Accident to the Airbus BK117 C-2 (EC145) registered F-HSOC on Saturday 23 November 2024 at Montanel

Time	13:00[1]
Operator	Babcock MCS France
Type of flight	Air ambulance
Persons on board	Pilot, technical crew member and three passengers
Consequences and damage	Helicopter damaged
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.	

Tail rotor strike with an obstacle or an object, during a yaw rotation in hover flight before landing

1 HISTORY OF THE FLIGHT

Note: the following information is principally based on the CVFDR[2] and statements.

The pilot was contacted by the Rennes university hospital call centre (SAMU 35) for an emergency response on the site of a road accident at Montanel. The pilot, sat in the right-hand seat, took off at 12:45 with a technical crew member in the left-hand seat, and three medical personnel passengers in the rear seats.

After cruise flight of around 15 min at a height of 1,500 ft, the pilot, on arriving at the site, carried out a reconnaissance at 500 ft. He decided to land on a paved area composed of a road adjoining the car park of a cemetery (see paragraph 2.1) after deciding against two fields that he had identified for landing during flight preparation (see paragraph 2.6). The technical crew member agreed to this decision.

The final was carried out on a 150° path. The crew mentioned trees on the flight path, obstacles that the helicopter flew over.

During the landing phase, the crew ensured that there were no stakes in the chosen area (see paragraph 2.6) and no approaching vehicles on the road.

As he was approaching hover flight at a few metres above the ground, the pilot turned the helicopter towards the axis of the road (100°) and observed that the latter was on a slope. The pilot started a yaw rotation to the left-hand side, at a few feet from the ground, in order to position the helicopter in a suitable direction relative to the slope. Six seconds later, after rotating

[1] Except where otherwise indicated, the times in this report are given in local time.
[2] The glossary of abbreviations and acronyms frequently used by the BEA can be found on its web site.

approximately 90°, the helicopter suddenly yawed to the right-hand side. The pilot identified a loss of yaw control, he immediately lowered the collective pitch lever and touched down to stop the rotation. The helicopter turned approximately 90° before contact with the ground and then sliding, continued turning 40°. This rotation lasted between two to three seconds. On making contact with the ground, the pilot set the engines to idle before shutting them down.

2 ADDITIONAL INFORMATION

2.1 Site information

The paved area chosen for the landing was a road adjoining the car park of a cemetery. It has a ground width of around 11 m. The road has an east to west downward slope of roughly 5° (see **Figure 1**).

The cemetery is surrounded by a barrier made up of a 1.20 m high stone wall on top of which there is a 60 cm high plastic fence, and approx. 1.80 m high stone pillars spaced roughly 8 m from each other. The wall running along the car park is bordered by a hedge of hortensia around 1.70 m high and 1 m thick. There is a gate in the wall. The road follows a field where there is a bank of a height of between 50 and 120 cm.

No element observed (wall, pillars, plastic fence) that could have formed a fixed obstacle showed damage that could be attributed to a strike by a tail rotor blade turning at high speed (around 2,170 rpm). Only a few hortensia stems of a diameter of less than one centimetre were broken.

