ACCIDENT

Aircraft Type and Registration:	Aerospatiale/Westland SA 341G Gazelle, YU-HEW
No & Type of Engines:	1 Turbomeca Astazou IIIA turboshaft engine
Year of Manufacture:	1977
Date & Time (UTC):	26 January 2008 at 1625 hrs
Location:	Rudding Park, Harrogate, North Yorkshire
Type of Flight:	Private
Persons on Board:	Crew - 1 Passengers - 1
Injuries:	Crew - 1 (Fatal) Passengers - 1 (Fatal)
Nature of Damage:	Aircraft destroyed
Commander's Licence:	Private Pilot's Licence (Helicopters)
Commander's Age:	43 years
Commander's Flying Experience:	853 hours (of which 56 were recorded as helicopter and 46 recorded on type - see text) Last 90 days - 46 hours Last 28 days - 1.5 hours (approx)
Information Source:	AAIB Field Investigation

Synopsis

The pilot, who was experienced in fixed-wing aircraft but newly-qualified in helicopters, was undertaking a helicopter flight with a passenger, in gusty wind conditions. He was seen flying slowly, at a low level, near a chalet he owned in the grounds of an hotel when the aircraft was seen to spin around, before pitching up and falling to the ground, fatally injuring the two occupants.

It is considered that the pilot lost control of the helicopter whilst flying at low forward airspeed in strong and gusty wind conditions. The investigation revealed inconsistencies, and probable deficiencies, in the training of the pilot and inconsistencies, and possible deficiencies, in his subsequent PPL(H) Skills Test.

Deficiencies in the aircraft's maintenance were also identified, although these are not considered causal or contributory to the accident.

Five Safety Recommendations are made.

Background

On being purchased by the new owner, the aircraft involved in this accident, YU-HEW[1] (Figure 1), had been flown to Stapleford Airfield, Essex, in December 2007 to have its Certificate of Airworthiness renewed. The work was completed in January 2008 and the

Footnote

[1] A Serbian-registered aircraft.

(Photo courtesy of John Allan)

Figure 1

SA 341G Gazelle YU-HEW

owner, who had recently gained his PPL(H), planned to drive from his home in West Yorkshire to Stapleford, a distance of some 200 miles, to collect the aircraft. He then intended to fly it to an hotel near Harrogate where he was to be spending the weekend with family members.

On the morning of the accident the owner of YU-HEW contacted the owner of the training organisation he had used to gain his licence. Due to the forecast weather conditions and the length of the journeys involved, the owner of the training organisation offered to fly him to Stapleford in another helicopter and to provide an experienced pilot to accompany him on the return flight to the hotel. The owner of YU-HEW accepted this offer and on the morning of the accident was flown, along with the experienced pilot, in a Gazelle (registration HA-LFQ[2]) to Stapleford to collect YU-HEW. Accompanied by the experienced pilot, he then flew YU-HEW to a private landing site in East Ardsley, near Harrogate, to collect his wife before flying on to the hotel. HA-LFQ had been flown back from Stapleford with YU-HEW and both aircraft landed and shut down at the hotel at about 1535 hrs, the entire flight having taken 1 hour and 19 minutes. The owner of YU-HEW then went to check into the hotel with his wife whilst the experienced pilot, who had accompanied him on the flight, departed as a passenger in HA-LFQ at about 1546 hrs, when it returned to its base at Breighton.

The owner of YU-HEW had a chalet in the hotel grounds where he was expecting to meet with the family members after his arrival. After checking in at the hotel reception he contacted them by 'phone to discover that they had left for the afternoon to go to a shopping centre in Knaresborough, about 3 nm from the hotel.

History of the flight

At 1617 hrs the owner of YU-HEW took off from the hotel grounds in his aircraft, accompanied by his wife. The owner's intentions are unknown, but after departure the aircraft was seen by witnesses flying towards Knaresborough. This is supported by radar and GPS data which record that on reaching Knaresborough the aircraft circled the area of the shopping centre three times at heights recorded as varying between 548 feet and 1,212 feet agl, before heading back towards the hotel. Some witnesses described seeing the aircraft gaining and losing height and its tail moving from side to side, so that its flight path appeared at times erratic.

Radar and GPS data show the aircraft's return to the hotel was from the north and that it flew along the hotel grounds' south-west boundary at between 539 and 278 feet agl, the latter being the last height recorded by the aircraft's GPS unit, on a track of 127°T. In this direction the path flown would have taken the aircraft close to some chalets situated in the hotel grounds, including the one owned by the pilot. Witness descriptions of the aircraft's final moments varied, but

Footnote

[2] A Hungarian-registered aircraft

they generally described the aircraft "appearing to hover" in the vicinity of the chalets, just above the tops of some nearby trees. The aircraft then seemed to turn rapidly about its vertical axis, with descriptions varying from half a rotation to several rotations. There was no clear indication of the direction of rotation. The aircraft was then seen to pitch nose up and drop to the ground tail first, the impact fatally injuring both occupants.

Wreckage site

The wreckage was located in an area of deciduous trees 600 m south-west of the helicopter landing site from which it had taken off. The aircraft was significantly disrupted and was situated at the foot of a ring of six trees that were approximately 30 m high, the trunks of which formed a circle approximately 10 m in diameter. The engine was still inside its pod, although it had become detached from the fuselage. The jet pipe in the Gazelle faces rearward, and it appeared to have been damaged from the rear.

The vertical tail fin had become detached from the fuselage. Its trailing edge had been damaged by a load applied from the rear and a square-shaped 'cut out' had been made from right to left in the fin leading edge. The damage was consistent with the trailing edge of the vertical fin striking a branch, thus causing the fin to fail where it was attached to the fuselage, and the leading edge of the fin to enter the disk of the rotating main rotor blades, thus making the 'cut-out'. There were clear signs of rotation of the fenestron blades within the duct.

