BEA
Bureau d'Enquêtes et d'Analyses
pour la sécurité de l'aviation civile

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SAFETY INVESTIGATION REPORT

Serious incident to the Beechcraft C90A "King Air" registered **F-HHAM** on Monday 23 May 2022 on approach to Paris - Le Bourget airport

Time	Around 15:20[1]
Operator	Private
Type of flight	Own-account transport
Persons on board	Pilot and one passenger
Consequences and damage	None
This is a courtesy translation by the BEA of the Final Report on the Safety Investigation. As accurate as the translation may be, the original text in French is the work of reference.	

Subtle incapacitation, path deviation on approach, temporary loss of control, proximity with an aeroplane on approach to Paris - Charles de Gaulle airport

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on the CVR[2][3] flight recorder, statements, radio communication recordings, as well as radar data.

The pilot, accompanied by one passenger seated in the rear seat, took off at around 14:30 on a IFR flight plan from Ancenis aerodrome (Loire-Atlantique) bound for Paris-Le Bourget airport.

On arriving in the Paris - Charles de Gaulle (CDG) approach sector, the pilot was radar-vectored on a heading of 073°, at an altitude of 5,000 ft. The pilot then used the AutoPilot (AP) in HDG mode. The controller then asked the pilot to turn left onto a heading of 300° and cleared him for an ILS approach to runway 27 at Paris-Le Bourget airport. The pilot selected a heading of 300° on the AP. Shortly before intercepting the centreline, the aeroplane stopped following the 300° heading by turning right and crossed the centreline on a path roughly north.

The controller immediately ordered the pilot to turn left onto a heading of 180° (see **Figure 2** point ❷), and the crew of an Airbus A320, on approach to runway 27R at CDG and at the same altitude as F-HHAM, to turn right onto a heading of 360°. The pilot of F-HHAM read back the message and turned left. During the manoeuvre, he lost control of the aeroplane, which descended by around 3,000 ft in 15 seconds. The pilot regained control of the aircraft, announced over the radio that there was a problem with the artificial horizon and then climbed back to 5,000 ft.

[1] Except where otherwise indicated, the times in this report are in local time.
[2] The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.
[3] Current regulations do not require this category of aeroplanes to carry recorders. However, F-HHAM was equipped with a CVR.

During the loss of control, the aeroplane came close to a second Airbus A320 established on the approach path to runway 26L at Paris-Charles de Gaulle, initially 1,000 ft below F-HHAM. The crew of the A320 indicated that the TCAS issued a traffic advisory immediately followed by a resolution advisory. The A320, equipped with the AP/FD TCAS mode[4], descended automatically. After a descent of 200 ft, the AP levelled off the aeroplane. The minimum separation estimated by air navigation services was approximately 0.6 NM and 125 ft (point 3). This proximity triggered an alert from the air traffic control's conflict detection system (STCA) for a few seconds.

After moving away to the south of the approach path and after discussions with the controller, the pilot indicated that he was continuing the approach based on the indications of the instruments on the right side. With radar vectoring, the pilot intercepted the centreline of ILS 27 in manual flight, then he flew the final approach and landed without further difficulty.