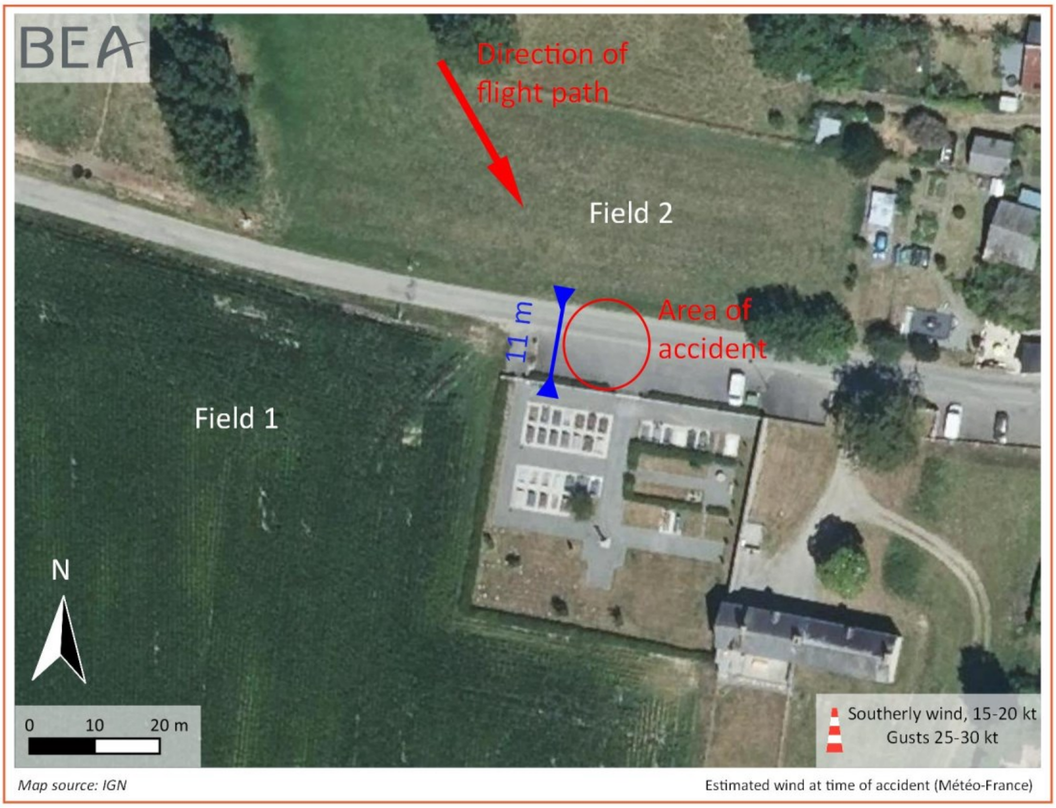

Figure 1: site layout

Figure 2: final position of helicopter (source: GTA)

Figure 3: hortensia hedge at landing site (source: BEA)

2.2 Damage information

The most significant damage observed on the helicopter was situated on the tail rotor (TR) and tail rotor drive shaft. The two tail rotor blades were destroyed. Their metal leading edges were torn over approximately 5 cm and the separated parts showed substantial rub marks. The two blades were substantially delaminated. There were no vegetation marks on the blades. Debris was collected in the cemetery, on the landing area and in the fields. There were no damage or marks on the two vertical stabilizers and the tail guard.

Figure 4: delaminated blade (source: BEA)

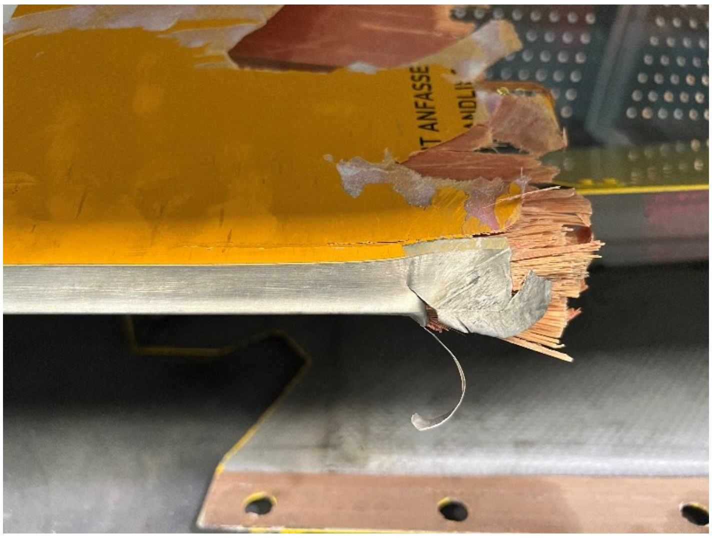

Figure 5: damaged leading edge (source: BEA)

The tail rotor drive is composed of three drive shafts:

- the front drive shaft connecting the main gearbox (MGB) to the first mount on the tail boom;
- the long drive shaft made up of several segments, running along the tail boom to the intermediate gearbox (IGB), and held by several bearings;
- the intermediate drive shaft situated on the fin between the IGB and the tail gearbox (TGB) level with the TR.

