TRANSPORT ACCIDENT INVESTIGATION COMMISSION
TE KOMIHANA TIROTIRO AITUA WAKA

AIRCRAFT ACCIDENT REPORT

No. 91-008

HUGHES 369HS ZK-HZG

22 km north-north-west of Castlepoint

17 March 1991

Transport Accident Investigation Commission
Wellington · New Zealand

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Transport Accident Investigation Commission
Wellington

Chief Commissioner
Transport Accident Investigation Commission

The attached report summarises the circumstances surrounding the accident involving Hughes 369HS aircraft ZK-HZG near Akitio on 17 March 1991 and includes suggested findings.

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 as to the contributing factors and causes of the accident.

3 October 1991

R CHIPPINDALE
Acting Chief Executive

APPROVED FOR RELEASE AS A PUBLIC DOCUMENT

7 October 1991

M F DUNPHY
Chief Commissioner

TRANSPORT ACCIDENT INVESTIGATION COMMISSION

AIRCRAFT ACCIDENT REPORT NO. 91-008

Aircraft Type, Serial Number and Registration:	Hughes 369HS, 360803S, ZK-HZG
Number and Type of Engines:	1 Allison 250-C20
Year of Manufacture:	1976
Date and Time:	17 March 1991, 1530 hours NZST
Location:	8 km south-south-east of Akitio Latitude: 40°41"S Longitude: 176°24"E
Type of Flight:	Other Aerial Work - Seaweed Harvesting
Persons on Board:	Crew: 1
Injuries:	Crew: Nil
Nature of Damage:	The aircraft was destroyed
Pilot in Command's Licence:	Commercial Pilot Licence - Helicopter
Pilot in Command's Age:	38
Pilot in Command's Total Flying Experience:	2080 hours of which 800 were on type
Information Sources:	Pilot and Witness Statements, Transport Accident Investigation Commission Inquiries
Investigator in Charge:	Mr A.J. Buckingham

1. INTRODUCTION

1.1 The pilot had been contracted to sling-load bales of seaweed from a beach 8 km south-south-east of Akitio to a collection point close to the township.

1.2 About 25 loads had been flown uneventfully during the two hours prior to the accident. Each load consisted of two or three bales, depending on the helicopter's fuel level. Loading and refuelling was coordinated by an assistant, himself a commercial pilot, stationed on the beach at the pickup point, and equipped with a VHF hand-held transceiver for communicating with the helicopter.

1.3 In the hover, whilst offloading the last of the loads before the accident, the pilot sensed a transient "buzz" from the tail rotor area, but attributed it to the effect of a crosswind gust. The "buzz" disappeared with slight application of yaw pedal in either direction.

1.4 On the transit back to the pickup point, the pilot positioned the helicopter parallel to and about 200 m seaward of the shoreline, to facilitate a right hand circuit onto the beach.

1.5 At about 200 feet amsl, with an IAS of 60 knots on the downwind leg, the pilot felt a brief high-frequency vibration throughout the airframe, followed by a loud noise. Both yaw pedals "kicked back" momentarily, then "went slack". The helicopter's nose pitched down sharply, giving the pilot the impression that it was going inverted.

1.6 At this point, the attention of the co-ordinator on the beach was drawn to the helicopter by a loud noise. The witness observed that the tail rotor, apparently intact, had separated from the helicopter and was "half spinning, half fluttering" towards the sea surface.

1.7 The pilot lowered the collective lever, at which point the aircraft began to rotate to the right. In an attempt to raise the nose, he applied full aft cyclic, which was only partially effective. He raised the collective, accepting that the aircraft was going to continue to rotate, to explore the possibility that it might assist in raising the nose. The rotation was so violent that he hit his head on the side of the cabin and the top of the instrument panel. He was restrained by a full harness and was wearing a safety helmet.

1.8 The helicopter descended, still rotating uncontrollably, toward the beach and the high ground beyond. The pilot stated that his intention throughout these evolutions was to arrive on dry land, avoiding ditching at all costs.

1.9 As it crossed the beach the aircraft's rate of rotation appeared to decrease as the aircraft slowed and its direction of travel changed away from the high ground and back to seaward. At that stage the pilot closed the throttle and pulled full collective. The helicopter landed on some rocks with sufficient sideward motion to roll it onto its side. The rotor blades struck the rocks and "thrashed themselves to pieces".

1.10 The pilot stopped the engine by closing the fuel valve and vacated the wreckage, shaken but uninjured. When it was evident that there was no risk of fire, he returned to the aircraft and switched off the ELT which had activated. He was then able to use his co-ordinator's hand-held VHF transceiver to contact a passing aircraft which relayed details of the accident to Air Traffic Control.

