State Commission on Aircraft Accidents Investigation

FINAL REPORT

2022/2454

OCCURRENCE NUMBER

ACCIDENT

LOC-I: Loss of control – in flight

The sole purpose of both the investigation and the Final Report is to prevent aviation accidents and incidents.

The Commission does not apportion blame or liability The investigation is independent and distinct from any judicial or administrative proceedings.

Any use of this Report for any purpose other than prevention of air accidents and incidents may lead to wrong conclusions and interpretations.

Helipoland Sp. z o.o.

Aerospatiale AS350B3e, F-HCHB

Rogoźnik Lake, 23 May 2022

This Final Report was issued by the State Commission on Aircraft Accidents Investigation (PKBWL) on the basis of information available on the date of its publication.

This Report presents the circumstances of the aviation occurrence concerned, as well as its causes, contributing factors and safety recommendations.

This Report was drawn up in Polish.

Warsaw, 20 March 2024

State Commission on Aircraft Accidents Investigation
ul. Nowy Świat 6/12, 00-497 Warszawa

kontakt@pkbwl.gov.pl

24h Duty Phone: +48 500 233 233

https://www.pkbwl.gov.pl

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INTRODUCTION

LEGAL GROUNDS

The State Commission on Aircraft Accidents Investigation (PKBWL) is a safety investigation authority referred to an Article 4(1) of Regulation (EU) No. 996/2010 of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC (Official Journal of the European Union L 295, 12.11.2010, p. 35, as amended).

The Commission conducts safety investigations pursuant to the provisions of the Aviation Law of 3 July 2002 (Journal of Laws No 130 of 2002, item 1112, as amended) and the European Union law on accidents and incidents in civil aviation, taking into account the standards and recommended practices laid down in Annex 13 to the Convention on International Civil Aviation made in Chicago on 7 December 1944 (Journal of Laws of 1959, item 212, as amended).

KEY INFORMATION ON THE OCCURRENCE

Operator (user), flight number or type– Helipoland Sp. z o.o.

Manufacturer, type, model and registration marks of the aircraft – Aerospatiale AS350B3e, F-HCHB.
Place and date of the occurrence– Rogoźnik Lake, 23 May 2022.

NOTIFICATION OF THE OCCURRENCE

The PKBWL was notified of the occurrence under the mandatory reporting system on 23 May 2022.

The occurrence was assigned the reference number – 2022/2454.

Based on initial information, the occurrence was classified as an accident.

The classification was not changed in the course of the investigation.

OCCURRENCE NOTIFICATION

PKBWL notified the occurrence to:

- State of registry – France;
- State of design – France;
- State of manufacture – France;
- EASA;

- European Commission;
- ULC.

ORGANISATION OF THE INVESTIGATION

The investigation was conducted by – PKBWL.

Investigator-in-Charge (IIC) – Michał Ombach

Member of the investigation team – Mieczysław Wyszogrodzki

Member of the investigation team – Krzysztof Błasiak

Member of the investigation team – Paweł Jajkowski

Member of the investigation team – Jacek Bogatko

Member of the investigation team – Ireneusz Boczkowski

Specialist groups – no specialist groups were appointed.

Accredited Representatives (and their advisers) – the state named below appointed ACCREPs.

- State of registry – France;
- State of design – France (BEA, Airbus Helicopters, Safran Helicopter Engines);
- State of manufacture – France (BEA, Airbus Helicopters, Safran Helicopter Engines);
- State providing information, significant facilities or experts – France (BEA, Safran Helicopter Engines).

PKBWL requested BEA to provide technical assistance in reading the flight data recorders installed in the helicopter.

RECOMMENDATIONS

Unless otherwise specified, the recommendations contained in this Report are addressed to the regulatory authorities of the State concerned. The decision on how to proceed is the responsibility of those authorities. Details are provided in Chapter 4 of this Report.

TIME

Time in the Report is provided as LMT. LMT on the occurrence day = UTC+2.

DATE

Where a date is provided in this Report in a digital format, the respective digits represent DD/MM/YYYY, where DD means day, MM means month, and YYYY means year.

FIGURES AND TABLES

Unless otherwise specified in this Report, the PKBWL is the source.

SYNOPSIS

On 23 May 2022, an Eurocopter AS350B3e helicopter with registration marks F-HCHB took part in the fire-fighting operation for a forest fire which broke out in the municipality of Świerklaniec. The helicopter would take water from the nearby Rogoźnik Lake and transport it in its underslung bambi bucket.

After performing 8 water drops, the helicopter collided with the surface of the lake while refilling the bambi bucket.

The pilot sustained minor injuries and got out of the sinking wreckage on his own. The helicopter was destroyed.