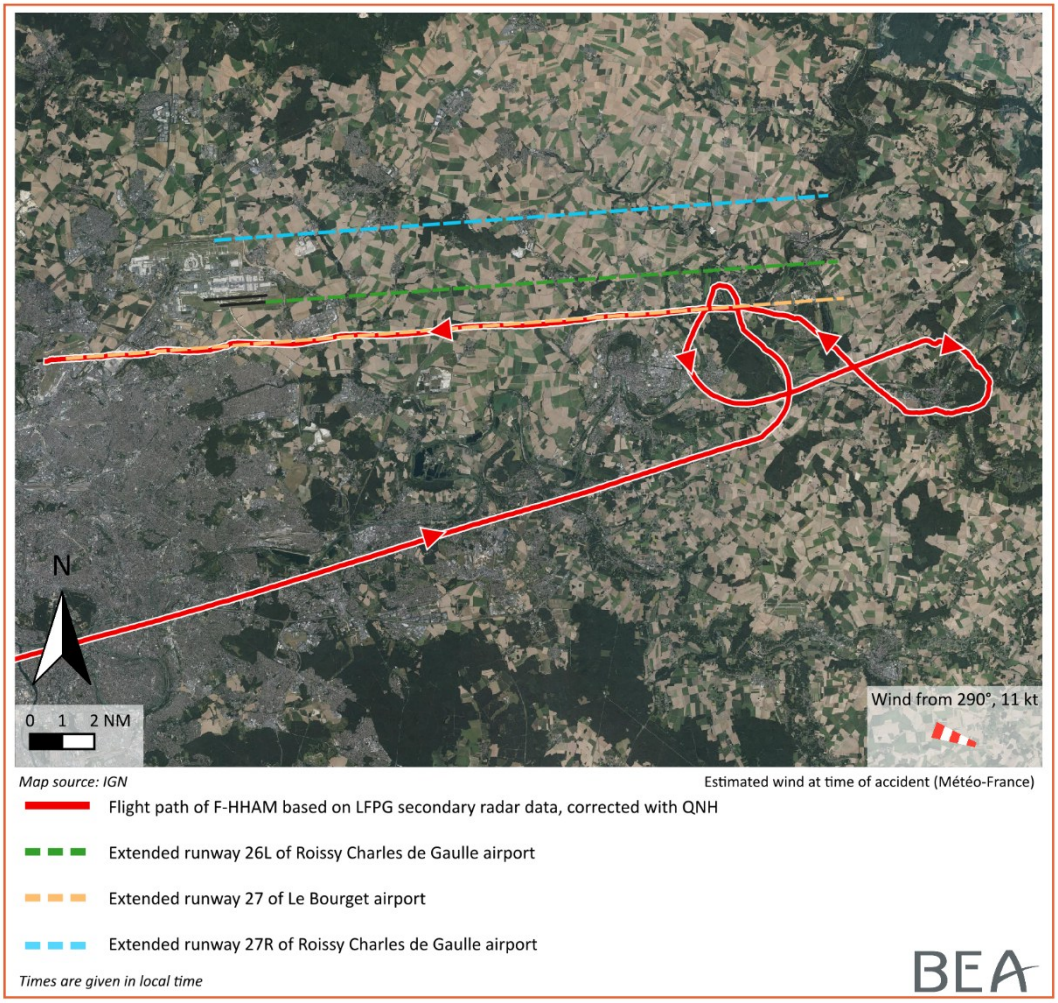

Figure 1: path of F-HHAM based on radar data

[4] TCAS AP/FD is a vertical guidance mode. When the AP is engaged, it controls the aeroplane's vertical speed and adapts it to the resolution proposed by the TCAS.

