AIR, MARITIME, AND RAILWAY ACCIDENT INVESTIGATION NATIONAL BOARD 9, Dyakon Ignatiy Street, 1000 Sofia, Bulgaria
https://www.ntib.bg

SAFETY INVESTIGATION REPORT

Ref.:
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Issue date:
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Status:
FINAL

ACCIDENT, OCCURRED ON SEPTEMBER 22, 2023, INVOLVING ROBINSON R44 HELICOPTER, REGISTRATION LZ-RAD IN THE AREA OF GARMEN VILLAGE, GOTSE DELCHEV MUNICIPALITY

Purpose of Report and Responsibility Level

Under Annex 13 of the Chicago Civil Aviation Convention of 07.12.1944, Regulation 996/20.10.2010 of the European Parliament and the Council on the investigation and prevention of accidents and events in Civil Aviation and Ordinance No. 13/27.01.1999 of the Ministry of Transport (last amendment and addition - 22.01.2016) of the Republic of Bulgaria, the investigation of an aviation event aims at identifying the reasons that led to the event to eliminate and exclude these in future **without identifying someone's guilt or liability**.

Contents

01. List of abbreviations

ALT	-	Altitude
AMSL	-	Above Mean Sea Level
AMRAINB	-	Aircraft, Maritime and Railway Accident Investigation National Bord;
AMM	-	Aircraft Maintenance Manual
A/C	-	Aircraft
BULATSA	-	Bulgarian Air Traffic Services Authority
CAA	-	Civil Aviation Authority
CPL (A)	-	Commercial Pilot License
FIC	-	Flight Information Centre
FCL	-	Flight Crew Licensing
DG CAA	-	Directorate General Civil Aviation Administration
EASA	-	European Aviation Safety Agency
FH	-	Flight Hour
ft	-	Foot
ICAO	-	International Civil Aviation Organization
IFR	-	Instrument Flight Rules
KT	-	Knots
MAG	-	Magnetic course
MSN	-	Manufacturer Serial Number
MTITC	-	Ministry of transport, information technology and communications
MTOM	-	Maximum Take-Off Mass
NTSB	-	National Transportation Safety Board of USA
FI(A).	-	Flight instructor
PIC	-	Pilot in Command
POH	-	Pilot's Operating Handbook
RWY	-	Runway
TLB	-	Technical Log Book
VFR	-	Visual Flight Rules
VMC	-	Visual Meteorological Conditions
UTC	-	Universal Coordinated Time

1. Introduction

Date and time of the aviation event: September 22, 2023, 07:44 h (local time) 04:44 h UTC The difference between local and universal coordinated times is +3 h. All times in the report are given in local time.

Notified: Air, Maritime and Railway Accident Investigation National Board (AMRAINB) and Directorate General "Civil Aviation Administration" (DG CAA) of the Republic of Bulgaria, the European Commission, the European Aviation Safety Agency (EASA) and the National Transportation Safety Board (NTSB) of USA.

On the grounds of Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation and the provisions of Article 9, Para1 of Ordinance No 13 of the Ministry of Transport of the Republic of Bulgaria dated 27.01.1999 on Investigation of Aviation Accidents the occurrence was classified as an Accident by the AMRAINB. The materials on the aviation occurrence have been filed in case No 05/2023 in Aviation Transport Unit archives at AMRAINB.

In accordance with the provisions of Article 5, para 4 of Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, Article 142. Para. 2 of the Civil Aviation Act of the Republic of Bulgaria, dated 01.12.1972, and Article 10, para. 1 of Ordinance No. 13 of the Ministry of Transport, dated 27.01.1999, on the Investigation of Aviation Occurrences, and on the grounds of the provisions of Article 6, para 1, point 8 of the Rules of procedure on the activity, structure and organization of the AMRAINB by Order No. RD-08-37 dated October 13, 2023, of the Chairperson of the Management Board, a Commission is appointed for investigation of the accident.

