AAIB Bulletin No: 12/93 **Ref: EW/C93/5/2** **Category: 2.3**

Aircraft Type and Registration:	Bell 206L-1 LongRanger, G-LONG
No & Type of Engines:	1 Allison 250-C28B turboshaft engine
Year of Manufacture:	1979
Date & Time (UTC):	24 May 1993 at 1410 hrs
Location:	Battersea Heliport
Type of Flight:	Positioning for Passenger Charter
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - None Passengers - None
Nature of Damage:	Tail boom creased in down flexure, engine turbine case ruptured with minor non-containment of debris
Commander's Licence:	Airline Transport Pilot's Licence (Helicopters)
Commander's Age:	46 years
Commander's Flying Experience:	9,100 hours (of which 1,100 were on type) Last 90 days - 109 hours Last 28 days - 41 hours Last 24 hours - 0.55 hours
Information Source:	AAIB Field Investigation

At the end of an uneventful positioning flight from Elstree, a normal approach to the landing platform at Battersea was made. The helicopter was brought into a hover taxi at about 8 feet above the platform and turned in towards the apron to land on Pad 7. Immediately after turning in over the pontoon, a loud 'bang' was heard and all engine power was lost. An engine off landing was made on the apron which caused the tail boom to flex down sufficiently to suffer permanent deformation.

The aircraft was moved from Battersea to its maintenance base where examination revealed a hole in the turbine case (Fig 1) of the engine and evidence of small fragments having pierced the engine cowlings from the inside. It could be seen, through the hole, that the 1st stage turbine of the gas generator had fragmented and the loose segment (Fig 2), which could be extracted, constituted about 1/3 of the perimeter of the complete turbine wheel.

The engine was removed from the helicopter and taken to the UK overhaul agency where strip examination of the turbine module revealed that all the damage was consistent with that to be expected to result from the imbalance caused by the separation of the 1/3 portion of the 1st stage turbine wheel.

(On this type of engine the turbine blades are integral with the disc.) There was no evidence of any pre-rupture malfunction of the engine nor of any of its accessories. The examination also revealed that the containment shield had retained the major separated segment of the turbine but small debris had escaped through the resulting hole in the casing. The failed turbine wheel, which had a declared finite life of 1,550 hours, had been fitted as a new item 620 hours previously.

The 1st stage turbine fragments were subjected to metallurgical examination at DRA Farnborough which revealed that the major portion of the fracture had occurred as a fast brittle mode. This had, however, emanated from the base of a sector of the crack which ran almost directly radially towards the wheel centre and exhibited heavily oxidised fatigue like features. Examination also revealed a considerable number of small radial cracks in the rim of the turbine wheel disc. One of these was broken open and revealed some evidence of progression by a thermal fatigue mechanism. Metallographic examination of the only remaining full length turbine blade revealed evidence that the turbine had been subjected to an overtemperature within the recent past, probably of the order of 10 hours previously.

The C28 & C30 versions of the Allison 250 engine type are known, by the manufacturer, to be sensitive to starting technique. It was found that the turbine wheel suffered less distress on a quick start where the temperature rose to nearer the limits than on a slower, cooler start. As a result of this, Allison issued Commercial Service Letters giving advice on optimising the starting technique (2035 on C28 and 3049 on C30) in July 1980, which were combined and revised in August 1982. These letters were cancelled in May 1987 after the content of the letters had been incorporated into the Allison Operation and Maintenance Manuals

Bell Helicopter had reinforced this advice specifically for the Bell 206L-1 in August 1980, when they issued an Information Letter (IL 206L-80-10) on Optimised Starting Procedures. They subsequently issued an Alert Service Bulletin (206L-81-20) in April 1981, requiring the fitting of large diameter starter leads and an uprated generator to ensure that the starter accelerated the engine as quickly as possible. This was followed in September 1981 by an associated Technical Bulletin (206L/81-72), which recommended the fitting of a heavy duty battery. G-LONG had all these improvements fitted.

As a result of this accident, Bell Helicopter are about to issue an Alert Service Bulletin which will require that Bell 206L-1 aircraft are fitted with a turbine temperature gauge incorporating a 'tell tale' light, to assist operators to avoid inadvertent turbine overheat damage during start-up. There are currently only 3 aircraft, all of them Bell 206L-1 LongRangers, on the UK register which are fitted with this engine type.

