ZK-HOP at the time of its departure would have been sufficient for approximately 3 hours flying. The amount which remained in the helicopter's fuel tank, and the "reserve" in jerry cans still containing fuel recovered at the accident site, suggested that the crew had already commenced working their way homeward, or were about to do so, when the accident intervened. The operator's known and established practice was to maintain an adequate fuel reserve in ZK-HOP at all times and it was likely that the helicopter would have been landed and shut down for a period to conserve fuel if it were necessary to prolong operations, for example, to take advantage of hunting conditions later in the evening. The evidence suggested that if such a procedure had been followed on this occasion, the accident was most likely to have occurred during the latter part of the evening. If the crew had planned to return to Te Anau in daylight directly from the location of the accident site, the accident could have taken place as late as 2030 hours (i.e. within some 30 to 40 minutes of last light).

2.5 It was evident that hunting had progressed with success and six deer already formed a prepared sling load which had apparently been released hastily on the mountain slope. Two adjacent deer, which had been lifted out on individual nylon strops were to be gutted and added to the existing load before ZK-HOP returned to Te Anau.

2.6 The load of deer lay on a steep, but open, tussock covered face, some 60 m above the bushline. A small hollow some 25 m further upslope would have been a more suitable location for the load to have been released, had this been a pre-meditated action (e.g. to enable the preparation of a final sling load). The possibility was considered that the pilot was proceeding toward this hollow with the prepared sling load and the two separate deer on the hook, when some untoward event occurred, prompting him to release the load prematurely. However, the lack of any evidence to suggest a mechanical failure or malfunction in the airframe or engine of ZK-HOP rendered such a scenario unlikely.

2.7 The manner in which the carcasses had come to rest on the slope supported an alternative and most probable sequence of events in which the two recently killed animals may have been deliberately positioned close to the previously jettisoned load, after they had been lifted out from the location, probably nearby, where they had been shot. If the crew of ZK-HOP had observed the two deer at the edge of the bush, while in flight above the slope with the six deer slung beneath the helicopter, it was consistent with deer recovery practice for the pilot to have released the existing load without delay in order to make certain of the further kills. The shot deer would then be transported back to the jettisoned load.

2.8 There was clear evidence that Mr Thompson, who was acting as a shooter was not seated in the helicopter when the accident occurred. It was not practicable to determine where he was positioned. The shooter's brother, who was very familiar with Mr Thompson's deer recovery technique considered it

likely that he had already disembarked to hook on the load (which would then comprise 8 deer). It was his habit always to check the load before boarding. If this had been done and a main rotor strike occurred as the pilot endeavoured to maintain the helicopter's skids close to the steep slope to enable Mr Thompson to embark, there was considerable potential for the shooter to be caught or struck by the skid and thrown off balance, or flung from the skid during the subsequent gyrations of the helicopter once control was lost.

2.9 The extensive but localised and clearly defined gouging of the slope and the similarity of damage to each of the five main rotor blades of ZK-HOP indicated that all the blades had struck the slope in close succession. The location of the gouge was consistent with a main rotor strike against the slope as the pilot manoeuvred the helicopter in an approach or hover, close to and above, the deer carcasses. The heading of the helicopter when the main rotor strike occurred could not be established with certainty. The proximity of the fractured tailboom, tail rotor and horizontal stabiliser assembly, to the deer carcasses and the evidence from "doghouse" fragments and tailboom paint flecks found nearby, indicated the probability that as a consequence of the blade strike, the main rotor blades had flapped out of track and struck the aft sections of the helicopter. The damage to the main rotor blades and complete loss of the tailboom would have rendered the helicopter uncontrollable, with ensuing rotation and nose pitch-down. The wreckage distribution and damage sustained by ZK-HOP confirmed that such events had occurred.

2.10 No conclusive reason was established to explain the main rotor blade strike against the slope. Engineering inspection of the rotor head assembly and examination and testing of the engine and its systems revealed no evidence to suggest that any component failure or significant change in power had occurred which might have resulted in a sudden loss of height, jetisoning of the sling load and a subsequent main rotor blade strike. The damage to the main rotor blades and the melted foreign matter induced into the engine indicated that substantial power was being developed.