Summary:

On 22.09.2023 at 07:43 h from the stadium of the village of Garmen takes off helicopter Robinson R44 Raven II with registration marks LZ-RAD, owned by "Aviootryad Varna Ltd", for rebasing under the rules of visual flights to the village of Tsalapitsa. The aircraft was operated by a pilot with many years of experience, without the presence of other persons on board. During the preparation for the flight the weather in the stadium area was sunny with good visibility. However, one minute after take-off, flying north over hills with elevations 800 - 1000 m above the ground, the aircraft entered into fog and low dense cloud, hit a lone tree on the hill and stalled in a vegetated ravine. After the collision, the helicopter broke up, caught fire and burned, and the pilot died.

The Safety Investigation Commission points to the following as the probable cause of the accident:

Root Cause

The pilot’s incorrect decision to continue flight on the previously selected route, entering an area with reduced visibility due to fog and low ceiling, which resulted in the pilot’s spatial disorientation, loss of control of the aircraft and collision with the ground.

Immediate Cause

Ineffective preparation of the pilot in command for the execution of the flight, consisting in incomplete assessment of the actual and forecast meteorological conditions in the area of departure and along the route.

2. Factual information

2.1.1. Flight number and type, the last point of departure and time, and planned destination point

Flight Number: LZ-RAD.
Type of flight: Not Commercial – Ferry flight - Relocation
Last point of departure: Landing area of Garmen village, Bulgaria.
Take-off time: 07:44 h Local time.
Planned destination point: Landing area of Tsalapitsa village, Bulgaria.

2.1.2. Flight preparation and description of the flights

The factual information is based on data collected from:

- An inspection of the site carried out by the AMRAINB investigation team.
- Interviews conducted with the ground crew who had accompanied the pilot to the landing area and observed the initial phase of the flight.
- Conducted interviews with residents of the surrounding communities over which the helicopter flew.
- Conversations with the management of Aviootryad Varna Ltd and analysis of the electronic flight record provided by them.

In September 2023, a pilot and ground support personnel of a Robinson R44 Raven II helicopter, registration marks LZ-RAD, were sent by Aviootryad Varna Ltd under a contract with the State Enterprise "Southwest State Enterprise", Blagoevgrad, to treat forest land against weevils. On 19.09.2023 the aircraft was based in the village of Satovcha, Blagoevgrad municipality, where an engineer of Aviootryad Varna Ltd performed a planned 50-hour inspection of the aircraft. The next day, after completion of the planned activities, the pilot flies back to the stadium in the village of Garmen, where the team's temporary work site is located.

According to witness statements, on 21.09.2024 at the same time early in the morning, the meteorological situation around the village of Garmen was identical - rain, light fog and despite this around 06:45 h the pilot made a decision and took off. There is good visibility above the clouds, and he goes to the area of the neighboring village of Gega where he performs the tasks for the day, thus ending the team's mission.

About 7:00 h the aircraft was refueled with fuel, the engine was started and warmed up. After the routine pre-flight checks, the Pilot in Command (PIC) took off at 07:42 h and with a smooth right turn headed on a climb along the route, first to the west, then to the northwest, north, northeast, avoiding the nearby heights. The team watched him for about a minute, listened to the steady noise of the aircraft, then boarded the service van and headed for Tsalapitsa to meet the pilot where the helicopter never arrived.
After returning to Garmen, he coordinated their next obligations and planned a flight to Tsalapitsa the next day. On the 21st vs. 22nd September, a light prolonged rain fell throughout the night and in the morning light fog again fell in the area. At the stadium where the helicopter was positioned, the weather was clear, the sun was breaking through the thin ground veil, there was dense cloud to the north with a visibly high lower limit above 2000 m and the pilot decided to fly a direct route according to the previously prepared flight plan.

In the climb, the aircraft suddenly entered an area of reduced visibility due to low clouds and ground fog descending of the hillside. The pilot attempts to divert back to the stadium but loses visual contact with ground references. In the turn, the propeller blades of the nose rotor hooked the branches of a lone pine tree, and the helicopter stalled into a ravine overgrown with dense vegetation of shrubs and trees, with the left landing gear skid hitting a rock and crashing. Twenty meters further down the pilot dropped out of the cockpit, the engine broke off and slid down the slope. The aircraft is destroyed, caught fire and burned. The pilot died.