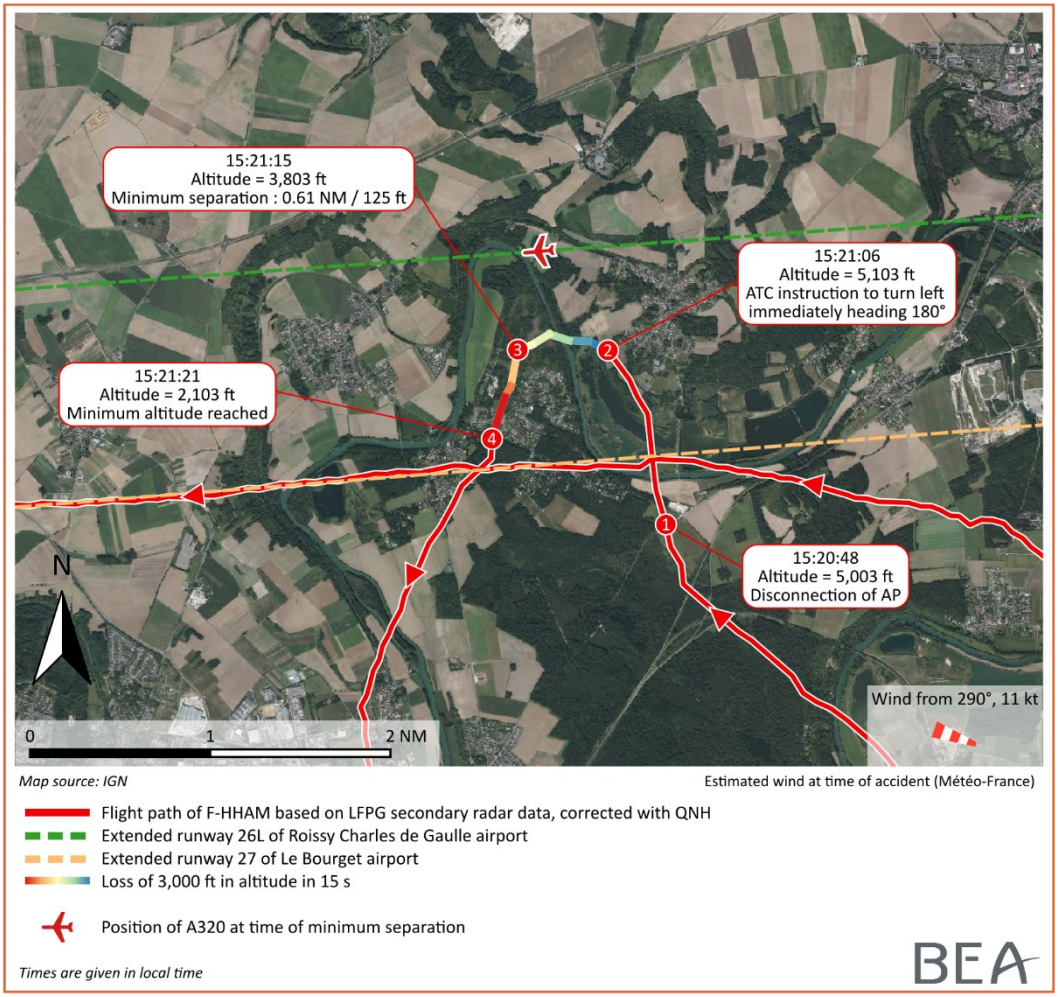

Figure 2: path of F-HHAM based on radar data (in green, the path of the second A320 nearby)