SYMBOLS, ACRONYMS AND ABBREVIATIONS

SYMBOLS

°	degree e.g. °C (temperature) and 1° (angle)
'	minute
”	second

ACRONYMS AND ABBREVIATIONS

AGL	Above Ground Level
AMO	Aircraft Maintenance Organisation
AMSL	Above Mean Sea Level
ATS	Air Traffic Services
ATO	Approved Training Organisation
BEA	the French civil aviation safety investigation authority (French: *Bureau d'Enquêtes et d'Analyses pour la sêcuritê de l'aviation civile*)
C	degree Celsius
CAA/ULC	the Polish Civil Aviation Authority (Polish: *Urząd Lotnictwa Cywilnego*)
	Civil Aviation Administration
CAMO	Continuing Airworthiness Management Organisation
CAVOK	visibility, cloud and weather conditions at the moment of observation are better than the recommended values or conditions (Cloud And Visibility OK)
CofA	Certificate of Airworthiness
CPL	Commercial Pilot Licence
CRS	Confirmation of Release to Service
CVR	Cockpit Voice Recorder
E	East / eastern longitude
EDR	Engine Data Recorder
EECU (ECU)	Electronic Engine Control Unit

ELT	Emergency Locator Transmitter
FADEC	Full Authority Digital Engine Control
FDR	Flight Date Recorder
FH	Flight Hours
FI	Flight Instructor
FIS	Flight Information Service
ft	foot/feet
GPS	Global Positioning System
h	hour/hours
hPa	hectopascal
HFM	Helicopter Flight Manual
ICAO	International Civil Aviation Organisation
IIC	Investigator-in-Charge
kg	kilogram(s)
km	kilometre(s)
km / h	kilometres per hour
kt	knot / knots
OPC	Operator Proficiency Check
kW	kilowatt
l	litre(s)
LMT	Local Mean Time
LPR	Polish Medical Air Rescue (Polish: *Lotnicze Pogotowie Ratunkowe*)
m	metre(s)
MHz	megahertz
min	minute(s)
ms	millisecond(s)
MSL	Mean Sea Level
MTOM	Maximum Take-Off Mass

N	North / northern latitude / Newton
PIC	Pilot-in-Command
PSP	Polish National Fire Service (Polish: *Państwowa Straż Pożarna*)
QNH	the altimeter subscale setting in which after landing the instrument will indicate the altitude of the place of landing (the pressure setting to indicate the height above mean sea level)
S	second(s)
SOP	Standard Operating Procedures
SPO	Special Operations
STC	Supplement Type Certificate
TSN	Time Since New
TR	Type Rating
TRQ	Torque
TWR	aerodrome tower / aerodrome control
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VEMD	Vehicle and Engine Multifunction Display
VMC	Visual Meteorological Conditions
VNL	Correction for Defective Near Vision

1. FACTUAL INFORMATION

1.1. History of the flight

On 23 May 2022 at 10:00 hrs, the pilot of a Eurocopter AS350B3e helicopter with registration marks F-HCHB started its duty time at the Forest Air Base (Polish: *Lotnicza Baza Leśna,* LBL) in Brynek. At 10:40 hrs, the pilot was called by the Emergency Dispatcher (Polish: *Punkt Alarmowo Dyspozycyjny,* PAD) of the Regional Directorate of the State Forests (Polish: *Regionalna Dyrekcja Lasów Państwowych,* RDLP) in Katowice to fight the first fire. The helicopter took off for the first time at 10:44; the flight lasted 23 minutes and involved one water drop with return to the air base in Brynek. At around 14:20 hrs, the pilot was called to fight another fire in the area of points By 40 (50° 25’ 30” N, 019° 03’ 33” N) and Cy 40 (50° 23’ 00” N, 019° 02’ 40” E) in the municipality of Świerklaniec. The helicopter would take water into an underslung bambi bucket from Rogoźnik II Lake close to the fire site. The operation involved also other aircraft, i.e. a PZL M-18 "Dromader" aeroplane operating from the Niegowoniczki airfield (EPNI).

After performing 8 drops, while lifting the bambi bucket from the lake at around 15:00 hrs, the helicopter started to change direction itself, rotating to the right. The rotation started smoothly and amounted to 270° or "1 rotation spin and 270°". The pilot stabilised the direction, stopping the rotation by reducing the general pitch. This resulted in ditching without rotation. The rotor blades collided with the surface of the lake, the helicopter tilted to the left side, sank and settled on the bottom at the depth of around 2.5 m.

The pilot sustained minor injuries as a result of the collision with water. He unbuckled his safety belts, got out of the cabin on his own and waited for help on the helicopter wreckage.

On the day of the occurrence, the pilot did not use the assistance of the so-called task specialists who remain on the ground to provide information, by means of visual signals or radio communication, about the appropriate positioning of the helicopter during refilling the bucket.

The rescue operation was initiated by the pilot of the M-18 "Dromader" fire-fighting aeroplane, who radioed the air traffic services with a situation report and access instructions for the rescue services.

First aid was administered to the pilot by a diver of the National Fire Service (Polish: *Państwowa Straż Pożarna*, PSP), and subsequently the injured was transported to the shore by pontoon. There, the pilot received medical assistance, and was subsequently taken to hospital. The rescue operation involved also an LPR helicopter.

