**AAIB Bulletin No: 10/94** **Ref: EW/C94/5/3** **Category: 2.3**

| | | |
|---|---|---|
| **Aircraft Type and Registration:** | Bell 206B JetRanger III, G-STST | |
| **No & Type of Engines:** | 1 Allison 250-C20J turboshaft engine | |
| **Year of Manufacture:** | 1983 | |
| **Date & Time (UTC):** | 22 May 1994 at 1722 hrs | |
| **Location:** | Near Gwytherin, Clwyd ( N53°08' W003°39') | |
| **Type of Flight:** | Private | |
| **Persons on Board:** | Crew - 1 | Passengers - 3 |
| **Injuries:** | Crew - Fatal | Passengers - 2 Fatal<br>1 Serious |
| **Nature of Damage:** | Helicopter destroyed | |
| **Commander's Licence:** | Airline Transport Pilot's Licence (Helicopters) with Instructor Rating | |
| **Commander's Age:** | 34 years | |
| **Commander's Flying Experience:** | Approximately 2,525 hours (of which 510 were on type)<br>Last 90 days - 95 hours<br>Last 28 days - 40 hours | |
| **Information Source:** | AAIB Field Investigation | |

## History of the flight

On the day before the accident, the helicopter departed its normal operating base north of Birmingham bound for Plas Coch near Llanfairpwllgwyngyll on the island of Anglesey. It had been leased to the operating company for the weekend for the purpose of selling 'pleasure flights' to members of the public attending a steam rally in the grounds of Plas Coch. The commander had flown the machine before and was aware that the horizontal situation indicator (a sophisticated gyro compass) was totally unserviceable and that he would have to rely upon the direct-reading magnetic compass for heading information. The weather in the Birmingham area was poor and to avoid high ground, he routed towards Liverpool and then along the Welsh coast. The commander was accompanied by three assistants, one of whom was a student helicopter pilot who occupied the front left seat and assisted the commander with navigation; two more assistants travelled to Plas Coch by road in a ground support vehicle. During this positioning flight, the commander did not allow the student pilot to handle the controls because the weather was unsuitable.

Numerous, brief passenger flights were successfully completed during the afternoons of Saturday and Sunday. On Sunday afternoon the commander flew 25 pleasure flights totalling approximately four hours in the air, interspersed with engine shutdowns and short rest breaks. The helicopter was flown spiritedly throughout the afternoon and there were no indications of any technical defect. Late in the afternoon, after refuelling almost to full with 163 litres of Jet A1 at Caernarfon Airport, the commander completed a short charter flight taking four passengers to Treaddur Bay. He then returned to Plas Coch where he shut down at about 1645 hrs to collect three of his assistants for the return flight to Birmingham. The other two assistants left Plas Coch in the ground support vehicle at about 1655 hrs to return along the A55 coastal road.

At 1700 hrs, according to a meteorological aftercast, there was a trough of low pressure covering Wales and much of England with a weakening occlusion lying across north Wales, probably just to the south of Gwytherin, with associated hill fog and intermittent outbreaks of drizzle. The surface wind was light from the north east; at 2,000 feet amsl it was 040°/15 kt and the air temperature was +6°C. The main feature of the weather was the extensive cloud which was broken at base 1,000 feet, broken at base 1,500 to 2,000 feet and overcast at 6,000 feet or above. The moist north-easterly flow was producing orographic stratus on the northern slopes of hills in the Gwytherin area; the visibility varied between 5 and 12 km outside cloud but deteriorated to 200 metres or less within the cloud covering the hilltops. Local people in the valley below the accident site reported that the weather at the time of the accident was dry but very cloudy, the visibility was poor, and there was no wind.

The helicopter left Plas Coch shortly after 1700 hrs and was seen, inland, heading in a south-easterly direction near Conwy by the assistants in the support vehicle. The next reported sighting of the helicopter was near Pandy Tudur at about 1710 hrs. Initially it was travelling in a north-easterly direction at low altitude towards Llangernyw but it then changed direction and flew towards the eyewitness's house on a south-westerly heading. The witness saw the occupants, waved to them and they waved to him as the helicopter flew over his house. It then turned on to an easterly heading towards Llansannan; he formed the opinion that the occupants of the helicopter were either sightseeing or were trying to find their bearings. He then lost sight of the helicopter although he could still hear it heading in the general direction of the 1,450 foot high peak named Moel Goch. A short time later he heard the sound of the helicopter suddenly change as though the pilot had 'opened it up to try and get over Moel Goch'. There followed a loud bang and then silence.

The second reported sighting was by a farmer walking in his field a mile and a half north east of Gwytherin. He heard the helicopter approaching for some time from the area of Pandy Tudur. He first saw it as it crossed the Afon Cledwan Valley and he stopped to watch its progress. It passed abeam him about half a mile distant and then flew away from him at low altitude on an approximate

track of 170°M towards Moel Goch. To the witness the helicopter's engine sounded to be working hard but evenly as he watched it steadily climb the hillside at moderate forward speed for about two minutes. As it met the cloudbase just below the peak, it suddenly went up at an angle away from the ground. He heard a loud revving noise and saw a big flash, the helicopter then dropped very quickly, hit the ground and caught fire. The farmer was 3,200 metres away from crash position; he was quite certain that he never lost sight of the helicopter in mist or cloud and that it had remained on a southerly heading until impact with the ground. He was, however, less certain as to the precise order in which he perceived the sounds and motions of the helicopter. Sound from the crash position would have taken 9.4 seconds to reach him.