2 ADDITIONAL INFORMATION

2.1 Aircraft information

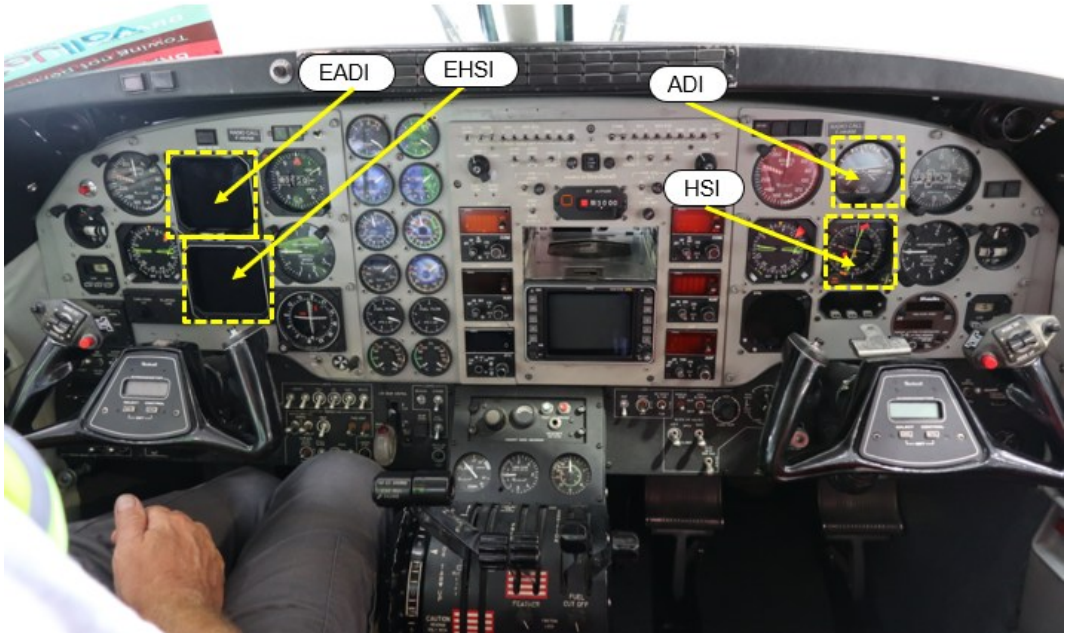

Figure 3: instrument panel of F-HHAM (Source: BEA)

F-HHAM features avionics incorporating digital systems, albeit with a predominantly analogue display. Flight parameters are not recorded.

In particular, the installed avionics equipment includes:

- an Electronic Attitude Director Indicator (EADI) and an Electronic Horizontal Situation Indicator (EHSI). These are digital displays, both installed on the left side. The EADI displays the aircraft's attitude, the AP modes engaged, the flight director and deviations from the selected path. The EHSI acts as a conventional HIS;
- an air artificial horizon, installed on the right side;
- an AP control panel, located on the pedestal;
- a control panel for selecting PA modes, located on the pedestal.

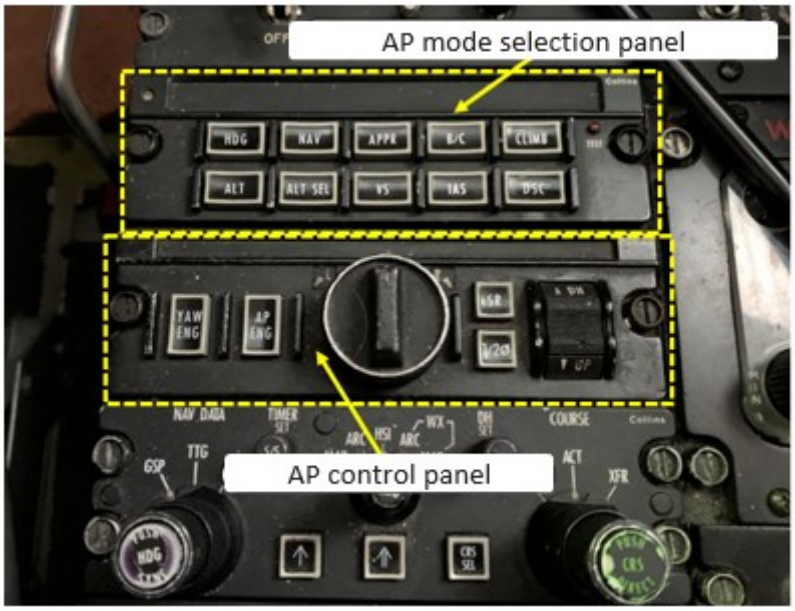

Figure 4: F-HHAM's AP control and mode selection panels (Source: BEA)

2.2 Pilot information and statement

The 59-year-old pilot held a Commercial Pilot Licence - Aeroplanes (CPL(A)) and had logged approximately 11,000 flight hours. He held a BE90 rating and a Cessna C501/551 rating, as well as examiner authorisations (TRE-SP) on these types of aeroplanes. He had logged four flight hours on the day of the event and two flight hours the day before. He specified that he had a lot of experience on BE90s, and that he had already flown F-HHAM several times, on which he had never observed any particular technical problem. His Class 1 medical certificate was valid up to 31 October 2022.