The three bolts of the flange attaching the front drive shaft to the MGB and the rivets of the rear attachment of the long drive shaft had sheared in the direction of the engine torque.

Figure 6: ruptured bolts (source: BEA)

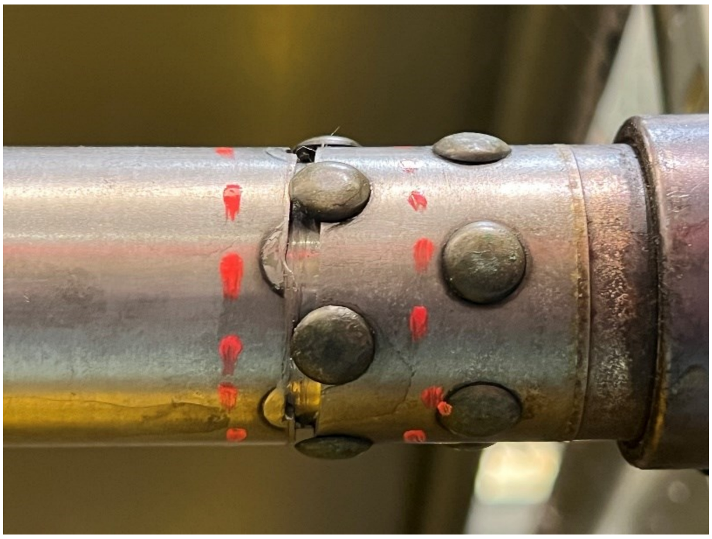

Figure 7: ruptured rivets (source: BEA)

This damage was consistent with the TR blades coming into contact with an external object while the engines were providing substantial torque. The manufacturer, Airbus Helicopters Deutschland, specified that the damage observed was similar to that usually observed during accidents in which the TR has struck hard obstacles such as rock.

Other damage from the accident sequence was observed on the helicopter:

- the landing skid cradle and the tail boom were deformed;
- some damage to the airframe paintwork seemed to indicate possible deformation of the airframe;
- the upper cable cutter was bent in the direction of rotation of the main rotor and the rotor blades all had marks level with this cable cutter indicating contact due to excessive flapping of the blades on making contact with the ground.

2.3 Meteorological information

The French met office, Météo-France, estimated that the conditions at the accident site were:

- overcast with stratocumulus cloud based at a height of between 1,300 and 1,500 ft;
- potentially a layer of stratus cloud based at a height of 800 ft;
- southerly surface wind of 15 to 20 kt with gusts between 25 and 30 kt;
- visibility greater than 10 km;
- moderate turbulence, locally strong, between ground and 4,000 ft;
- temperature 10°C.

For the cruise flight between Rennes and Montanel (flown at 1,500 ft), Météo-France estimated that the sky was overcast with stratocumulus based at a height of around 2,500 ft with potentially a layer of stratus cloud based at a height of between 500 and 800 ft. Météo-France specified that the estimated wind between Rennes and Montanel was a south-south-west wind of 40 to 45 kt.

The pilot confirmed that the wind was strong the day of the accident, that the meteorological conditions were good north of Rennes and that the ceiling was around 2,500 ft en route and on the site. He had spoked to the Météo-France services before his departure. He added that the surface wind in the landing area was south-south-east.

2.4 Helicopter information

2.4.1 Helicopter dimensions and slope limitations

The helicopter’s dimensions are described in the Flight Manual:

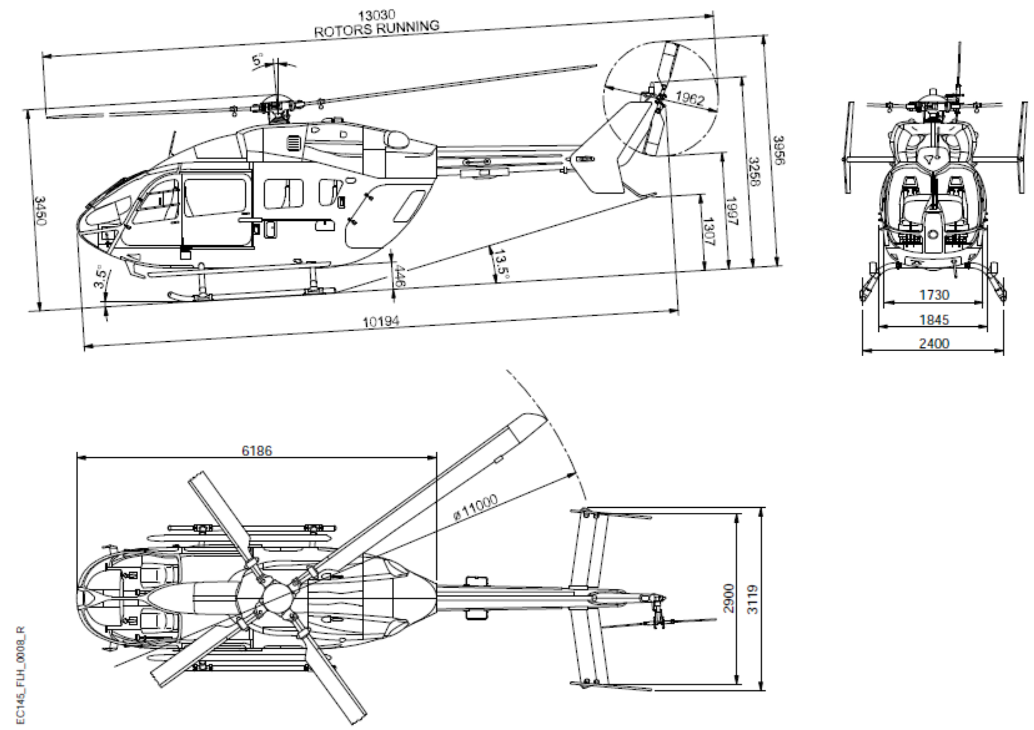

Figure 8: dimensions of BK117 C-2 in mm (source: Flight Manual, Airbus Helicopters Deutschland)

The slope limitations mentioned in the Flight Manual are the following:

- left-hand sloping ground: maximum 11°;
- right-hand sloping ground: maximum 6°;
- forward or aft sloping ground: maximum 8°.

2.4.2 Procedure in event of loss of yaw control

The manufacturer's Flight Manual and the operator's Operations Manual contain a procedure in the event of loss of yaw control. This is also given in the QRH:

ACTIONS PILOTE

VOL STATIONNAIRE DES

1. Les deux poignées tournantes .... Tourner sur IDLE

Et simultanément :

2. Assiette d'atterrissage.. Etablir

3. Manche collectif .... Ajuster selon besoin

Après atterrissage:

4. Coupure d'urgence des deux moteurs....................................... Effectuer

Figure 9: procedure in event of tail rotor failure (source: QRH, Babcock)

With respect to this procedure, the manufacturer specified that when the helicopter is equipped with twist grips without automatic governing (as is the case with F-HSOC), the procedure initially requires the pilot to reduce the power delivered by the engines (IDLE) to reduce torque to a minimum, to slow down or even stop rotation, and to use the collective pitch control to soften contact with the ground. For helicopters without twist grips, the procedure requires the pilot to lower the collective pitch control.

2.5 Crew information

The 45-year-old pilot held a commercial pilot licence (CPL(H)) obtained in 2023 along with the EC145 (BK117) SP type rating. He had been a pilot in the French navy between 2000 and 2021. He was an instructor pilot in the navy and continued this activity as a reservist after leaving the forces. At the time of the accident, he had logged more than 4,300 flight hours, including approximately 320 hours on the BK117.

The 41-year-old technical crew member did not hold a pilot licence, however he was following training in order to obtain the theoretical PPL(H). He was a trained ambulance driver.

The two crew members indicated that in the weeks preceding the accident, they had flown a lot together.

2.6 Crew statements

The pilot specified that tiredness was not a factor in this accident. He carries out his duties from Thursday to Thursday. The accident flight was the first one of the day, the meteorological conditions had not been favourable for flight in the morning, particularly south of Rennes.