The tail rotor control quadrant (in several pieces), the quadrant support and the tip of a main rotor blade (mass 2.3 kg) were all found in a narrow wreckage path within 5° of a line north-east radially from the main wreckage. The rotor blade tip and the quadrant support were both located over 300 m from the main wreckage. There were many chordwise witness marks on the blade tip and these were consistent with the blade tip having struck something metallic; there were further witness marks from the main rotor blades on the horizontal tail surfaces, which are below the quadrant for the tail rotor control.

There were many freshly-broken branches on the ground, some up to 10 cm thick, and evidence of newly-broken branches in the trees above. On several of the fresh fracture surfaces of the broken branches there were green marks, and these were consistent with having been made by the main rotor blades, which were painted green. The location of the broken branches in the trees was assessed both from the ground and from photographs taken during an aerial survey conducted by the Police's North East Air Support Unit, and all the broken branches were on the inner side of the ring of six trees, with no evidence of broken branches on the outside of this ring. Thus, there was very strong evidence that the helicopter had struck the tops of these trees before falling almost vertically to the ground inside the ring of trees.

The fuselage had rolled over and was lying on its upper right side and facing due east. An indeterminate, but significant, quantity of fuel had leaked from the two fuel tanks, and over 60 litres were subsequently recovered from the tanks at the wreckage site.

Recorded information

Radar data from the Claxby radar head were available for YU-HEW during the accident flight, starting at 16:18:13 hrs and ending at 16:25:57 hrs, with returns approximately eight seconds apart. No altitude information was available. The aircraft was, however, equipped with a Bendix King KMD 150 GPS that

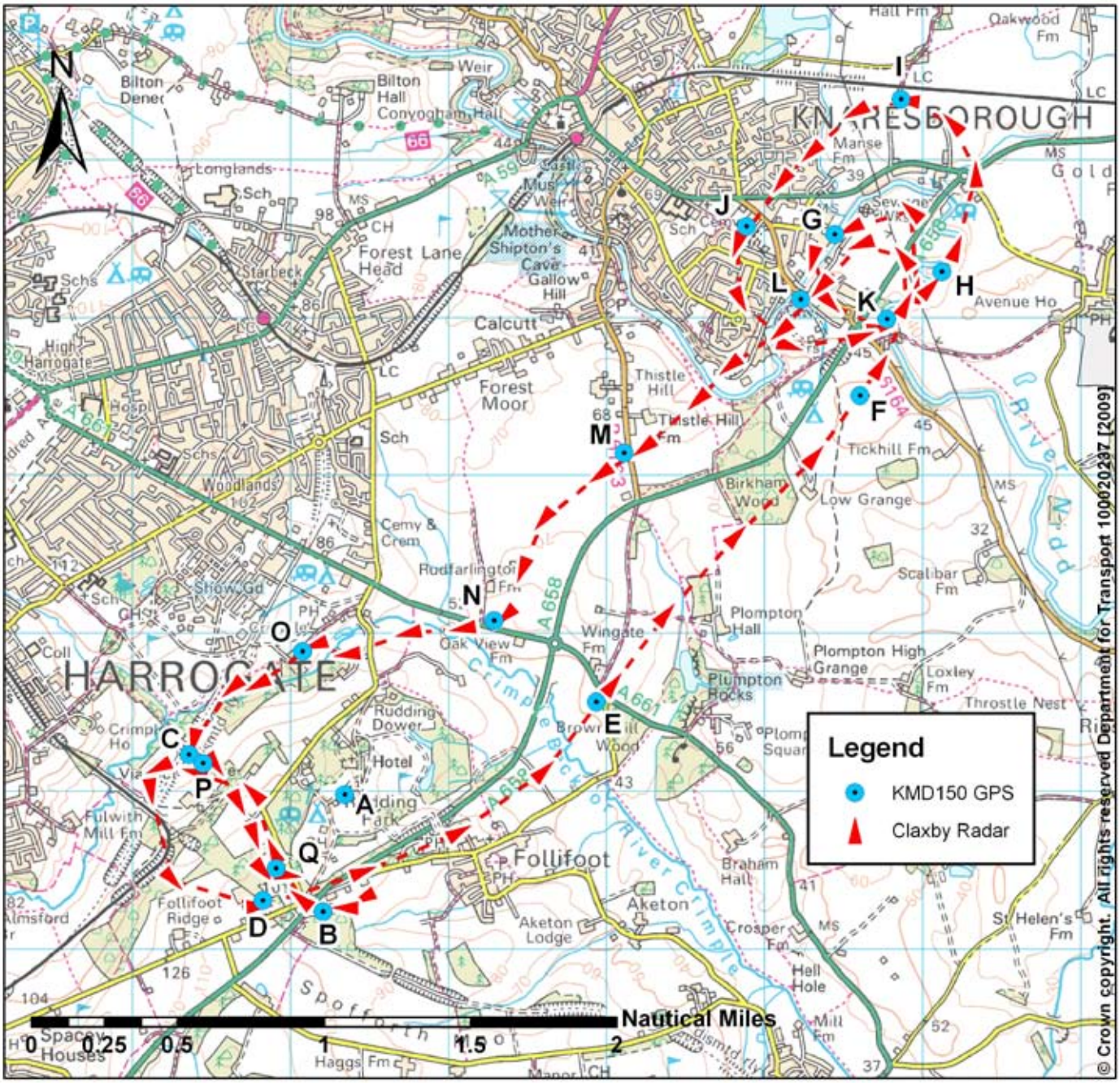

Figure 2

Radar and GPS tracks

recorded position, ground speed and ground track angle every 30 seconds, giving 17 points starting 16:17:54 hrs (just after takeoff) and ending 16:25:54 hrs. The radar track (in red) and GPS points (in blue and labelled A-Q) are illustrated in Figure 2.