The pilot reported that on the day of the incident, he got up early, had breakfast, before taking a scheduled flight at around 7:30 bound for Montpellier (Hérault). He was then taken by car to the Montpellier - Candillargues aerodrome (Hérault). He then had one hour to prepare a flight bound for Paris - Le Bourget airport onboard F-HHAM. This flight, which lasted one hour and forty minutes, took place without any problems. He specified that he made an ILS approach for runway 07 at Paris - Le Bourget airport with AP engaged.

After a short break, during which he ate some biscuits in the aeroplane, he took off at around 12:50, still in F-HHAM, from Paris - Le Bourget airport bound for Ancenis aerodrome, where he made a visual approach. This flight, which lasted approximately one hour, was also uneventful.

The pilot then took off bound for Paris - Le Bourget airport at around 14:50. During the approach, he was flying in the cloud layer. He had no memory between the time when he was established on a heading of 300° and the loss of control[5]. He could not explain this lack of memory during this flight phase, which requires considerable vigilance, and added that it was as if he was "sleeping".

He explained that he usually armed the APPR mode on reaching the intercept heading. He thought that he saw an unusual indication on his EADI. Then, looking at the artificial horizon on the right side of the instrument panel, he realised that the aeroplane had adopted a very steep bank angle. He then regained control of the aeroplane, relying only on the instruments located on the right side.

[5] The pilot could not remember having read back the controller's instruction to turn immediately onto a heading of 180° when he overran the approach path to Paris - Le Bourget airport.

Once the wings were level, he performed a smooth pull-up manoeuvre. During this manoeuvre, he temporarily regained external visual references.

After regaining control of the aeroplane, he noticed a discrepancy between the horizon indication on the left side and that on the right side, as well as between the EHSI and the HSI. He made the end of the flight manually, relying on the instruments on the right side. He specified that shortly before landing, the indications on the right side and on the left side became consistent with each other again.

Following this incident, concerned about his lack of memory, the pilot consulted a general practitioner on his own initiative. The pilot was prescribed several medical examinations, the results of which he communicated to the BEA. These examinations did not reveal any element that may have contributed to the incident.

2.3 Medical conditions

2.3.1 Medical fitness and capability

From an operational point of view, we can distinguish between fitness and capability. Medical fitness refers to someone's natural or acquired aptitude for performing an activity. It is associated with the idea of a pilot's medical "profile" likely to enable them to fly safely. Once established, this profile can be reassessed as part of regular medical examinations to detect any deterioration.

Capability - implicitly, to perform flying tasks safely - refers to the pilot's ability to make use of this aptitude in preparation for or during a flight. Capability can deteriorate at any time due to the conditions of the flight (e.g. altitude hypoxia, blackout during aerobatic manoeuvres) or due to the occurrence of a health event (e.g. seasonal viral disease leading pilots to question their ability to perform the flight, or a partial incapacitation during the flight).

Fitness is assessed by a specialist in aviation medicine at regular intervals as defined by regulations, whereas capability must be self-assessed by pilots at all times.

2.3.2 Lifestyle and dietary factors

In the absence of a medical explanation for an incapacitation, physiological factors, in particular lifestyle and dietary factors, come to the fore.

Given the time at which the pilot got up and the fact that he did not have a full lunch, it is possible that he had hypoglycaemia, which resulted in a subtle incapacitation. Moreover, in the context of a recently altered sleep pattern due to the flight organisation conditions, cognitive impairments, or even hypovigilance or microsleep, may have occurred. This could explain the pilot's inappropriate reactions or his lack of memory of this part of the flight.

2.4 Meteorological information

The METAR report at 13:30 for Paris - Charles de Gaulle airport indicated the following:

- wind of 11 kt from 290;
- visibility greater than 10 km;
- FEW clouds at 700 ft;
- broken (BKN) cloud masses at 1,500 ft and 2,100 ft.

The pilot said that there were no particular difficulties associated with the weather conditions. In particular, he did not encounter any turbulence.