The wreckage was recovered from the lake after some three days from the accident. Until the recovery, the wreckage site had been secured by PSP and police.

Fig. 1 Accident site – Eurocopter AS350B3e helicopter submerged in the lake and white absorbent sleeves deployed to collect contamination.

1.2. Injuries to persons

Table 1. General summary of the number of injuries

Injuries	Crew	Passengers	Total on board the aircraft	Other
Fatal	0	-	0	0
Serious	0	-	0	0
Minor	1	-	1	Does not concern
None	0	-	0	Does not concern
TOTAL	1	-	1	0

1.3. Damage to aircraft

As a result of the collision with water and sinking, and the subsequent recover operation, the helicopter was destroyed (Fig. 2-3).

The helicopter's fuel tank in the fuselage, holding around 450 l of Jet A-1 fuel, remained leak-tight.

During the impact against water, the main rotor hub complete with rotor blades and main gearbox detached from the airframe. To lift the wreckage, the divers cut off the oil and fuel pipes and electrical wiring which were connecting the fuselage with the main gearbox, and dismounted (under water) the main rotor blades from the rotor hub.

Due to main gearbox detachment, the kinematic connections between the engine and the main gearbox and between the engine and the tail rotor shaft were severed. The engine was torn out from its rear fittings.

The tail rotor final gearbox was destroyed (the blades detached from the hub), as was the tail rotor driving shaft. The bearings of the tail rotor driving shaft were torn out of their nests on the tail beam.

The helicopter's fuselage was substantially damaged - it was deformed and cracked. The windshield was broken and its composite central support was broken away.

The avionics and all mechanical systems of the helicopter were immersed in water until the wreck recovery, i.e. for about 77 hours.

The structure of the cabin floor, the seats and their fittings were not affected.

Fig. 2 The helicopter wreckage while being pulled onto the shore of the lake. Note the missing rotor and detached main gearbox.

Fig. 3 The damaged fuselage of the helicopter and the place of the missing main gearbox.

1.4. Other damage

As a result of the occurrence, water in the lake was slightly polluted by fuel and other operating fluids. PSP secured the wreckage with absorbent sleeves for the time it had remained under water.

1.5. Personnel information

1.5.1. Pilot-in-Command

Pilot: male, aged 62.

Licence: CPL(H) – Commercial Pilot Licence (Helicopters).

Ratings endorsed in the licence:

- R44/TR valid until 30 June 2022;
- AS350/EC130/TR valid until 30 April 2023;
- SC 330 expired on 30 June 2019;
- ICAO level 4 valid until 6 May 2022;
- FI valid until 31 May 2023.

Overall flight time: 3,540 h.

Type flight time:

- AS350: 100 h.

Flight time before the occurrence:

- within last 24 h: 1:17 h on Eurocopter AS350B3e;

- within last 7 days: 14:29 h on Eurocopter AS350B3e;
- within last 90 days: 25:09 h on Eurocopter AS350B3e.

Flight check – a successful OPC carried out on 23 March 2022.

Aero-medical certificate – Class I with VNL, valid until 24 September 2022.

Rest during last 48 h – the pilot had been provided with 12 h rest time in hotel accommodation.

The pilot's knowledge of the aerodrome and experience on the flight route – the pilot had good knowledge of the Rogoźnik Lake area because he had previously performed flights there.

Seat in the cockpit and actions performed – during the occurrence, the pilot was in the right seat and was the only person on board.

1.6. Aircraft information

The helicopter crew consisted of one pilot. The aircraft can seat 5 passengers, depending on the cabin configuration. It can be deployed to fight fires by carrying water in a bambi bucket suspended on a rope of around 6 m in length.

The bucket is suspended on a rope from the helicopter's centre of gravity. The pilot in the cabin can release the bucket in the event of emergency. The release system is duplicated: mechanical and electric. Fire-fighting water is taken from water reservoirs in the vicinity of the fire site, or alternatively from special pools.

1.6.1. Airworthiness and maintenance

a) General information:

- single-engine, single-rotor classic light helicopter design (Fig. 4), manufactured between 1974 and 2011 under the name H125. The fuselage is a metal-composite design with skid undercarriage.

Fig. 4 Eurocopter AS350B3e helicopter and a bambi bucket designed to carry water [source: airplane-pictures.net]

- manufacturer – Eurocopter (currently Airbus Helicopters);
- factory designation (model) – AS350B3e (H125);
- serial number – 7695;
- year of manufacture – 2013;
- registration marks – F-HCHB;
- owner – Helipoland Sp. z o.o.;
- operator – Helipoland Sp. z o.o.;
- Certificate of Registration – date of entry 25 March 2021, no. of registry B31930 – valid as of the day of the occurrence;
- CofA – issued on 23 June 2014, no limitations – valid as of the day of the occurrence.

b) History of the aircraft:

- time since new – 2438:37 h, 4478 landings;
- time since overhaul – no overhaul carried out;
- time since last check – 150 h/12 month check (16 February 2022) – 44:12 h;
- modification – as per the STC list attached to this report;
- aircraft technical log – carefully kept, no errors or deletions;
- maintenance documentation – complete, kept in a transparent manner;