The time, ground speed and height above ground level for each of the GPS logged points are given in Table 1.

An expanded view of the start and end of the accident-flight track is given at Figure 3.

Point	Time (UTC)	Ground Speed (knots)	Height (feet agl)	Track (degrees true)
A	16:17:54	22	66	193
B	16:18:24	68	456	260
C	16:18:54	82	768	289
D	16:19:24	154	914	93
E	16:19:54	158	877	39
F	16:20:24	167	572	39
G	16:20:54	80	702	233
H	16:21:24	106	548	40
I	16:21:54	82	673	275
J	16:22:24	97	754	213
K	16:22:54	92	1212	52
L	16:23:24	96	1179	221
M	16:23:54	95	840	236
N	16:24:24	86	567	221
O	16:24;54	72	440	256
P	16:25:24	68	539	170
Q	16:25:54	38	278	127

Table 1

Logged GPS data for points in Figures 2 & 3

Aircraft information - general

The Gazelle is a single-engine helicopter (Figure 1). YU-HEW's fuselage was painted black and the main rotor blades painted green. YU-HEW featured a stretched fuselage and did not have a Stability Augmentation System (SAS) fitted. The diameter of the Gazelle main rotor is 10.5 m and it comprises three blades, which rotate clockwise when viewed from above. In the case of an abnormal and extreme downward flapping motion, the blades would touch the vertical fin just above the junction between the fin and the rear fuselage.

The engine is mounted in a pod aft of the main rotor gear box and has a distinctive rearward-facing exhaust pipe.

The Gazelle has a fenestron, or 'fantail', which is a shrouded fan, enclosed inside the vertical tail fin. Eurocopter's Service Letter 1673-67-04, issued in February 2005, describes how, when transitioning from cruise to hover flight, a larger yaw pedal control input is required for a fenestron-tailed helicopter compared to a conventional tail rotor. Also noted in this Service Letter is that, if the wind is coming from the left or from behind, it will increase the rotation speed of the helicopter and hence more right rudder pedal is required to counteract this effect.

Engineering investigation - mechanical

The control runs for collective, cyclic, tail rotor, throttle and rotor brake were all checked and no evidence of a pre-accident defect, foul or discontinuity was found. A

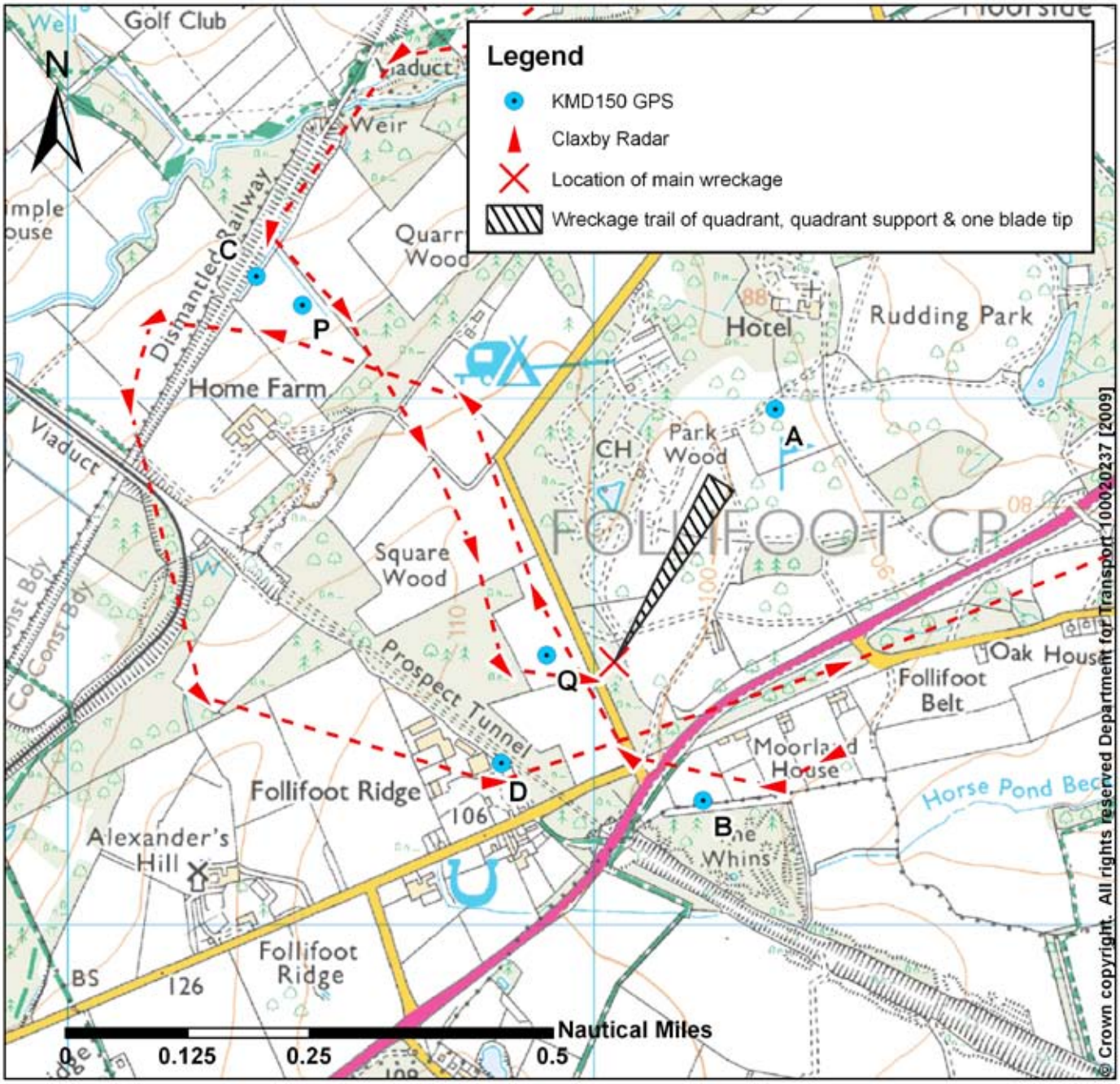

Figure 3

Expanded view of flight track, with wreckage locations

sample of fuel taken from the ruptured supplementary tank at the wreckage site was analysed at a fuels laboratory and was found to be fit for use as Jet A-1. The pieces of the tail rotor control quadrant and its support, which were found a significant distance from the main wreckage, were inspected by a metallurgist and the fracture surfaces were found consistent with overload from the impact of a main rotor blade, with no evidence of a pre-impact failure.