2.5 Read-out of CVR data

No communication between the pilot and the passenger was heard during the event. By synchronising the audio and radar data, it was possible to determine that the AP disengagement[6] audio alert sounded after the path deviation to the right. The altitude alert then triggered (C-Chord)[7] while the altitude exceeded the selected altitude by 100 ft. During the loss of control, no audio alerts or warnings were triggered.

2.6 Tests and research

Tests on the attitude acquisition system and the AP were carried out in the workshop responsible for maintaining the aeroplane, in the presence of two BEA investigators and in accordance with Maintenance Task 22-10-01 of the Maintenance Manual.

During these tests, the heading displayed on the EHSI was found to be correct and the flux valve slaving system was found to be functional. The AP also performed as expected during all the ground tests, which included using the APPR mode with a cut-off box simulating an ILS signal. Still using the cut-off box on the ground, simulations of an ILS path acquisition (with HDG mode engaged, and APPR mode armed) did not show any anomalies.

Following these various tests, a check flight was carried out with a BEA investigator on board. The operation of the AP and the various avionics systems was nominal during the flight. In particular, an ILS approach to runway 27 at Paris - Le Bourget airport was made with the AP engaged.

2.7 Incident on 2 November 2022

The BEA was notified by the air navigation services of a similar incident to F-HHAM on 2 November 2022 during an approach to Paris - Le Bourget airport. During this incident, the pilot[8] had difficulty intercepting the approach path to runway 27 at Paris-Le Bourget airport. On several occasions, the pilot crossed the approach path without managing to intercept it. The controller regularly provided the pilot with headings and gave him his position in relation to Paris - Le Bourget airport on several occasions. When questioned by the controller, the pilot reported that he had a “GPS flickering problem”. After landing, the pilot announced to the controller that he had experienced AP problems. He recorded an AP cut-off problem on approach in the aeroplane’s Technical Log Book.

[6] It was not possible to determine whether this was a manual (deliberate or accidental) or automatic AP disengagement.

[7] This alert is triggered when a discrepancy is detected between the aeroplane’s altitude and the selected altitude (whether the AP is engaged or not).

[8] Pilot different from the one involved in the incident of 23 May 2022.

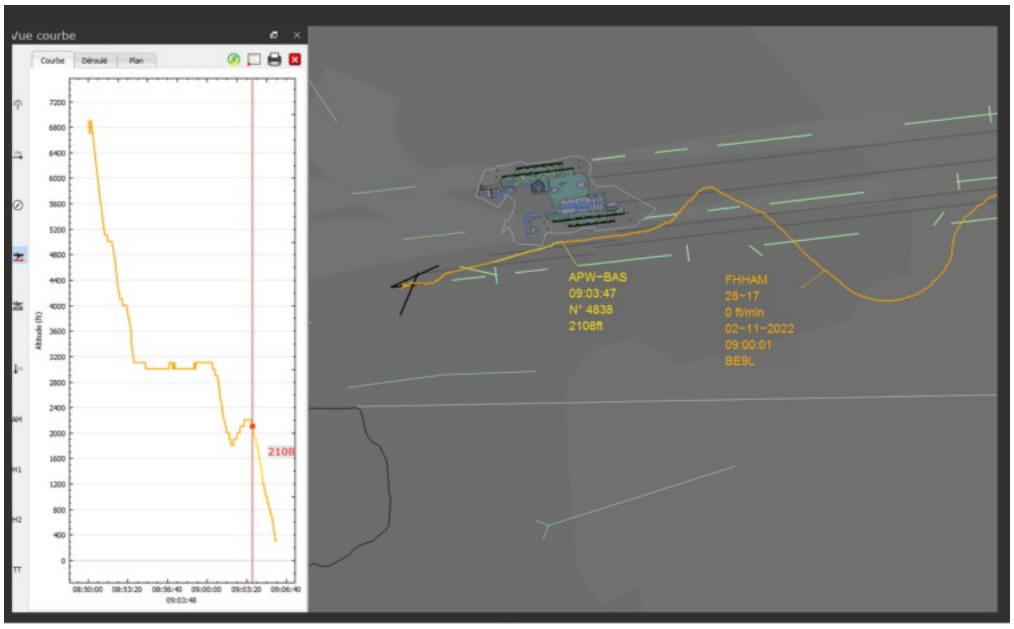

Figure 5: ELVIRA screenshot (Source: DSNA)