1.11 The approximate position of the tail rotor was marked by a crayfish pot and float, but despite a number of attempts, it was not recovered.

1.12 Examination of the wreckage revealed that the tail rotor, its driveshaft and a substantial portion of the tail rotor gearbox housing had parted company from the aircraft. The remaining portion of the gearbox was that housing the input drive shaft with its crown wheel and associated bearings. There was no evidence of the tail rotor having struck any part of the airframe as it departed.

1.13 The available gearbox parts were submitted to the Department of Scientific and Industrial Research, Industrial Development Group for detailed analysis to determine the mode and cause of the failure.

1.14 The DSIR report stated, in part:

> "The magnetic chip detector was removed and there was no significant debris attached. However, the detector was found to have a very low level of magnetism."
>
> and:
>
> "None of the parts examined showed failure as a result of progressive deterioration prior to the accident or the presence of a defect and it is likely that the component that failed and initiated the incident was lost with the tail rotor.
>
> The input shaft crown gear showed some evidence of wear and some pitting had commenced. It is possible that this damage was related to the presence of moisture in the gearbox* and it is considered probable that the extent of damage may have resulted in the gear being rejected on inspection, if the failure had not occurred.
>
> The drawings supplied with the gearbox suggest that the output crown gear was smaller than the input crown gear. Other things being equal therefore, each tooth on the output gear would have experienced more service and hence wear than those on the input shaft gear.
>
> It is considered possible that as a result of surface spalling and/or fatigue initiating at such an area of damage, a sizeable piece of an output crown gear tooth was lost. If this were to get caught between the two crown gears, it may have caused rapid separation of the gears, overload failure of the gearbox and the crushing damage seen on the top leading edge of one tooth of the input crown gear.
>
> The fact that one tooth was damaged implies the presence of a sizeable piece of debris but the fact that only one tooth was damaged implies that it was not present for a long period of time. The effective 'levering' apart of the two crown gears is also consistent with the observed direction in which the crack propagated, i.e. from forward to rear.
>
> It is stressed that the above description of the failure sequence is based on secondary evidence and depends entirely on the supposed failure of a component (the output crown gear) that is not available for inspection.
>
> 1. The input crown gear suffered crushing damage to the top leading edge of a single tooth.
> 2. The gearbox showed evidence of water contamination.*

3. The input crown gear teeth exhibited wear on the driving faces and some had begun to pit.

4. The fracture surface of the gearbox was produced by an overload failure originating at the forward edge and propagating rearward.

5. Although it was not available for inspection, it is suggested that the failure occurred because the output crown gear lost part or all of a tooth which interfered with the mesh of the two crown gears."

* It was later established that the remains of the gearbox had been immersed in seawater for some time prior to retrieval. This had given rise to some post-accident corrosion of various components.

1.15 At the time of this accident, the tail rotor gearbox had accrued some 1371 hours in service since overhaul; the output pinion however, had 6171 hours since new. The time between overhauls for the gearbox was 3000 hours; the retirement life of the pinion was "on condition".

1.16 The aircraft records showed that the tail rotor had suffered a strike 192 flying hours prior to this accident (see accident brief 88-087). The gearbox had been dismantled, examined and rebuilt before being restored to service.

1.17 Information received from another company which operated a fleet of Hughes 369 helicopters, was that loss of a gear tooth subsequent to a tail rotor strike was a known phenomenon, the first 300 hours after the strike being the "danger period", in their experience. Such occurrences had often resulted in the severed tooth being picked up on the magnetic chip detector plug, however the magnetic plug in this case had a "very low level of magnetism".

1.18 The tail rotor of ZK-HZG was not fitted with abrasion strips. (Loss of an abrasion strip had caused tail rotor imbalance and consequent gearbox failure in another Hughes 369 accident - see accident brief 86-039.)

1.19 The witness who saw the tail rotor separate from ZK-HZG was certain that both blades remained attached to the hub as they fell to the sea.

2. FINDINGS

2.1 The probable cause of the gearbox failure was the separation of a gear tooth from the output drive pinion and its lodgement between the two gear wheels, but other causes could not be eliminated as the remainder of the tail rotor assembly was not recovered.

2.2 The resultant loss of anti-torque effect, coupled with the sudden change in centre of gravity due to the departure of a significant mass from the tail, rendered the helicopter uncontrollable.

2.3 The pilot's lack of injury was attributable to the helicopter's low touchdown speed and wearing a full harness and safety helmet.

7 October 1991

M F DUNPHY
Chief Commissioner