The engine was stripped at the manufacturer's facility under AAIB supervision and, whilst there was nothing found that was judged causal or contributory to the accident, the following observations were made:

a) a crack in the combustion mixing chamber was present. This was subsequently analysed by a specialist forensic engineer using a scanning electron microscope (SEM). Whilst fatigue striations were present it was "not possible to determine the age of the crack"

b) there was corrosion on the axial compressor blades

c) there was erosion on the first stage diffuser

It is not clear whether the items above were present when the engine was last overhauled. The engine manufacturer considered that the combustor crack and the corrosion could have developed in the 150 hours and 25 months since overhaul, however an operating regime in which this high level of diffuser erosion could occur was unlikely.

The fuel control unit (FCU) was functionally tested and this did not reveal any discrepancy that could have contributed to the accident.

Engineering investigation - maintenance documents

This SA 341G, a civilian version of the Gazelle, was manufactured in France in 1977. It was transferred to the Serbian register in January 2006 and prior to that it had been on both the French and UK registers. The certificate of airworthiness for the aircraft had been issued by the Serbian Civil Aviation Directorate (CAD) on 25 January 2008 (the day before the accident). At the time of the accident it had completed 2,868 flying hours.

The engine was a Turbomeca Astazou IIIA and was manufactured in 1990. It was overhauled by the manufacturer in 1994. In 2003 it was returned to the manufacturer for an overhaul quotation, was subsequently returned to the owner without any maintenance being undertaken and was declared '*unserviceable*' in the logbook. It was then overhauled by an organisation in Serbia, and an EASA Form 1[3] was issued on 16 December 2005. At the time of the accident the engine had completed 151 hours since overhaul.

The Serbian CAD confirmed in a letter to the AAIB that:

> *'at the time of issuing the Licence to Use on 16.12.2005, the maintenance organisation was not authorised by the CAD for this type of engine, but only for the Astazou IIIB model.'*

The Astazou IIIB is a military variant of the Astazou engine.

The EASA was contacted and confirmed that there were, at that time, no organisations in Serbia approved by EASA to undertake EASA Part 145 maintenance on either the Astazou engine or the Gazelle aircraft.

An attempt was made by the AAIB to assess whether there were other Gazelle aircraft maintained in the UK on the Serbian register that had engines that had been overhauled by an organisation not approved for the type of engine. Four Serbian-registered Gazelle aircraft were found, with engines overhauled in 2005 by an organisation in Serbia (and with EASA Form 1s issued) that was not approved for the type of Astazou engine. One aircraft was fitted with an Astazou IIIA and three were fitted with Asatzou XIVH.

In *'CAP 393 - The Air Navigation Order'* (ANO), Part 3, Article 8(1) states that:

Footnote

[3] An EASA Form 1 is a certificate for the release to service of an aircraft part.

'...an aircraft shall not fly unless there is in force in respect thereof a certificate of airworthiness duly issued or rendered valid under the law of the country in which the aircraft is registered or the State of the operator, and any conditions subject to which the certificate was issued or rendered are complied with.'

Since the EASA Form 1 appears to have been issued by an organisation that was not approved to do so, the Certificate of Airworthiness may have been invalid and hence the operation of this aircraft, and the other four Serbian-registered Gazelles based in the UK, may have contravened the ANO.

Weather

Aftercasts of the weather conditions in the area of the accident site were obtained from the Met Office:

Synoptic situation - At 1200 hrs there was a warm front lying northwest to southeast over Yorkshire, moving northeast to lie along the east coast by 1800 hrs. The pressure pattern was significant due to its generation of a strong west to west-northwesterly gradient on the northern flank of a high pressure area that covered France and the southwest approaches. A subsidence inversion associated with this high pressure would have generated mountain wave conditions over the area of the accident site.

Actual conditions - Whilst cloudy, it is most likely that the conditions were dry with no significant weather at the time of the accident. Surface visibility is likely to have been of the order 15 to 27 km below cloud, although scattered cloud may have covered hills above 1,600 ft amsl, giving hill fog and visibility of less than 200 metres. There was possibly scattered stratocumulus cloud with a base of 1,300 ft above the accident site. Cloud may have covered high ground in the distance.

Wind conditions - The Met Office aftercast indicated turbulent conditions, with winds at 500 feet agl of 270°/15-44 kts and surface winds 260°/20-25 kts, gusting 30 to 35 kts and occasional 10 kts in lulls. Analysis of the synoptic situation indicated that the conditions were conducive to mountain wave activity, and there was evidence from satellite imagery that such activity existed.

Met Office modelling did not provide explicit indications of the magnitude of the turbulence, but their empirical considerations of the flow and terrain suggested that moderate, occasionally severe, low level turbulence was likely in the area.

The pilot who had flown in YU-HEW with the owner, from Stapleford to the hotel, reported that, whilst it had been windy, it had not appeared particularly so after landing at the hotel when he was walking around the aircraft. He believed this may have been due to the shelter afforded the landing site by trees in the hotel grounds. He further commented that he had not expected the pilot to go flying again that day and would have advised him against it under the prevailing weather conditions.