- airworthiness directives – all airworthiness directives have been implemented;
- service bulletins – all mandatory service bulletins have been implemented; implementation of 3 non-mandatory service bulletins have been scheduled for the next periodic check (C2).

c) Engine, main rotor and tail rotor:

- 710 kW Safran HE Arriel 2D turbine engine, controlled by EECU[1] (FADEC);
- semi-rigid main rotor with three epoxy composite rotor blades reinforced with glass fibre with foam filler. The rotor rotates clockwise (as seen from above);
- articulated twin-blade composite tail rotor. The tail rotor blades were made of epoxy composite reinforced with glass fibre with foam filler.

d) Fuel:

- recommended – Jet A-1;
- used during the flight – Jet A-1;
- quantity of fuel on board (as indicated by the fuel gauge) – around 450 l;
- distribution on board – a fuel tank in the helicopter fuselage.

e) Devices and generators which malfunctioned during the flight:

- no malfunctions occurred.

f) Defects:

- there were no defects.

g) Aircraft load:

- MTOM – 2,250 kg;
- MTOM with an external load – 2,800 kg;
- maximum mass of underslung load – 1,400 kg.

1.6.2. Aircraft systems or components which influenced the accident:

[1] EECU (ECU) – Electronic Engine Control Unit is fully autonomous electronic device that controls the performance of the engine, depending on the situation and signals received from the cockpit. The EECU collects and analyses sensor data and receives commands from the cockpit, which ensures comprehensive control of the parameters of the engine and power plant components, enhancing their efficiency under specified conditions.

Not applicable.

1.6.3. Serviceability and use of collision avoidance systems:

Not applicable.

1.7. Meteorological information

The flight was performed under VMC in daylight.

According to METAR for EPKT as of 23 May 2022 at 15:00 hrs (13:00 hrs UTC), the weather conditions were as follows:

METAR EPKT 231300Z VRB05KT CAVOK 19/03 Q1011=

Which means:

- date: 23 May 2022;
- time: 13:00 hrs UTC;
- wind direction: variable;
- wind speed: 5 kt;
- visibility: at least 10,000 m;
- cloud cover: no clouds below 5,000 ft, no Cumulonimbus or towering cumulus clouds, no precipitation, storms, etc.;
- ambient temperature: 19ºC;
- dew point temperature: 3ºC;
- pressure: QNH 1011 hPa.

1.8. Aids to navigation

The pilot did not use any aids to navigation during the fire-fighting mission. He had a switched on navigation tablet which he did not use. The pilot performed approaches to the fire zone and water collection site on the basis of visual observations of the terrain.

1.9. Communications

The pilot maintained communication with Katowice Pyrzowice aerodrome TWR at frequency 129.255 MHz, communication with the supervisor of the fire-fighting operation on the ground, and with the M-18 "Dromader" aeroplane on frequency 123.450 MHz. He did not manage to notify air traffic services or other airspace users on time of the ditching.

1.10. Aerodrome information.

The helicopter took off from the Forest Air Base located in the town of Brynek. The Brynek airfield is registered in the ULC register under number 233, and it was submitted for registration by the State Forests National Forest Holding, State Forest District of Brynek.

Geographical coordinates of the airfield: 50°31’08” N, 018°44’17” E.

1.11. Flight recorders

The helicopter was not equipped with a Flight Data Recorder (FDR), but it had the following data recording devices installed on board:

- Engine Data Recorder (EDR);
- Electronic Engine Control Unit (EECU/ECU);
- Appareo Vision 1000 camera;
- VEMD displays on the instrument panel in the cabin.

Furthermore, the pilot had a personal navigation tablet.

1.11.1. EDR

The EDR recorded (exchanged data) engine performance parameters sent by the EECU (FADEC), mainly for the purposes relating to the operation of the power plant. The recording was doubled (on 2 channels) and contained *inter alia* error codes. The recording frequency was 1 s. Where the system detected a defect, it increased to 20 ms (milliseconds).

The position of the EDR and EECU in the airframe is shown in Fig. 5.

The EDR can communicate directly with the computer to retrieve performance data stored in the recorder's memory.

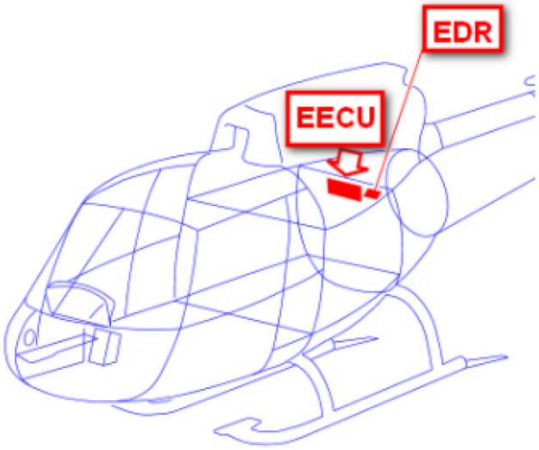

Fig. 5 The positions of the EDR and EECU in the helicopter's fuselage [source: BEA]

The EDR collected the following data automatically:

- the number of work cycles, consumption of service life, other;
- measurements of TRQ (torque), T3 (temperature at the combustion chamber exhaust) and T4 (temperature at the high pressure turbine);
- codes of errors which occurred during operation (the so-called flags);
- engine performance parameters measured;
- configuration data (serial numbers etc.).