The team started looking for him by phone, but when they couldn't reach him, they called his relatives, Tsalapitsa airport, the company's management and then called 112 to report a possible accident. At noon, search and rescue activities began, involving teams from the mountain rescue service, the Ministry of Interior, a military helicopter from Krumovo air base, a private plane. Due to the worse weather conditions, the wreckage of the aircraft was not discovered until late in the evening in the inaccessible site of the accident. The pilot's body was taken to a hospital for autopsy and the remains were collected and moved to the Border Police base in Gotse Delchev for storage and analysis.

2.1.3. Location of aviation occurrence

The location of the aviation accident a hill with an altitude of 600 m, 800 m north of the stadium of the village of Garmen. with geographical coordinates:
LAT 41°36'22.35" N; LON 23°48'25.77" E.

Date and time: September 22, 2023, 07:44 h local time.
The event was realized early in the morning, during daylight hours.

2.2. Injuries to persons

Injuries	*Crew*	*Passengers*	*Total in the aircraft*	*Others*
Fatal	*1*	*0*	*1*	*0*
Serious	*0*	*0*	*0*	*0*
Minor	*0*	*0*	*0*	*0*
None	*0*	*0*	*0*	*Not applicable*
Total	*1*	*0*	*1*	*0*

2.3. Damage to aircraft

After the collision the structural integrity of the helicopter was destroyed. The damage to the aircraft is described in Paragraph 2.12 of this report and photographs are provided in Appendix 1.
As a result of the impact, fuel leaked, and the helicopter caught fire and burned. On contact with the ground, the pilot's body fell out of the cockpit to the side of the crashed aircraft, he sustained serious non-life-threatening injuries and died from his injuries.

2.4. Other damages

No other damage.

2.5. Personnel information:

2.5.1. Commander

The 62-year-old pilot in command held a Commercial Pilot License CPL (A) with date 5 August 2008 issued in accordance with Part-FCL (Flight Crew Licensing) for Civil Aviation Aircrew by the Bulgarian civil aviation authority, with the class rating R-44, PIC valid until 31 July 2024 and Flight Instructor R-44, TRI (H). He had a class 1 medical certificate valid until 7 March 2024 limited to VNL (Shall have available corrective lenses for near vision and carry a spare set of spectacles).

Last check:

- LPC/Skill test/AoC – July 22, 2023.
- Proficiency check – July 22, 2023.

Total flying: KA-26 and R-44 over 11000:00 h.

2.5.2. Flying experience

The pilot's flying career began in the SAA in 1983 as a PIC of KA-26, since 1988 he has been an instructor (TRI). In 2008 he switched to the Robinson R-44 helicopter, in the same year he qualified as an instructor (TRI). Until the fatal accident on 22.09.2023. The pilot had no interruptions in his flying activity.

The Commission assumes that the PIC possess the required qualifications and medical fitness for flights in accordance with existing regulations.

2.6. Aircraft Information

2.6.1. Airworthiness Information

The R-44 Raven II helicopter, registration LZ-RAD serial number 12534, was manufactured on October 21, 2008, by Robinson Helicopter Company, USA. The General Directorate of Civil Aviation Administration of the Republic of Bulgaria issued Registration Certificate No 2247 dated 05.02.2009 with registration marks LZ-RAD and holder Darik Radio. The helicopter was purchased by Aviootryad Varna Ltd. in 2020. AO holds CAO No. BG. CAO. 0443. The Certificate of Airworthiness is No. 2247 and the Airworthiness Review Certificate is No. BG-ARC-2247 with date June 20, 2023 of issue by Aviootryad Varna Ltd. valid until July 2, 2024.

Since the beginning of operation until the last airworthiness review on 20.06.2023, the helicopter has flown 1680 flight hours. The helicopter's specified technical resource is 2200 h or 12 years (whichever comes first). According to the Maintenance Programme, the helicopter does not have an assigned total technical service life. The remaining resource to first repair is 520 h.