The pilot of the police helicopter which attended the scene about 50 minutes after the accident estimated the wind at about 700 ft agl to be approximately 285° at 30 kt, gusting 40 kt.

Fuel and loading

The aircraft had its main tank filled prior to leaving Stapleford, which would have been sufficient for both the flight to the hotel and the subsequent flight leading to

the accident. Calculation by the manufacturer showed that the aircraft was operating within its weight and centre of gravity limits at the time of the accident.

Pathology

The pilot held a valid JAA Class II medical certificate at the time of the accident and there was no past medical history or evidence from the post-mortem of natural disease which could have caused or contributed to the accident. The post-mortem revealed injuries consistent with the pilot having the collective lever in his hand at the point of impact, which implies he was not incapacitated and was actively attempting to fly the aircraft. Toxicological examination revealed no drugs or alcohol in the pilot's blood.

The nature of the injuries sustained by both the pilot and passenger indicated the accident was non- survivable. It is unlikely that the provision of additional or alternative safety equipment would have altered the fatal outcome.

UK flight training regime

In the UK, three classifications of training organisation exist under JAR (Joint Aviation Requirements) for rotary-wing aircraft:

- Flight Training Organisation (FTO) - conducts training of existing licence holders and integrated commercial licence courses

- Type Rating Training Organisation (TRTO) - conducts training for the issue of type ratings only to licence holders

- Registered Training Facility (RTF) - conducts training for the issue of private pilot licences and night flying qualifications.

In order to qualify as either an FTO or TRTO, organisations must seek approval from the CAA. They must have a training and an operations manual and pass an initial inspection as part of the approval process. If successful, approval is granted for an initial period of one year after which another inspection is carried out. If passed, the approval can be renewed for up to a further three years. Each organisation is allocated a CAA inspector who carries out an inspection at least once a year.

To become an RTF no approval needs to be granted; organisations are only required to register with the CAA and certify that they comply with certain required conditions. No inspections are carried out and no training or operations manuals are required. Registration remains valid until either the CAA is informed that PPL training is to cease or the CAA establishes that training is not being carried out safely or is not in compliance with JAR-FCL. In these instances the registration may be revoked.

An FTO or TRTO which provides training for the attainment of private pilot licences would also need to register as an RTF. Inspections undertaken as part of being an approved organisation would not extend to those elements covered by being an RTF. As a result, private pilot training conducted by any category of training organisation is not subject to routine inspections, although the CAA has the authority to conduct such inspections should they believe there is cause to do so. In reality this would only be done as the result of information being received by the CAA that raises sufficient concern about an organisation to warrant possible intervention. At the time of this report there were over 500 RTF organisations in existence, although it is not known how many are active. In the year to February 2009 eight such inspections being made by the CAA.

As a result of this accident the CAA attempted to audit the RTF involved, but were unable to do so as the owner surrendered the registration.

Flight training - JAR-FCL PPL(H) training syllabus

JAR-FCL 2 Subpart C lists a series of exercises, numbered 1 to 28 which form the syllabus for training for the PPL(H), exercise 28 being for night flying. Exercises 15, 23, 25, and 26 are listed below:

Exercise 15

Hover out of ground effect (OGE), vortex ring

- establishing hover OGE
- drift/height/power control
- demonstration of incipient stage of vortex ring, recognition and recovery (from a safe altitude)
- loss of tail rotor effectiveness

Exercise 23

Advanced take-off, landings, transitions

- landing and take off out of wind (performance reduction)
- ground effect, transitional lift and directional stability variation when out of wind
- downwind transitions
- vertical take off over obstacles
- reconnaissance of landing site
- running landing
- zero speed landing
- cross wind and downwind landings
- steep approach
- go-around

Exercise 25

Limited power

- take-off power check
- vertical take-off over obstacles
- in flight power check
- running landing
- zero speed landing
- approach to low hover
- approach to hover
- approach to hover OGE
- steep approach go-around

Exercise 26

Confined areas

- landing capability, performance assessment
- locating landing site, assessing wind speed/ direction
- reconnaissance of landing site
- select markers
- select direction and type of approach
- circuit
- approach to committed point and go-around
- approach
- clearing turn
- landing
- power check, performance assessment in and out of ground effect
- normal take-off to best angle of climb speed
- vertical take-off from hover

Flight training - aircraft types approved for training

JAR regulations limit the size of helicopter to be used for ab initio training to those with a maximum of four seats. Exemption from this rule can be applied for under exceptional circumstances.

The helicopter used by the pilot for his training, HA-LFM, had five seats but dispensation was sought, and granted, from the CAA for it to be used. At the time of the accident the CAA considered that owning an helicopter with more than four seats was sufficient justification to allow it to be used for ab initio training of that owner. The CAA considered this justified as it would allow the owner significantly more instructional time on the helicopter than if the licence was gained on a different type followed by conversion onto type via a type rating course.

Flight training - RTF and Operating Permit applications

The pilot had decided that the helicopter type he wished to buy was a Gazelle. In the course of attempting to find a suitable aircraft he had been put in contact with an instructor, who in turn put him in contact with the owner of several Gazelle helicopters based at Breighton Airfield in Yorkshire. It was reported that this resulted in the pilot buying a part share, together with two other unqualified pilots, in one of these Gazelles, a Hungarian-registered aircraft HA-LFM. Investigation has failed to reveal evidence that any of these three people actually purchased a share in the aircraft, which remained registered solely in the name of the original owner.