During the flight preparation, the pilot had planned to carry the fuel required for a round trip between the Rennes university hospital and Montanel. The pilot indicated that on arriving at the helicopter for take-off, the medical personnel had specified that the victims were in a very serious condition, severely burned and that it was a father and his son. The pilot then realised that he had not taken sufficient fuel to take one of the injured persons to the Nantes or Tours university hospitals capable of treating serious burn victims. The organisation of the return flight and refuelling had preoccupied him during the flight.

The pilot explained that he did not wish to know the seriousness of the injuries and the context during the missions as this inevitably gave rise to a certain emotional pressure which could have operational consequences given the urgency of the situation. The pilot added that there was a certain time pressure with respect to the situation of road accident victims.

The pilot specified that during the reconnaissance on arriving at the site, he identified the gate in the wall, an element which can be affected by the downwash during the landing. He indicated that he started the yaw rotation to the left on very short final to position the helicopter on the axis of the road facing eastwards, suitable for the slope limitation. He added that he then continued the rotation to position the helicopter perpendicular to the road on a northerly heading that was both suitable for loading the stretcher and was the best direction for the slope limitation. In fact, when on the axis of the road, the left part of the helicopter was close to the bank bordering the road which would have been a hindrance when loading the stretcher[3]. He specified that he could not remember whether he called out safety aspects during the different phases of the yaw rotation. The two crew members indicated that they were principally focused on the bank bordering the road, which was initially visible on their left-hand side and then through the low window situated near the pedals, during the rotation.

The pilot explained that before departing, he had identified three landing options: two fields (field 1 and field 2, see **Figure 1**) and the area that he finally chose. On arriving on site, during the reconnaissance, he observed that the first field was muddy and the second field had a bank. According to him, these two options would have made it difficult for the ground emergency services to load the stretcher. The pilot explained that when he did not take into consideration aspects facilitating the work of the emergency services and the medical personnel, this could have an impact on the next mission which could immediately follow on (mud in the helicopter for example) or lead to comments from the medical personnel experiencing difficulties in working in good hygiene and/or access conditions. The pilot often tried to conciliate safety and satisfying the passengers.

To identify the landing areas, the crew used the HELISMUR application which allows the user to move the equivalent of a 30 x 30 m square on an interactive map. This allows them to comply with the operator's operational instructions which require that the crew choose a minimum surface area of 2D x 2D (see paragraph 2.8.1) in the daytime, free of obstacles. The pilot stated that for the EC145, he used D = 13 m. He indicated that he was often asked about this notion of obstacles as air ambulance pilots are often required to land in areas surrounded by obstacles of a low height (lower than the main rotor blades) such as the crash barrier[4] on motorways which they regularly use. He added that this was often a subject of discussion between pilots and with the operator's

[3] The stretcher is loaded from the left side of the rear compartment of the helicopter.
[4] The minimum width of a motorway (2 x 2 lanes) is of the order of 10 m, between the central reservation and the crash barrier of the hard shoulder. The height of the crash barrier is of the order of 80 cm.

instructor pilots during recurrent training. The crew also added that in training, case studies describe incidents where a crew landed on a stake hidden in tall grass in a field that perforated the helicopter airframe or on a hidden bump in the ground which caused the helicopter to tip over. These cases encourage pilots to prefer prepared surfaces such as stadiums (there was no stadium in Montanel, the closest was around 3 km from the site) or paved surfaces such as roads or car parks.

2.7 Analysis of CVFDR data

The discussions between the pilot and the technical crew member were analysed. The analysis showed the following points:

- the crew mentioned safety aspects in proximity to the helicopter on taking off, on final (trees under the flight path) and on short final (no stakes or vehicles);
- during the reconnaissance before landing, the pilot mentioned his choice of landing in the cemetery car park rather than in the fields. The obstacles represented by the bank of field 2 and the barrier between the car park and the cemetery (hortensia and low wall) were not mentioned. The crew did mention however, the cemetery gate;
- while hovering before landing, the pilot said that he was going to turn the helicopter because of the slope, he did not mention the stretcher loading aspect;
- the crew did not mention safety aspects with respect to manoeuvring in hover before landing. The bank and the barrier were not mentioned. The pilot did not mention safety aspects on his right-hand side before starting the left-hand rotation;
- a noise consistent with that of a TR collision was heard at the end of the yaw rotation;
- the pilot mentioned that the TR must have struck something.