1.11.2. EECU (ECU) Thales, FADEC D

Manufactured by Thales, the EECU is fully digital electronic engine control system. It comprehensively controlled parameters of the engine and engine components, including the fuel feed system, engine thrust, power management. It collected, for maintenance purposes, operational recordings, including defects. As with the EDR, the device's standard recording frequency was 1 s, and in the event of a defect 20 ms.

1.11.3. APPAREO Vision 1000 – camera

The camera (Fig. 6), designated Vision 1000 and manufactured by Appareo, was pre-installed by the manufacturer under the cockpit ceiling (left side of the helicopter's central axis) between the front seats.

The helicopter camera should record the following parameters:

- the helicopter's GPS position (longitude and latitude), GPS altitude, ground speed, vertical speed and heading);
- attitude (pitch, roll and yaw);
- acceleration and angular speeds relative to three axes;
- video images from the cockpit (instrument panel, position of the controls and, partially, outside view from the helicopter);

– audio inside the cabin.

In the description of the camera, the manufacturer noted that the camera had two independent memories: internal and external. The external memory, made as crash resistant, can serve as the first source of information for investigation of occurrences. It contains the last 2 h of video and sound from the camera, as well as aircraft position data in the last 200 h. The sampling rate is 0.25 s.

Fig. 6 APPAREO Vision 1000 camera [source: Internet].

1.11.4. VEMD (Vehicle and Engine Multifunction Display)

VEMD is installed in the centre of the instrument panel (Fig. 7). It provides graphical presentation of the main parameters of the helicopter and the engine. The VEMD consists of redundant data processing module and data display module which has a double display.

Fig. 7 VEMD [source: Internet / Airbus Helicopters]

1.11.5. Apple iPad mini 4 with SkyDemon software

The pilot had an Apple iPad Mini 4 navigation tablet with the SkyDemon recording software. In addition to navigational data, the device recorded *inter alia* the flight path, height and ground speed based on GPS data.

PKBWL requested BEA's assistance in reading the data from the EDR, EECU and Vision 1000.

The reading and analysis of the electronic records from the EDR was carried out by BEA's laboratory based on Safran Helicopter Engines software.

The technical document drawn up by BEA (BEA2022-0220_tec01) described that the EDR was in an appropriate condition and had the required seals. The EDR memory contained records of the parameters (power plant operation) of the accident flight. Since the EDR cooperates with the EECU in exchanging the data, BEA found that it was not required to read the data from the EECU.

When retrieving the EDR data, it was decided not to analyse the contents of the VEMD screens memory, which ultimately were not sent to BEA.

The Vision 1000 camera was tested by BEA in laboratory conditions. The camera did not record any data from the accident flight. It was demonstrated that the latest recording on the memory card dated from July 2018, i.e. around 4 years before the occurrence.

Point 1.16 lists the actions carried out and evidence material obtained.

1.12. Wreckage and impact information

1.12.1. Place of the occurrence

The collision with the water surface of Rogoźnik II Lake took place near the town of Rogoźnik, the municipality of Bobrowniki (Fig. 8).

Coordinates of the place of the occurrence: 52°24'12" N, 019°03'04" E.

The lake's elevation at that place is 958 ft AMSL.

Fig. 8 The place of take-off and accident [source: Geoportal]

1.12.2. Helicopter wreckage

A general view of the accident site is shown in Fig. 1.

All helicopter wreckage found were located on the bottom of the lake, in the immediate vicinity of the wreck. No component of the helicopter was found to have detached from the helicopter prior to the impact against water.

1.13. Medical and pathological information

The pilot got out of the wreckage on his own. As a result of the occurrence, he sustained a contusion of his right shin. He was evacuated by fire fighters to the shore of the lake, where he received medical assistance and was subsequently take to hospital. On examination, the pilot was discharged home.

1.14. Fire

No traces were found that would indicate fire in flight or after collision with water.

1.15. Survival aspects

The pilot was not equipped with a life jacket. The collision with water from the height of around 5 m took place during a slow descent of the helicopter. During the occurrence, the pilot had fastened four-point safety belt with a central buckle secured. At the moment of the helicopter impact against the lake surface, he opened the right door so as it could not be blocked by water pressure. After opening the door, the pilot switched off the engine. The sinking wreck fell on its left side, which enabled the pilot to get out directly onto the surface of the lake (onto the wreckage). The depth of the lake at that place was around 2÷2.5 m; the wreckage settled on the bottom and protruded slightly over the water surface.