An application was made by the owner of HA-LFM, dated 27 August 2007 and received by the CAA on 5 September 2007, to set up an RTF in order to train the three individuals who, it was stated, had purchased a share in the aircraft. The RTF was to be registered to the original owner of HA-LFM with the instructor, who had introduced the pilot, registered as the only instructor. It was stated in correspondence supporting the application that the aircraft was maintained to a public transport standard and that the Hungarian authorities would be informed of the intention to use the aircraft for training in the UK in order to ensure their requirements had been met. No evidence has been found of permission being sought from the Hungarian authorities to use HA-LFM for training.

This registration was approved by the CAA on 19 November 2007, dependant on the training organisation seeking the necessary permission from the Department for Transport (DfT) to use a foreign-registered aircraft in the UK for training, as it constituted aerial work. Enquiries confirmed that permission for an Operating Permit from the DfT had been sought concurrently with the RTF application. The DfT rely on the CAA to review aviation-related paperwork as part of their approval process to ensure it complies with required UK aviation regulations. This process is completed by a different department within the CAA from that which deals with RTF applications and was delayed as the applicant originally failed to supply all the necessary information. In addition, the original insurance certificate provided did not provide cover for training and there was no evidence of the named trainee pilots being co-owners. In a subsequent email to the DfT dated 28 September 2007 the owner of HA-LFM stated that of the three pilots in question, one was his spouse and the other two each owned a sixth share. He further stated that:

> *'Training to be from Beverley Airfield on a CAA Registered Training Facility [RTF] with CAA Instructor Capt [A] and CAA Examiner Capt [B].'*

It is believed that the majority of the deceased pilot's instruction was given by 'Capt A'. 'Capt B' was the examiner for the subsequent PPL(H) Skills Test. The owner of HA-LFM, 'Capt A' and 'Capt B' were known to each other professionally, although 'Capt B' later commented that he had not known that he had been mentioned as part of the DfTapplication process.

Pilot's flying experience and training history

Logbook evidence indicates the pilot commenced fixed-wing flying lessons in November 1988, gaining a fixed-wing private pilot's licence on 24 February 1989 and a fixed-wing commercial licence on 4 October 1990, by which time he had logged 771 hours. It is understood that he had intended to become a commercial pilot but went into business instead, there being no further flights logged until February 2007. His records show that he then flew a further 26 hours on fixed-wing aircraft between February and August 2007.

The pilot had expressed a desire to learn to fly a helicopter and to purchase his own. Another logbook held by the pilot records that on 5 July 2007 he started flying lessons on a Schweizer 300 (269C-1) helicopter, undertaking eight lessons between 5 July and 7 August 2007, totalling 10 hours and 18 minutes flying time, with a training organisation based at Sheffield Airport.

There were no flights recorded in the pilot's logbook between 7 August and 19 November 2007, but on 19 November 2007, the day the RTF and DfT Operating Permit for HA-LFM were issued, the logbook records he commenced flying lessons on HA-LFM. It records a number of training flights being flown from Beverley Airfield on ten different days between 19 November and 5 December 2007. The flights were all recorded as being flown on the same aircraft, HA-LFM, and with the same instructor as named in the RTF application, totalling 25 hours dual instruction and 10 hours 6 minutes supervised solo flying. Of the solo time recorded, up to 6 hours 36 minutes was recorded as having been spent on navigation exercises. During this time the pilot also took and passed a theoretical technical exam on the Gazelle.

The pilot's logbook records he undertook a two-hour PPL(H) Skills Test on 12 December 2007 from Beverley Airfield, which he passed, and was issued his PPL (H) on 21 December 2007.

Log book entries made subsequent to the entry recording this Skills Test showed that on the 23 and 24 November 2007 the pilot flew YU-HEW from Stapleford to Aarhus in Denmark and back, in the company of a family member. This was one of the other reported co-owners of HA-LFM, who was also undergoing training with the RTF. They were accompanied on this flight by a qualified Gazelle pilot who held a UK PPL(H) and an FAA helicopter instructor's rating.

The last entry in the pilot's logbook was for a flight on 5 December 2007, this time from Breighton Airfield, with the same instructor who had conducted his PPL training on the Gazelle. The takeoff and landing times indicated the flight took place at night and lasted one hour, although it had been recorded claiming one hour of dual day flying and an additional 42 minutes of dual night flying.

Enquiries into inconsistencies in the pilot's logbook revealed that he had, in fact, commenced flying training on HA-LFM prior to 19 November 2007. The instructor stated there had been delays in getting the RTF issued and so he had begun training with two of the three trainee pilots prior to its issue, although he

was unable to say exactly when that was. It had been decided that, in order to satisfy the requirements of the CAA, none of these training flights would be logged, but instead entries would be made in the pilot's logbook indicating that all the training flights post-dated the granting of the RTF. The instructor was not able to produce training records or other supporting evidence to show which flights had actually been conducted by the pilot fatally injured in the accident. In addition, the owner of HA-LFM stated that there were no technical records kept for flights undertaken by the aircraft that might have provided a record of the flights undertaken. The only corroborating evidence available for any of the training flights logged by the pilot on HA-LFM was the cross-country flight certificate for a flight logged on the 29 November 2007.

The instructor, whilst unable to provide supporting evidence, stated that the pilot had nevertheless completed all the necessary flying training. He also stated that the pilot had completed all the ground school training required and had passed his technical exam with a mark of 100%. This ground school training had also included a brief on the effects of a loss of tail rotor effectiveness although there were no questions on this in the exam.

A document subsequently provided by a member of the pilot's family was presented as an apparent record of the pilot's actual flying hours. The first flight date recorded on this document was 20 August 2007 and the last flight recorded was 12 December 2007. Between these dates the sheets recorded the pilot as having flown 25 hours 24 minutes dual instruction, and 8 hours 36 minutes solo. Of these hours, two hours were flown when undertaking the Skills Test and there is evidence that one hour was undertaken in a rear seat, flying as a passenger, whilst another pilot was receiving training. The document would thus indicate the pilot having undertaken 22 hours and 24 minutes dual training and 8 hours 36 minutes supervised solo flying between the dates recorded.