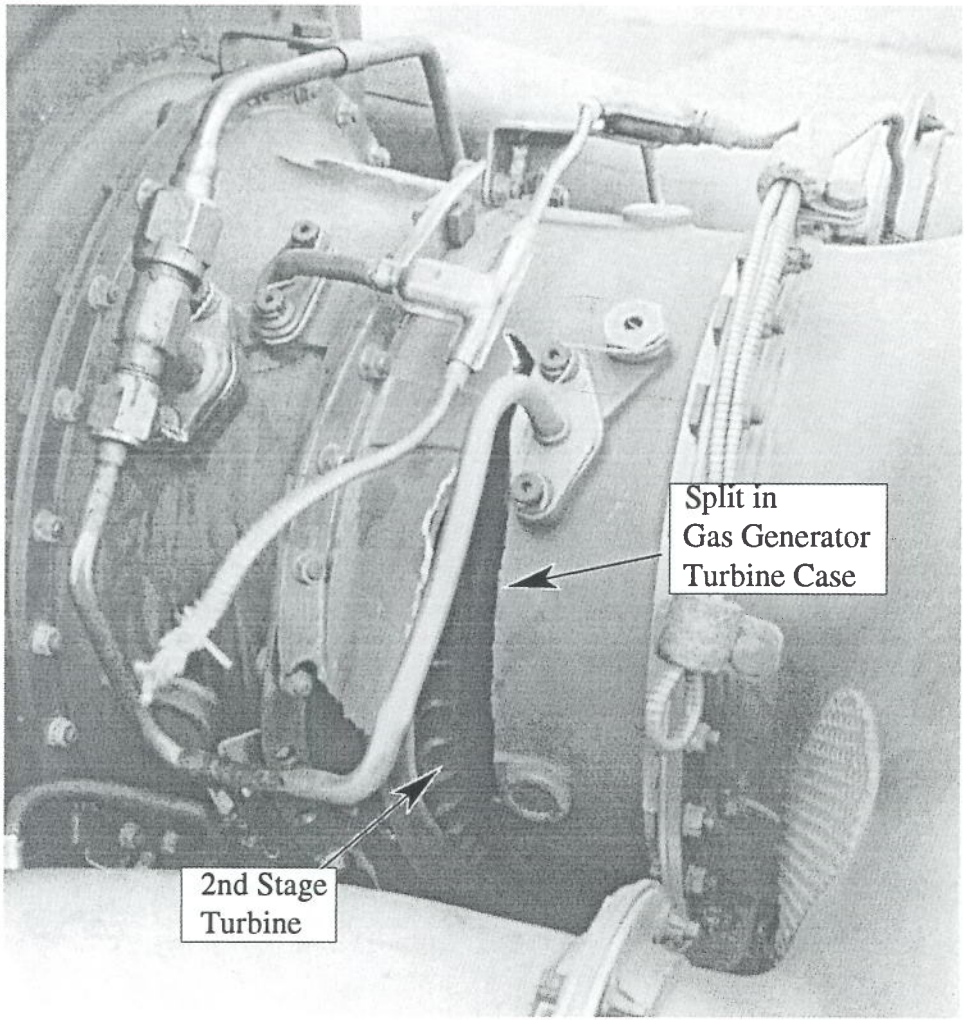

Fig 1 Turbine Section of engine of G-LONG

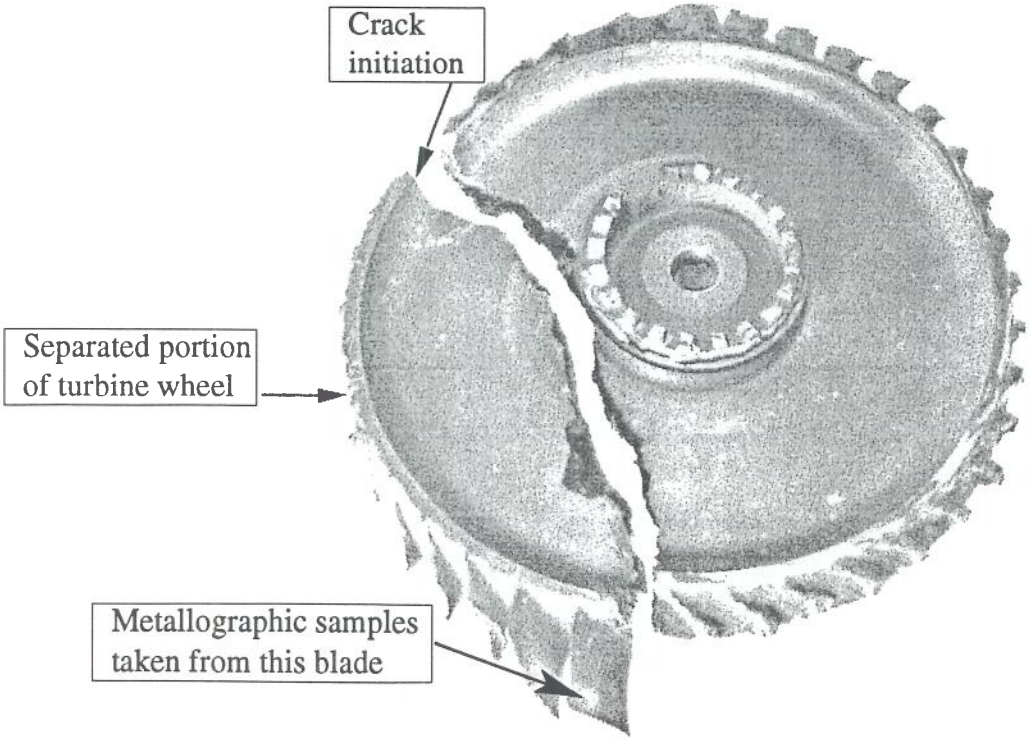

Fig 2 Fragmented 1st Stage Turbine Wheel