2.11 It was evident, however, that the steepness of the slope resulted in minimal clearance for the main rotor blades of ZK-HOP if the pilot was approaching close to, or hovering above, the area where the deer carcasses were lying, and manoeuvring the helicopter to enable the shooter to hook on and then embark. While a pilot such as Mr Nicholson was likely to be accustomed to manoeuvring ZK-HOP with precision, the prevailing conditions suggested that an unanticipated "sink", or wind gust may have been sufficient to erode the margins of clearance which had been allowed and resulted in an inadvertent main rotor blade strike. The possibility that Mr Thompson, the shooter, was about to board the helicopter at the time of the accident, leading to the potential for some resultant imbalance, may have been a contributory factor. Other factors such as the difficulty of judging, from the pilot's position in the left front seat, the degree of main rotor clearance available, the varying nature of the slope itself, fatigue due to the demanding nature of the task and the sorties already flown, and the possibility that the accident may have occurred in fading light conditions, could also have been relevant.

2.12 Examination of the main rotor head at the accident site showed that the long chain and spliced rope strop which was normally stowed on board ZK-HOP in a neat coil at the shooter's feet, was wrapped very tightly around the mast. Marks on one of the main rotor blades and a length of solid cap strip

from the leading edge, also wrapped around the mast, confirmed that the rope and chain had been "picked up" by the blade at some stage during the accident sequence and subsequently wound onto the rotor head. The possibility could not be discounted that the rope had been drawn into the main rotor disc as the helicopter hovered close by, or overhead, the deer carcasses and that this event itself had precipitated the accident. However, the evidence suggested this did not occur but rather the rope and chain were "picked up" by the main rotor blade(s) after being flung from the stowed position during the gyrations and tumbling of the helicopter once the main rotor strike had taken place. This was known to have occurred in other helicopter accidents and it was the most likely explanation in this case.

2.14 Although the strop and chain were not considered significant in relation to the cause of the accident to ZK-HOP, the extent to which the leading edge strip from the blade and the whole length of the rope and chain had become wrapped around the rotor head, allied with the fragmentation of the main rotor blades and other head damage, was supportive evidence that the engine continued to deliver considerable power to the main rotor system throughout a major part of the accident and impact sequence.

3. FINDINGS

3.1 The pilot in command held a valid Commercial Pilot Licence — Helicopter, and a Type Rating for the Hughes 369 series helicopter.

3.2 The aircraft's Maintenance Release had expired four days prior to the accident.

3.3 The expired Maintenance Release invalidated the Certificate of Airworthiness.

3.4 The expiry of the Maintenance Release was not a factor in the accident.

3.5 The aircraft's estimated all up mass was within specified limits at the time of the accident.

3.6 The shooter was not seated in the helicopter when the accident occurred.

3.7 The aircraft's centre of gravity position could not be estimated as the position of the shooter at the time was not established.

3.8 The aircraft was being manoeuvred close to a steep slope at the time of the accident. Limited clearance existed between the main rotor blades and the slope.

3.9 While in flight the aircraft's main rotor blades contacted the slope. The damage which ensued from a main rotor strike rendered the aircraft uncontrollable.

3.10 The time at which the accident occurred was not determined.

3.11 No evidence was found to suggest that any malfunction in the aircraft's airframe, control systems, or engine contributed to the accident.

3.12 During the accident sequence a long rope strop and chain became entangled around the rotor head. This was not a factor in the accident.

3.13 The pilot's shoulder harness had worn a metal shroud to a sharp edge where it passed over this part of the inertia reel assembly.

3.14 The shoulder harness failed during the impact sequence, increasing the pilot's risk of serious injury.

3.15 The probable cause of this accident was the manoeuvring of the helicopter in close proximity to a steep slope with insufficient clearance margin for the main rotor blades to allow for an unanticipated gust or "sink", imbalance of the helicopter, fading light or fatigue.

4. SAFETY RECOMMENDATIONS

4.1 As a result of the investigation into the circumstances of this accident it was recommended to the General Manager of the Air Transport Division of the Ministry of Transport that:

An Airworthiness Directive be issued in respect of the harness inertia reel assembly of the Hughes 369 Series helicopter outlining appropriate inspection and/or modification procedures (if required) to ensure that the inertia reel assembly in existing and new helicopters of this type will not contribute to failure of the shoulder harness under impact loading.

5. REGULATORY

5.1 Pursuant to Section 14(5) of The Transport Accident Investigation Act 1990 the legal personal representatives of the pilot in command and the shooter were invited to avail themselves of the opportunities afforded to them thereunder.

5.2 As a result of representations received the report was amended and amplified to clarify some of the points raised.

5.3 The representations made to the undersigned are not to be taken as an admission of liability on the part of the pilot in command or the shooter and the statements of their personal representatives are without prejudice to their right to act in any way they may consider fit in any proceedings or action which may be based on the events to which this report refers.