The pilot's logbook recorded all the training flights as originating from Beverley Airfield, although there was no supporting evidence that this was the case. The aircraft was based at Breighton Airfield and the pilot would not have been able to log the transit time between Breighton and Beverley towards his flying training hours. As the unofficial flight time record maintained by the pilot appears to have recorded the total flight times, rather than just training hours, had the training actually been conducted from Beverley Airfield then it follows that his actual training hours might have been less than the total recorded.

Application requirements for PPL(H) Skills Test

An application was made on 12 December 2007 for the pilot to take the Skills Test in order to gain his PPL(H). This application stated that the pilot had flown a total of 45 hours 18 minutes on helicopters, 10 hours 6 minutes solo and 35 hours 12 minutes dual. The normal required minimum flight time on helicopters to undertake the Skills Test is 45 hours; however, due to his previous experience and licences on fixed-wing aircraft the pilot was only required to undertake 39 hours training. Of this at least 25 hours dual instruction and 10 hours of supervised solo flight time were required to have been completed on one type of helicopter and at least five hours of solo cross-country flying conducted. The form was certified by the RTF's instructor that the pilot had completed the necessary training and that the instructor had checked the pilot's logbook to ensure the entries met the flying experience requirements. The logbook, however, contained no record of exercises 23, 25 and 26 of the syllabus having been flown. When interviewed, the instructor stated these exercises had been completed but, in error, had not been recorded in the logbook.

Conduct of PPL(H) Skills Test

The examiner who conducted the test was a freelance pilot who had originally been trained as an instructor in 1994 whilst serving as a helicopter pilot in the military. As a result he had considerable experience instructing on the Gazelle. He was also an experienced civilian examiner, although the majority of the tests he conducted were licence proficiency checks, this being only the second Skills Test he had undertaken.

During the investigation it became apparent that, on one previous occasion, on 14 September 2007, the examiner had flown with the pilot at Breighton Airfield to demonstrate autorotations. The flight had been undertaken with one of the other pilots being trained under the RTF on HA-LFM, the two pilots flying for approximately one hour each, spending the other hour observing from the rear seat. The examiner stated that he had pointed out that these hours could not be included towards their flight training as the RTF had not been issued. These flights were included in the unofficial record maintained by the pilot.

The pilot's navigation log for the Skills Test showed the flight commencing from Breighton Airfield. The first leg recorded on the log was to Beverley Airfield and the examiner stated that this is where the test element of the flight had commenced The examiner reported it was conducted in good weather conditions with only a light wind and that he was impressed by the standard of the pilot. He passed the pilot on all elements of the test, assessing him as well above average ability. The examiner stated that the pilot had, however, allowed the aircraft to weathercock during a spot turn, requiring him to repeat the exercise. The pilot had, however, been able to control the weathercocking without intervention and had repeated the exercise to a satisfactorary standard. The examiner stated that the pilot was 'level headed and capable' and he considered that he had flown to the same standard expected of a pilot undergoing a commercial Skills Test.

Subsequent analysis of radar data identified the Skills Test flight and indicated discrepancies between the route and the timings of the test and those recorded on the examination paperwork.

Previous occurrences

The AAIB has investigated seven previous occurrences to civil Gazelle helicopters involving loss of yaw control, the last being on 8 May 2005 (EW/C2005/05/01). A recurring factor is a lack of pilot experience.

The Gazelle tail fin is considerably larger than most non-fenestron-equipped helicopters, making the execution of a spot turn a challenge due to the weathercock effect in windy conditions. The Gazelle was used extensively by the UK armed services as a training aircraft and incidents where there had been an apparent loss of yaw control led to research by both the UK military and Eurocopter into their cause and, in particular, whether a condition termed 'fenestron stall' existed. Although the existence of fenestron stall was not established, the research led to the provision of advice to pilots on how to avoid the phenomenon of loss of yaw control and how to deal with it should it occur.

The CAA published an amendment to the Gazelle flight manual in 1992 titled 'Uncontrolled Yaw Breakaway'. As previously stated, Eurocopter produced Service Letter 1518-67-01 dated 26 April 2001, and later Service Letter 1673-67-04 dated 4 February 2005 (Annex A) regarding yaw control under various flight conditions. The requirement for instructors to include training on 'loss of tail rotor effectiveness' (LTE) for all types was

included in a CAA Helicopter TrainingCom of 1/2003, issued to all instructors and Training Organisations after a previous AAIB recommendation.

Analysis - engineering

Damage to the trees, the compressive damage to the rear of the helicopter, and the damage to the engine jet pipe, demonstrated that the aircraft struck the trees tail-first in an approximately vertical descent. The geometry of this helicopter type is such that the observed damage to the fin leading edge could only have occurred after the fin had detached from the fuselage and moved forward, probably as a result of striking the fin trailing edge against part of a tree as the aircraft fell backwards.

Given that the fin was forced forwards into the arc of the main rotor blades, this would have caused the tail rotor drive shaft to fail and the cable controls for the tail rotor and the tail rotor quadrant to be disrupted. There were witness marks from the main rotor blades on the horizontal tail surfaces, which are below the quadrant for the tail rotor control. Therefore, it would have been the main rotor blade disc which propelled both a blade tip and the tail rotor quadrant support over 300 m from the main wreckage. As the pieces of tail rotor quadrant and the quadrant support were located on an almost straight line over 300 m long, starting at the main wreckage, it is highly probable that the 'cut out' in the fin leading edge, and the damage to the tail rotor quadrant and support, both occurred very close to the main wreckage site, almost simultaneously, and probably when the aircraft was orientated nose vertically upwards. Subsequent analysis by a metallurgist confirmed that the tail rotor quadrant and support failed in overload, and that there was no evidence of an in-flight failure. This indicates high energy in the rotor system at the start of the accident sequence.

