

## LOCATION OF OCCURRENCE

Darwin Harbour, Northern Territory	Height a.m.s.l. (ft) 0	Date 25.3.72	Time (Local) 1330	Zone CST
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## 2. THE AIRCRAFT

Make and Model Sikorsky S58E/T Helicopter	Registration VH-UHV
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## 3. CONCLUSIONS

The helicopter was substantially damaged when it was ditched in the harbour at Darwin, Northern Territory as a result of the tail rotor and the tail rotor gearbox separating from the aircraft in flight.

- (ii) The helicopter was owned and operated by Helicopter Utilities Pty. Ltd. and, at the time of the accident, it was engaged on a charter flight from the off-shore oil drilling rig "Navigator" to Darwin. One pilot and nine passengers were on board.
- (iii) The pilot, Jerome Michael Wallace Hart, aged 24 years, held a valid senior commercial helicopter pilot licence endorsed for the aircraft type. His total flying experience amounted to 2,206 hours of which 50 hours had been gained on S58E/T helicopters.
- (iv) The aircraft was substantially damaged by impact forces and sustained further damage as a result of the recovery procedures and salt water immersion. There was no other damage to property.
- (v) There was no injury to the pilot or passengers during the accident or the subsequent emergency evacuation of the aircraft.
- (vi) There was a valid certificate of airworthiness for the aircraft.
- (vii) The helicopter was loaded within safe limits.
- (viii) The weather in the area of this accident was fine, the visibility was unrestricted and the wind was calm. The surface of the water in Darwin Harbour was smooth.
- (ix) The flight from the oil rig, positioned 227 degrees (M), 137 miles from Darwin, was uneventful until the helicopter was crossing Darwin Harbour some seven miles from the airport at a height of 1,000 feet and at a speed of 100 knots. At this point the pilot noticed a slight vibration, lasting about five seconds, which he was unable to identify. The vibration increased in intensity and there were three distinct thumps after which the helicopter pitched violently nose down and yawed to the right. The pilot lowered the collective pitch and brought the helicopter under control. Although the vibration was less severe he was unable to read any instruments. He transmitted a distress message which was received and acknowledged by Darwin Tower. The pilot then attempted to apply a small amount of collective pitch but the vibration became violent. He continued with the auto rotation, armed the flotation gear, closed the throttles to the flight idle position and the aircraft landed smoothly on the water with some right yaw. The helicopter turned clockwise in the water through about 240 degrees before it rolled onto its port side and the main rotors struck the water. Both of the wheel-mounted flotation units inflated but the one mounted on the left wheel was breached, probably during inflation. The pilot, after vacating the aircraft, assisted the passengers and all were quickly rescued by nearby boats. The aircraft remained partially submerged, resting on a sand bar, and was later recovered.
- (x) The examination of the wreckage indicated that, with the exception of the tail rotor and gearbox which had separated from the aircraft and fallen into the harbour, all the other damage was attributable either to impact with the water or to the aircraft recovery processes. Despite an extensive under-water search, the tail rotor and gearbox were not recovered.