The pilot at the controls during this incident indicated that this was an own-account flight with three passengers seated in the rear seat. During the first interception of LOC 27 at Le Bourget, he engaged APPR mode. He specified that he had checked the selected frequency as well as the heading. He then noticed that the LOC and Glide information had disappeared from the EADI, and the AP disconnected without any input from him. He engaged the HDG mode and tried to manage the fault. He specified that he focused on the fault and may have lacked concentration in conducting the flight. Once he had sight of runway 27 at Le Bourget, he did not manage to engage APPR mode and did not recover the LOC and Glide information. He therefore continued the visual approach, without encountering any particular difficulties. He specified that, during the approach and landing, the weather conditions were VMC. The pilot added that he did not observe any discrepancy between the instrument indications on the left side and on the right side.

No malfunction of the AP or avionics systems was recorded in the Technical Log Book between the incident of 23 May 2022 and this one.

Following this new incident, the workshop responsible for maintaining the aeroplane carried out an ILS signal acquisition test on the ground. This test did not reveal any anomaly.

3 CONCLUSIONS

The conclusions are solely based on the information which came to the knowledge of the BEA during the investigation.

Scenario

The pilot took off from Ancenis aerodrome bound for Paris - Le Bourget airport for an own-account flight. On arriving in the sector, he was cleared to make an ILS approach to runway 27. While he was approaching to intercept the ILS localizer with the AP engaged, the aeroplane turned right and crossed the approach path perpendicular to it.

The tests carried out on the avionics systems did not reveal any anomaly that could explain why the AP did not acquire the approach path. The pilot had no memory of this sequence or his inputs.

The controller immediately became aware of the aeroplane's path deviation leading to a conflict with an A320 which was located at the same altitude as F-HHAM and on approach to runway 27R at Paris - Charles de Gaulle airport. He then asked the pilot of F-HHAM to turn immediately onto a heading of 180° and the crew of the A320 to turn onto a heading of 360°.

During the manoeuvre, the pilot of F-HHAM lost control of the aeroplane, the altitude of which fell by around 3,000 ft in approximately fifteen seconds. During this uncontrolled descent, F-HHAM flew close to another A320 on approach to runway 26L at Paris - Charles de Gaulle airport.

It is likely that the crossing of the approach path and the subsequent loss of control were the result of inappropriate inputs by the pilot following a subtle incapacitation possibly linked to hypoglycaemia.

The pilot then managed to regain control of the aeroplane and to continue the flight. He noticed inconsistencies in the indications of the instruments located on the right side and on the left side, which gradually disappeared during the end of the flight. Examinations carried out on the aeroplane's equipment were unable to explain the anomalies reported.

Safety lessons

Lifestyle and dietary factors

Own-account transport, which is not subject to the obligations associated with commercial transport and is governed by general aviation regulations[9], may expose pilots to operational constraints that can put a strain on their bodies (time constraints and amplitudes, successive flights, etc.). In a context of fatigue resulting from the flight conditions as well as from insufficient rest and inadequate diet, hypoglycaemia can lead to insidious problems, in particular cognitive impairments, to the point that it can cause an incapacitation.

Self-assessment

Pilots must self-assess their capability at all times. Mnemonics (IMSAFE[10]) are designed to help pilots carry out a self-assessment, principally prior to undertaking a flight.

The BEA investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liabilities.

[9] The flight of F-HHAM came under the scope of Annex VI of Regulation (EU) No 965/2012 known as "Air Ops" relating to the non-commercial operation of complex motor-powered aircraft.

[10] Pilot's Handbook of Aeronautical Knowledge, FAA.