Regarding the safety aspect during the manoeuvre, this type of call allows the pilot in the right-hand seat to confirm that the area is clear on the right-hand side and that, consequently, there is enough space horizontally and vertically to accommodate the helicopter's new position, and in particular the tail rotor.

The analysis of the parameters showed that:

- the yaw rotation was carried out at a height of 2 ft;
- the heading changed from 100° to 7° in six seconds during the yaw rotation;
- the helicopter’s pitch attitude was 3° nose up at the time of the TR strike.

2.8 Operator’s manual information

2.8.1 Landing area and touchdown area

The Operations Manual stipulates that the landing area must be free of any obstacles so that the helicopter can land safely. It adds that it is the responsibility of the pilot-in-command, upon arriving in the area, to conduct a reconnaissance of the area and, if necessary, to reject the proposed site and submit another site that is safer in terms of operations and complies with the minimum dimensions required by regulation AMC1 SPA.HEMS.125(b)(4): during the day: 2D x 2D[5].

Requirement SPA.HEMS.125(b)(4) specifies that for take-off and landing, “*the operating site shall be big enough to provide adequate clearance from all obstructions*.”

[5] D is the largest dimension of the helicopter with rotors spinning (overall length).

The Operations Manual also stipulates that the touchdown area is a place on the ground whose characteristics allow the aircraft to make a full-stop landing with the rotating parts stopped, the personnel to disembark and the patient to be loaded safely.

The Operations Manual also specifies that reconnaissance must include verification of “ground safety”:

- suitability of the site:
    - dimensions, slope, type of surface,
    - precise landing point;
- absence of equipment, vehicles, people, etc. in the immediate vicinity that could be blown away;
- search for nearby and surrounding obstacles:
    - tracks, poles that may indicate the presence of cables, etc.,
    - obstacles, terrain that may interfere with the approach, go-around and take-off paths.

It also specifies the non-exhaustive decision parameters to be taken into account, particularly with regard to the touchdown point:

- rotor downwash and sufficient distance to buildings or vehicles;
- clean, free of stones, rocks, small shrubs, stakes, tree trunks and stumps;
- preferably flat and without a slope.

The operator explained that in practice, pilots sometimes landed in areas with obstacles. The operator conducted a study focusing on 64 flights carried out in the second half of 2024, which showed that 25% of the emergency response landing areas had obstacles higher than 1 m. In these conditions, the pilot's objective is to land safely while monitoring the margin relative to obstacles, provided that the touchdown area is free of obstacles.

2.8.2 Roles of crew members, communication

The Operations Manual specifies the pilot’s various roles, and in particular that:

- the pilot is responsible for the operation and safety of the helicopter, when the rotors are turning, in accordance with the Operations Manual instructions and procedures;
- the pilot shall comply with all the operational procedures and checklists in accordance with the Operations Manual;
- in the event of an emergency situation requiring a decision and an immediate reaction, the pilot shall take all necessary measures in such circumstances.

The Operations Manual specifies the various tasks of the technical crew member who assists the pilot, in particular:

- avoiding collisions;
- detecting obstacles;
- reading checklists and the QRH;
- other tasks delegated by the pilot.

The operators documentation also specifies that the division of tasks must be clearly defined, notably for monitoring and detecting threats. This is achieved through non-technical skills, particularly in terms of cooperation and communication: teamwork (exchanges within the crew) and support (assisting and helping when needed).