**CONCLUSIONS** (Cont'd)

- (xi) Examination of the tail pylon revealed that the tail rotor gearbox, including the greater part of its input housing, had separated from the pylon fitting to which it was bolted, carrying the tail rotor assembly with it. Some fifty per cent of the input housing flange, broken into four pieces, remained attached to the pylon fitting.
- (xii) The pylon fitting is a magnesium casting which is rivetted and bolted to the top of the tail pylon and has, on its upper surface, eight locating and retaining studs which mate with holes drilled in the flange of the input housing. The right, rear area of the pylon fitting had fractured in three places as a result of progressive cracking which bore fatigue characteristics.
- (xiii) The most forward stud had failed in tension but the remaining seven studs, complete with nuts and washers, retained four pieces of the input housing flange, although the nuts were only finger tight.
- (xiv) The fracture surfaces of the pieces of input housing flange on the left side of the fitting, although severely corroded by exposure to sea water, showed characteristics of progressive cracking, whereas the fracture surfaces on the pieces remaining on the right side were indicative of static failure.
- (xv) The helicopter is normally parked in the open and, some five weeks prior to the accident, following a day on which the helicopter had not flown because of heavy rain, the two pilots on board noted an unusual vibration after start-up. The engineer carried out a check of the engines and transmission but was unable to locate any source of the vibration in these areas and it was decided that it may have been due to rain water becoming lodged in the main rotor blade tips. It was also decided that this would be cleared centrifugally during flight. The pilots carried out a flight of 2.54 hours duration and, on return, reported a high frequency vibration which was believed to be associated with the tail rotor.
- (xvi) A visual inspection of the pylon, the pylon fitting, the gearbox and the tail rotor, by a licenced aircraft maintenance engineer, revealed no defects and a drying process was carried out on the root ends of the tail rotor blades in the belief that water may have entered the balsa fillers. This action was taken pending the arrival of a replacement tail rotor from the Operator's main base.
- (xvii) Following the drying action an engine run and a flight test were satisfactory and there were no indications of the previous unusual vibration. The helicopter then operated another two flights totalling 5.33 hours before the replacement tail rotor became available and was fitted. This tail rotor remained in service for a further 60.43 hours until it separated from the helicopter at the time of this accident.
- (xviii) During the investigation the tail rotor, which had been removed earlier from the aircraft, was subjected to a detailed examination and it was found to be grossly out of balance. A weighing and radiographic inspection revealed that one of the four blades contained a quantity of water in the honey-comb material with which the blade is filled. It was also established that the external sealant coat on the balsa filler at the root end of this blade was ineffective.
- (xix) The metal ribs in this blade, at each end of the honey-comb material, were exposed by removal of the blade tip and the balsa filler. In respect of both of these ribs the coating of sealant which forms the primary blade seal was found to be defective, the more significant leak being at the root-end where a hole more than 1/16 inch in diameter was found to be present at the extremity of the rib trailing edge. It is probable that this ineffectively sealed area of the blade rib had been present at least since the last recorded blade overhaul. No leak test was performed at that time although a radiographic examination was carried out. The balsa filler had not since been removed. The comparative weights of this tail rotor blade at the time of the last overhaul and then subsequent to this accident indicate clearly that the water entered the blade subsequent to its last overhaul.

**CONCLUSIONS** (Cont'd)

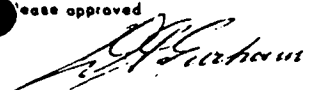
(xx) It has not been possible to determine the length of time that the cracks in the pylon fitting and in the input housing flange had been present, or to determine the rate of their propagation, but the cracking was almost certainly the result of an out of balance condition in the tail rotor. The first instance of an unusual vibration was noted immediately after the helicopter had been standing for a period of time in heavy rain and so it is reasonable to conclude that sufficient water entered the blade at that time to cause a detectable unbalanced condition. The entry of water at this time probably occurred because a deterioration in the external sealant allowed water to enter the balsa filler and to pass from there through the defective sealant at the root end rib.

(xxi) The drying process undertaken by the maintenance engineer in the field apparently removed water from the balsa filler and improved the balance of the tail rotor to the extent that, it was not detected as an unusual vibration by the pilot or the engineer who flew in the aircraft before placing the aircraft back into service.

(xxii) Since the tail rotor subsequently installed on the aircraft was not recovered, its state of balance could not be determined but the records indicate that it was properly balanced immediately before despatch for fitment. It seems most probable, therefore, that the fatigue cracking in the pylon fitting and the input housing flange was initiated during the eight hours 27 minutes of operation with the unbalanced tail rotor and, after this tail rotor was replaced, the cracking progressed under normal flight loads until failure occurred.

**OPINION AS TO CAUSE**

The cause of this accident was the lack of any specified maintenance requirement or adequate maintenance action to inspect the tail rotor gearbox mounting for damage after it was determined that the aircraft had been operated with an out-of-balance tail rotor.

Approved  (D.S. GRAHAM)	Designation Assistant Director-General (Air Safety Investigation)	Date 20.6.72
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