1.16. Tests and research

The following was carried out as part of the investigation:

1) A general inspection of the helicopter wreckage under water – carried out by a diver.
2) An inspection of the helicopter wreckage after it was recovered from the lake and transported to the operator's hangar. The actions taken were recorded in a report. The inspection involved:
   a) an inspection of the entire wreckage – described in the damage report;
   b) a check of the continuity of the helicopter controls kinematics;
   c) an assessment of the technical condition of the engine and gearbox to identify any external damage;
   d) a check of cleanliness of the main gearbox's and engine's indicators of metal filing content.
3) Samples of the sediment of fuel taken before the flight were taken possible tests – since no reasons to doubt the quality of the fuel were identified, the tests were not carried out.
4) The completeness of the airframe, power plant and equipment were checked for compliance with the continuing airworthiness documentation.
5) Electronic devices - namely the Vision 1000, EDR and EECU - were uninstalled, secured and sent to BEA.
6) The pilot's navigation tablet was secured for possible examination.
7) The VEMD was secured (the displays were uninstalled from the helicopter's instrument panel). Since BEA retrieved readouts from the EDR, no further actions relating to the VEMD were taken.
8) Acting in agreement with PKBWL, BEA carried out a technical assessment of the Vision 1000 camera, EDR and EECU. The data from the EDR was read. A relevant report, designated BEA2022-0220_tec01, was sent to PKBWL on 31 March 2023.
9) Acting in agreement with Safran Helicopter Engines, BEA sent to PKBWL a separate analysis of the EDR data drawn up by Safran – the document is designated RA 2022/119.

1.17. Organisational and management information

The operator of the aircraft was a provider of aviation services with its registered office in Bielsko-Biała. The business of the said entity includes commercial aviation training services, carriage, maintenance, rental and specialised helicopter operations.

The entity holds an air operator certificate (AOC) and ATO, AMO and CAMO certificates, as well as a high-risk SPO authorisation concerning fire-fighting operations.

The accident helicopter's continuing airworthiness management was carried out by an external company headquartered in France. The maintenance of the helicopter was provided by a Part 145 approved maintenance organisation holding a certificate issued by the President of ULC.

1.18. Additional information

Before publication of this final report, PKBWL held consultations of its draft by requesting the interested persons, entities and authorities, including BEA and EASA, to submit their comments:

a) the Pilot-in-Command and the operator of the helicopter submitted their comments concerning the circumstances of the accident;

b) a translated draft of the final report was submitted to BEA (representing the State of manufacture) and EASA. None of the aforementioned institutions raised any comments to the draft final report.

While the investigation was ongoing, the operator updated the provisions of its SOP by introducing the requirement for the helicopter crew to wear life jackets in the event of operations conducted over wetlands or water.

1.19. Useful or effective investigation techniques

Standard investigation techniques were applied.

2. ANALYSIS

2.1. General provisions

2.1.1. The analysis used the graphical and descriptive material provided by BEA - the data read from the EDR.

2.2. Flight operations

2.2.1. Crew qualifications

The pilot held the required qualifications and ratings to fly the Eurocopter AS350B3e helicopter. Considering the pilot's overall flight time on helicopters (3,540 h), his experience can be assessed as very high. The pilot had flown around 92 h on the accident helicopter. He took part in numerous fire-fighting operations involving the use of an underslung bambi bucket (fire extinguishing) system.

The pilot had remained in continuous training, and was rested prior to the flight.

The operational requirements concerning the pilot qualifications laid down in the operator's SOP were met.

2.2.2. Operating procedures

The operating procedures established by the operator for participation in fire-fighting operations concern *inter alia* flights with an underslung load – a fire extinguishing container (bucket).

In accordance with the provisions of the operator's SOPs, the presence of a task specialist was not required on the day of the occurrence. The pilot did not request it either. A decision to deploy task specialists belongs to the helicopter pilot.

As a risk factor in operations of a helicopter with a water container, the SOP mentions only the possibility of catching an obstacle with the underslung load. During the recovery of the helicopter wreckage combined with diver operations at the site where the wreckage was settled on the bottom of the lake, no obstacles were found that could catch the bucket (e.g. submerged trees, branches, other).

In his statement, the pilot did not mention catching an obstacle either.

Installed in the cockpit was an indicator of the load of the hook on which the water container was underslung. The pilot did not refer to that in his statement. Therefore, it should be considered that either the indication shown did not exceed the permitted value (no obstacle had been caught) or the pilot did not notice such an indication.

Releasing the underslunged load, while instable hovering, could save the helicopter against the damage.

In hover, probably when the helicopter was moving backwards (drifting), the tail rotor came into contact with water. Eurocopter AS350B3e tail beam is positioned low relative to the fuselage, and clearance between the rotor blades and the ground is small. The special skid which protects the tail against contact of the tail rotor with the ground does not serve its purpose and does not protect the rotor when the helicopter is hovering over water. It could also happen that as the drifting had been stopped by the water-filled fire extinguishing container, moment was generated rotating (pitching) the helicopter around its lateral axis towards the tail.