2.8.3 Operational pressure

The operator specified that the pilot may be subject to operational pressure, and that his primary mission is to transport passengers safely, not to save lives. The operator regularly receives reports from pilots about pressure. One of the reports mentioned degraded customer relations due to the inappropriate attitude of the SAMU manager: behaviour, pressure, comments, etc.; distress due to working conditions and relations with customers and all or part of his teams. A second report stated that a doctor assessed the weather conditions himself by looking outside and questioned a pilot about his refusal to carry out the flight, even though the weather conditions at the destination were not favourable with in particular, the presence of fog. A third report stated that doctors asked a pilot several times, to transport a child in distress to a hospital where, according to regulations, he did not have the authorisation to land. There was strong pressure on the pilot, who was not indifferent to the situation at the time. Other reports also mention similar pressure.

Based on the operator's analysis of these various reports, this pressure was of a kind to affect human performance and therefore flight safety, and impact decision-making.

The operator specified that the analyses of these reports are shared with all Regional Health Agencies, as well as with the various regulatory services, in order to raise awareness of this issue among medical staff, particularly during meetings with the operator's commercial services.

3 CONCLUSIONS

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

Scenario

Before departing to the emergency response site, the crew had identified three areas for landing: two fields and a paved area. During the reconnaissance, the pilot quickly discarded the two fields in favour of the paved area. This area was circumscribed by a bank and a barrier making it confined with respect to the dimensions of the helicopter. The crew did not consider the barrier, situated outside the touchdown area, as a hazard for landing on the road's axis.

The pilot then wanted to turn the helicopter into a suitable direction with respect to the slope of the landing area and, according to his statement, to allow the stretcher to be loaded on board. In hover, the pilot started rotating the helicopter to the left-hand side around the yaw axis without making a safety call and without discussing this with the technical crew member. According to their statements, they were focused on the bank on their left-hand side.

At the end of the yaw rotation of the helicopter, in the area of the barrier, a collision occurred between the tail rotor and an obstacle or hard object, which may have been ejected and that the investigation was not able to identify, resulting in particular, in the destruction of the tail rotor blades.

The pilot then lost yaw control and the helicopter started a right-hand turn. The pilot immediately touched down, using the collective pitch lever, to stop the rotation before putting the engines into idle. The landing was firm given the damage observed on the helicopter.

Contributing factors

The following factors may have contributed to the tail rotor striking an obstacle or object during the yaw rotation in hover, in a confined area:

- operational pressure stemming partly from the time pressure felt by the pilot, linked to the condition of the victims to be transported, and partly from the constraints imposed by the work of the medical personnel, in particular facilitating the loading of the stretcher on board;
- insufficient communication between the two crew members, who did not mention the presence of certain obstacles nor did they verbalise the safety checks before the yaw rotation in hover. The habit of flying together in the period leading up to the accident may have led to the simplification of certain technical calls.

Measures taken

Publication of a Safety Flash

In the weeks following the accident, the operator published a "Safety Flash" for its crews. This document, "Accident – Severe damage during an emergency response landing", describes the circumstances of the accident and the damage observed. It also reiterates the following points:

- TEM / systematically take the time to:
  - Establish an action plan: identify and assess threats, actions/precautions to be implemented, steps and coordination/briefing.
  - Repeat this process each time the action plan changes!
  - Communicate your thoughts to the crew (appropriate briefing: "NITS" Nature of the situation, Intentions, Timing, Special information).
- Upon arriving at the landing site and throughout the manoeuvres:
  - Take into account the dimensions of the site and compare them with those of your aircraft: what are your margins?
  - Take into account all obstacles present in your manoeuvring area: what are your margins?
  - Identify objects that could become FOD with the rotor downwash: how can you mitigate this?
- In areas that are not completely clear:
  - Prioritise the safety of your aircraft over the comfort of the medical team's manoeuvres.
  - Comply with the basics before any movement in the ground effect: I call out what I want to do, I call out the safety aspects, I do what I called out.
  - If you need to move from your "landing area" to your "touchdown area", take the time to reassess the threats on and around the path (obstacles, slopes, dimensions, downwash).
- Know how to deal with failures in the ground effect.

Update to the Operations Manual regarding landing areas

The operator has also added more detailed information in its Operations Manual:

- about obstacles in the landing area;
- manoeuvring in the ground effect between the landing area and the touchdown area.

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