The engine strip showed no indication of a mechanical failure, and there was no evidence that any of the flight controls were operating in an abnormal way. The sample of fuel taken from the ruptured collector tank was analysed and assessed as being fit for purpose. In summary, there was no indication of any technical causal or contributory factor in the accident.

Analysis - operations

From the evidence it appears that the pilot, who had limited helicopter experience, was attempting to operate in weather conditions which more experienced pilots might have chosen to avoid. Indeed, part of the reasoning for being accompanied on the flight from Stapleford by another, more experienced pilot included the forecast weather conditions. His colleagues stated that they had been surprised by the pilot's decision to undertake the flight from the hotel and the conditions were such that, had they known his intentions, they would have tried to dissuade him from doing so. They considered it possible that, as the helicopter had been parked in an area affording some protection from the wind, this had given the pilot false confidence about the prevailing weather conditions. Despite this, the pilot had only recently landed at the hotel and so would have been aware of the wind and would certainly have become aware of the deteriorating conditions once airborne again. It is possible that the enthusiasm of having just taken delivery of the aircraft overcame any concerns about the weather. It is also possible that the same enthusiasm led to the low-level nature of the flight around the shopping centre where family members were believed to be present.

The recorded data (radar and GPS) give reasonable indications both of track and ground speed and these correspond well to the witness observations, although they do not give an accurate indication of either the

aircraft's airspeed or heading. It is considered likely that, at the time of the accident, the pilot was trying to observe his chalet in the grounds of the hotel. In doing so, however, he had placed the helicopter in a precarious position with a strong blustery wind adversely affecting the controllability of the aircraft whilst flying at a low forward airspeed.

Inconsistencies in evidence provided during the investigation raised concerns about the level of training received by the pilot. The instructor's stated reason for commencing training prior to receiving approval for the RTF was the CAA's apparent delay in registering the training organisation. There was, however, a similar delay in receiving the relevant permission from the DfT which was due in part to the failure to provide the DfT with the required documentation. The instructor was aware that training conducted prior to the RTF being registered could not be counted towards the issue of the pilot's licence and this led to the false entries in the logbook. This in itself should not have affected the standard or amount of training received by the pilot. The absence, however, of documents that might be expected to exist, principally the aircraft technical log, instructor's logbook and training notes, raised further concern about the standard of operation of the RTF and removed the opportunity to confirm which flights had actually been undertaken. The evidence that does exist indicates that the pilot did not complete sufficient training hours and it is unlikely that the full syllabus was completed adequately in this time. Inconsistencies were also identified concerning the Skills Test the pilot undertook and, as a result, the investigation could not reliably ascertain the pilot's flying ability at the time of the accident.

Conclusion

In the absence of any significant technical defect, it is considered that the pilot lost control of the helicopter in yaw due to the strength, direction and gusty nature of the wind acting on the aircraft whilst flying at low forward airspeed. It is likely that in the attempt to recover the situation the pilot also lost control in pitch, causing the helicopter to pitch up severely before falling into the trees and impacting the ground.

Because of the lack of detailed recorded flight data and the fact the pilot died in the accident, it has not been possible to define causal factors beyond the pilot's loss of control of the helicopter. However, it is considered that the main contributing factors to this accident were the pilot's lack of experience and probable inadequacies in his training.

Deficiencies in the aircraft's maintenance were also apparent, although these are not considered causal or contributory to the accident.

Safety Recommendations

Whilst no technical cause for the accident was evident, the engine was found to have been overhauled by an organisation that was not approved for the engine type. Four further UK-maintained Gazelles were found in a similar situation. Therefore the following Safety Recommendations are made:

Safety Recommendation 2009-084

It is recommended that the Serbian Civil Aviation Department review its oversight and audit system to ensure that aviation maintenance organisations in Serbia release to service only items for which they have the correct approvals.

Safety Recommendation 2009-085

It is recommended that the Civil Aviation Authority conduct an audit of Serbian-registered aircraft in the UK to ensure that they meet the requirements of the Air Navigation Order.

The current system of oversight, under JAR-FCL, does not require oversight of RTF organisations. Therefore the CAA does not carry out routine audit of these organisations but only intervenes when a potential problem has already been highlighted to the CAA. It would be more appropriate to carry out proactive inspections to ensure standards are being maintained: at the time of the investigation it was uncertain how many of the RTFs were active. This is important as an RTF is likely to be the first contact for those new to aviation, who may have little understanding of what standards to expect.

Safety Recommendation 2009-086

It is recommended that the Civil Aviation Authority introduce periodic audits of Registered Training Facility (RTF) organisations to ensure appropriate private pilot training standards are being met at the current time and with the introduction of EASA FCL regulation.

The examiner was known to the instructor and had been included in paperwork supporting the setting up of the RTF. It is also known that he had flown with the pilot on at least one occasion prior to his Skills Test. The current system, whereby examiners are selected, and paid for, by those being tested, creates the potential for a conflict of interest and examiners for such tests should be allocated by the CAA.

Safety Recommendation 2009-087

It is recommended that the Civil Aviation Authority allocate examiners for the conduct of PPL Skills Tests.

Loss of tail rotor effectiveness currently forms part of the PPL(H) training syllabus; this is difficult to demonstrate in the air and thus relies upon theoretical briefing in the classroom. Some helicopter types, including the Gazelle, are considered particularly vulnerable to this phenomenon and this theoretical knowledge should, reasonably, be tested in the ground school theory exam. Therefore,

Safety Recommendation 2009-088

It is recommended that the Civil Aviation Authority review the training requirements for 'loss of tail rotor effectiveness' and ensure it is covered in written exam papers.