After a rotation around the horizontal axis and ditching, the collision of a blade of the main rotor immediately generated the force destroying the rotor. The resulting imbalance of the rotor (runout) caused further damage to the tail gearbox and shaft (see the description in Point 1.3).

As regards the scope described in the SOP, the operator's procedures were met.

The SOP did not provide for equipping the pilot with a life jacket for flights over water. The SOP did not contain a procedure for emergency ditching and actions to be carried out after ditching.

2.2.3. Weather

The weather was favourable to operations involving taking water from the lake and carrying out fire-fighting tasks. According to an interview with the pilot, there was no turbulence in the air, and weak or non-existent wind did not affect the helicopter performance and did not hinder its control.

The pilot stated that he had commenced taking water on "heading 90°", "upwind" (see also Point. 1.7 Meteorological information).

It was considered that weather had had no impact on the occurrence.

2.2.4. Human factor

Human factors that could contribute to the occurrence were analysed.

Piloting a loaded helicopter in hover over the lake surface was a demanding task. The pilot should have monitored the helicopter's position relative to the lake, both in terms of height and the position over the water collection site. In the absence of any orientation points in the immediate area of the hover (water surface), small and hard to notice movements of the helicopter were possible. Maintaining the position was difficult because the pilot did not use support of a task specialist. The pilot stated that he had had orientation points in sight, such as the shore covered with tall vegetation, fishing jetties and wooded hill slopes at the lake.

The pilot was experienced and prepared for the mission. Probably, the tail rotor contact with water was the result from brief inattention, lack of anticipation or delayed response to drifting.

The pilot did not explain why he had not performed an emergency release of the water container. In the Commission's assessment, it might have been due to the time deficit and focus on an attempt to control the rotation of the helicopter.

2.3. Aircraft

2.3.1. Aircraft maintenance

The helicopter's maintenance records were verified as far as work relating to maintenance of the camera is concerned. The Master Service Manual (MSM 05-21-02) for the "B3" helicopter type lists only one maintenance task: no. 25/10/40/000/000/000, maintenance procedure 25-10-40, 5-2. This is a check whether the camera is working (recording) which involves copying a file recorded on the camera's SD card to a computer and replaying it.

Such a check should be conducted every 12 months.

It was demonstrated that the task concerned was (should have been) performed on 16 February 2022 by a Part 145 maintenance organisation in Poland (a Confirmation of Release to Service was issued for all works on the airframe) as per a Work Order issued the French CAMO.

The work on the camera was not listed in the CRS.

The maintenance status issued by the CAMO on 24 May 2022 contains a confirmation of the work as per MSM 05-21-02.

It should be presumed that the said record in the maintenance status was just a formal action, but the camera's recording function was in fact not checked.

The examination conducted by BEA did not find any causes why the camera had failed to record video images - no damage to the device was found.

2.3.2. Aircraft performance

The helicopter was operational until the moment of the impact of the tail rotor against the water surface. There was no defect that could result in the necessity to perform emergency landing.

2.3.3. Mass and balance

The estimated mass of the helicopter in flight while it was lifting the water-filled container was:

- empty mass of the helicopter (as per the weighing report) – 1,352 kg

- fuel mass: – around 450 l = 369 kg (0.820 kg/l)
- pilot mass – 85 kg
- underslung water bucket mass – 500 kg

Total: around 2,306 kg.

at the permitted MTOW with a load of 2,800 kg and the maximum weight of the underslung load of 1,400 kg.

Neither the helicopter mass in flight (corresponding to 82% MTOM) nor the mass of the underslung load (corresponding to 36% of the permitted underslung mass) were exceeded.

2.3.4. Aircraft equipment

The helicopter was fitted with a hook with an emergency release system of the underslung load.

2.3.5. Aircraft systems

Apart from the Vision 1000 camera (see 2.3.1.), all systems of the aircraft were operational.

2.3.6. Psychological and physiological factors which affected the personnel involved in the accident

After carrying out between several drops on the day of the occurrence, the pilot could feel fatigue.

The intensity of the fire-fighting operations (flights) was high and the pilot could feel the pressure related to the effects of fire fighting. Therefore, he might have been operating in a hurry.

The aforementioned factors could have affected the pilot's perception and thus deteriorated his psychomotor fitness. It is obvious that conducting a fire-fighting operation requires strong concentration (focus of attention) on a number of factors, and the prevailing risk of a dangerous situation is higher than during non-specialised operations.

2.4. Survival

2.4.1. Actions taken by rescue services

Information about the accident and instructions how to reach the injured were provided to air traffic services by the pilot of the M18 "Dromader" fire-fighting aeroplane who maintained communication with EPKT TWR and operated from the airfield in Niegowoniczki. TWR notified rescue services.