There were no radar recordings of the helicopter's movements between Plas Coch and the accident site, and no evidence to indicate that the commander had contacted any ATC agencies. The helicopter was equipped with a GPS (global positioning system) satellite navigation system which was thrown clear of the wreckage. It was damaged but still operable and on applying external power, it attempted to initialise at the crash position indicating that it had been working at the time of the crash. Although the GPS had the capacity for 250 waypoints and ten stored routes, the commander habitually did not use the route facility and there were only 38 stored waypoints. He normally used the GOTO facility which provided him with steering and distance from present position to a stored or manually entered waypoint. The GPS also provided indications of track, ground speed and deviation from track. It was not possible to determine whether it had been producing steering information to a waypoint at the time of the accident but the crash position was close to the direct track between Conwy and the helicopter's destination.

## Search and rescue

On seeing the crash, the farmer ran to his home to telephone the emergency services. With his sons he then drove by road and farm track to within a few hundred metres of the crash site and walked through the mist to find the burning helicopter. When they found it, only one person showed any signs of life; this person had been thrown clear of the burning wreckage. Helicopters from the local police force and from RAF Valley landed at the accident site when the low cloud covering the peak of Moel Goch lifted slightly. Fire fighters also made their way towards the site but the soft, boggy ground prevented them from driving the last few hundred metres. The survivor, who had been occupying one of the rear seats, had sustained multiple bruises, serious chest injuries, broken ankles and some minor lacerations; also, fuel had contaminated his skin and clothing in the region of his buttocks and under one arm. He was given first aid by members of the public and the emergency services before being flown to a

nearby hospital. Although initially conscious, the survivor later lost consciousness and remained unconscious for several days. Since regaining consciousness he has been unable to remember anything of the accident flight. Post-mortem examination of the deceased revealed no medical condition which was likely to contribute to the accident.

**Wreckage analysis**

The helicopter had a current Certificate of Airworthiness and had no technical history considered relevant to the accident.

The helicopter had hit the ground 100 ft below a 1,450 ft hilltop on a heading of 348°, and travelling downslope. The average slope to the hilltop was approximately 10°, however just above the crash site the slope reduced to 5°. The surface was soft peaty earth, with patches of boggy ground. The site comprised two impact areas; the initial impact site, which contained the skids and associated crosstubes and ground marks showing a clear and deep impression of the underside of the fuselage, and a second site containing the burnt-out remains of the helicopter 150 ft beyond the first.

The technical investigation was hindered by two factors: that much of the helicopter had been destroyed in the ground fire, and that there had been two heavy impacts and it was not possible to determine whether some of the evidence found related to the first or second collision.

The tail rotor gearbox and blades had separated at the first impact, along with the skids, the vertical fin, most of the helicopter doors and a rear underside panel. There was evidence that the fuel tank had ruptured and the fuel, which had ignited, had been ejected forward by the deformation of the fuel tank.

After the first impact the helicopter had become airborne and travelled 150 feet forward, and again struck the ground, in a marshy area. The main rotors then hit the ground for the first time and both blades separated from the hub near the attachment grips. The rotor mast failed primarily in bending at a point just beneath the bump stops, both of which had taken a moderate impact. The direction and mode of the failure was compatible with the rotor not being under power at the time of the second impact. Whether this was because the first impact disrupted the aircraft fuel system, or whether there was some other reason, could not be determined because of lack of evidence. The comparative lack of damage to the tip and leading edge of one blade indicated that the rotor RPM were low at this time. The remains of the helicopter then rolled for 50 feet, and came to rest inverted and burned out, with only the tail boom and a few steel components surviving.

The ground marks at the first site gave the following approximate flight parameters at impact:

Angle of Descent The flight path angle of 20° below the horizontal

Pitch The helicopter was pitched up at 4° above the horizontal

Yaw Ground marks made by the skids indicated no yaw

Roll The left skid contacted the ground before the right skid, indicating a 7° bank to the left

These angles show that the helicopter hit the ground essentially level but with a significant rate of descent.

Many components were destroyed by the fire; in particular most of the helicopter flying control system, the main rotor gearbox casing, the engine control unit, the accessory gearbox casing and the aircraft fuel system were destroyed.

The remains of the engine were examined at an Allison overhaul agent's facility and it was determined that the compressor and turbine assemblies, and their bearings, had not sustained significant damage before the accident. The pilot's throttle control was found in the fully open position

The flying control system uses three servo jacks, which were relatively free from fire damage, and their positions corresponded to the cyclic controls being slightly forward and to the right, and the collective controls fully down. However the collective jack position was beyond the normal airframe limits, indicating that control system could have been disrupted during the impact sequence. The alloy components in the collective flight control system had been destroyed, but because of the significance of the vertical descent rate indicated by the ground marks an attempt was made to identify the steel components in this system. Both collective sticks were fitted and all the bearings in the collective system joints were identified and were complete with their respective bolts proving that there had been no disconnections due to loss of bolts within the collective system.

Both the main rotor gearbox and the engine accessory gearbox casings had been destroyed by fire, but their gears were recovered and showed no evidence of pre-impact damage. The freewheel unit fitted between the main rotor and the engine showed was damaged by heat and contaminated by molten brass from the adjacent bearings, but showed no indications that it had been unserviceable.

In summary the identifiable components recovered from the helicopter wreckage showed no evidence of a pre-existing defect which could have contributed to the accident.