The rescue operation involved an LPR helicopter which landed close to the place of the occurrence (on the shore of the lake) at around 15:30 hrs (30 minutes after the accident). Land rescue services arrived on the scene at a similar time, followed by a representative of the operator and PKBWL. Reaching the shore of the lake, wreckage and pilot was hindered by that fact that access to the shoreline was restricted by a forest.

2.4.2. Survival aspects

The scale and nature of the structural damage shows that the helicopter collided with the water surface under high torque conditions generated by the power plant. It is confirmed by the data from the EDR. On impact against the water, one of the rotor blades detached from the hub, causing immediate imbalance of the rotor and the phenomenon of "runout" on the gear box's main shaft. As a result, the gear box with the hub and main rotor were torn off the airframe. Sinking, the helicopter fell on its left side.

The position of the helicopter on its left side enabled the pilot, who occupied the right seat in the cockpit, to quickly evacuate onto the helicopter side that was over the surface of the lake. At the moment of ditching, the pilot conducted an emergency release of the right-hand door, and after the helicopter sank and the rotating movements stopped, he unfastened his safety belts, swam to the surface of the lake and climbed onto the wreckage. Fastening the safety belts assured that he remained in the seat and avoided serious injuries.

One of the rotor blades hit the left side of the helicopter near the cabin door (Fig. 9). The door was significantly deformed and the composite structure cracked.

The plexiglass cabin glazing was partially broken. The cracked glass shards posed a risk of injuries.

Fig. 9 External damage to the cockpit: breaches in the roof and large glazing fragments missing. The right-hand door is missing because it was released during evacuation.

Due to the damage to the external ELT antenna during the accident, the transmitter did not transmit any signals.

3. CONCLUSIONS

3.1. Findings

3.1.1. The helicopter had a valid CofA, and was equipped and maintained in accordance with applicable regulations.

3.1.2. The helicopter had a valid third-party liability insurance.

3.1.3. The mass, centre of gravity and loading of the helicopter were within the prescribed limits.

3.1.4. No evidence was found of any defects or irregularities in the helicopter functioning that could have contributed to the accident.

3.1.5. The helicopter's structure was intact prior to the impact against the lake surface.

3.1.6. All damage was caused by the forces generated during the impact.

3.1.7. The pilot held a valid licence and qualifications to perform the flight, as per applicable regulations and requirements of fire-fighting operations.

3.1.8. The pilot held an appropriate and valid aero-medical certificate.

3.1.9. The pilot was rested before the flights.

3.1.10. The pilot had access to an up-to-date weather forecast.

3.1.11. After exiting the controlled zone of the EPKT aerodrome, the pilot did not maintain any radio correspondence with ATS.

3.1.12. Water was taken from the lake without assistance of a task specialist.

3.1.13. Applicable operating procedures were met.

3.1.14. The operator of the helicopter was a holder of a licence to provide air services, including specialised operations.

3.1.15. The Operator's operating procedures did not encompass actions during forced ditching. Nor did they require the pilot to wear any personal protective equipment.

3.1.16. Water was taken from the lake in hover, far from the shore and obstacles.

3.1.17. The pilot's behaviour during evacuation from the cabin was in line with the behaviour trained during "techniques of rescue and self-rescue at sea" exercises.

3.1.18. The helicopter was not fitted with a flight data recorder (FDR) or cockpit voice recorder (CVR), which were not required according to the regulations.

3.1.19. The accident helicopter was fitted with other power plant performance recording devices.

3.1.20. The data retrieved provided for analysing the course of the occurrence, including the performance of the power plant.

3.1.21. After performing several fire-fighting flights, the pilot could feel fatigue.

3.1.22. No evidence was found that the pilot suffered a sudden illness or limitation which could affect his ability to control the aircraft.

3.1.23. The pilot in the cabin wore a fastened safety belt, which prevented more serious injuries.

3.1.24. The pilot did not have a life jacket.

3.1.25. The pilot got out of the wreckage on his own.

3.1.26. The pilot sustained minor injuries, was examined at the hospital and subsequently discharged home.

3.1.27. The tail skid did not protect the helicopter against contact with water.

3.2. Causes and contributing factors

3.2.1. Hovering over water, as a result of which the tail rotor came into contact with the lake surface, most likely caused by a human factor: a temporary inattention and/or delayed pilot's reaction to the helicopter drifting.

3.2.2. Likely fatigue after performing several fire-fighting flights on the day of the occurrence, hurry in carrying out the fire-fighting operation.

3.2.3. Focus-intensive control of the helicopter in hover, which was additionally hindered by the swell of the lake surface cause by the downwash and the underslung heavy water container.

4. SAFETY RECOMMENDATIONS

None.

5. ADDENDA

5.1. Technical investigation reports

a) Document titled "BEA2022-0220_tec01_F-HCHB" on the condition of and data retrieved by BEA from technical devices installed on board the helicopter – as an internal document of PKBWL, attached to the investigation documentation.

b) Document titled "SafranHE_EDR Data Analysis RA 2022-119_Helipoland - F-HCHB", an analysis of the EDR data – as an internal document of PKBWL, attached to the investigation documentation.

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