The helicopter is equipped with the Lycoming engine type IO-540-AE1A5, serial No. RL-21081-48E. The determined engine overhaul is 2200 h or 12 years (whichever comes first). The remaining resource to first overhaul is 520 h.

The helicopter is fitted with a carrier and tail rotor with resource limitations equivalent to those of the airframe.

The Maintenance is carried out by an approved maintenance organization "Aviootryad Varna" Ltd., holding a CAO certificate No. BG.CAO.0443, in accordance with the requirements of the "Technical Maintenance Program of Robinson R44II helicopter with registration marks LZ-RAD, serial No. 12534". The programme was approved by DG CAA on 06.04.2012 under reference No 0443.MP.R44.

The maintenance programme includes the completion of a pre-flight check prior to each flight, completion of Form A, fifty-hundred-hour baseline checks. In the event that the aircraft has not completed 100 flight hours within one year of the date of the previous basic maintenance, a 100-hour basic check shall be performed.

At the airworthiness review, the maintenance organisation declared maintenance performed for the period from 19.06. 2022 to 20.06.2023. The last 50 h inspection was performed on 19.09.2023 in Satovcha with 1782 h flown.

Therefore, at the time of the event, the helicopter R-44 with registration marks LZ-RAD, the engine, the main rotor and the tail rotor mounted on it had the necessary resources to perform the flight.

2.6.2. Aircraft characteristics

The Robinson R44 II, Reg. No. LZ-RAD, Ser. No. 12534, is a four-seat, single-pilot, single-engine helicopter with a normal rotor scheme - one Main rotor and one Tail rotor. Certification category - "Small Rotorcraft". The aircraft is certified in accordance with the requirements of the certification

specification issued by the European Union Aviation Safety Agency (EASA) - Small Rotorcraft, and is documented with TCDS Type Certificate No: EASA.IM.R.121.

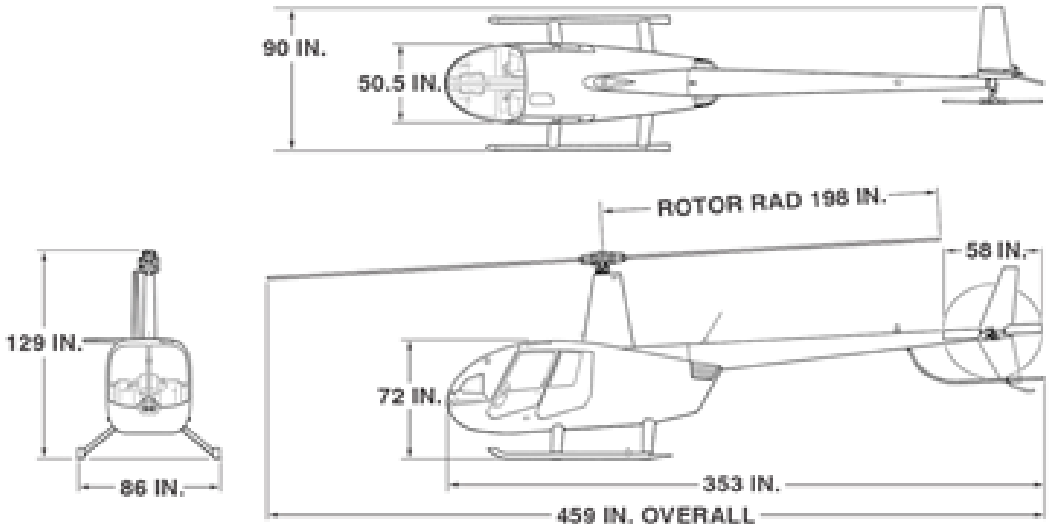


Fig. 1.

The Robinson R44 II helicopter, serial No. 12534, registration No. LZ-RAD, is equipped with a single piston, six-cylinder, horizontally opposed, air-cooled Lycoming IO-540 boxer engine. The helicopter's rotor system includes a main and tail rotor, driven by a main and tail reducer, respectively. The propellers each have two all-metal blades. Torque from the engine to the reducers is transmitted via a Vee-belts transmission with belts, sprag type overrunning clutch and a tailshaft. The helicopter uses a non-retractable skid-type landing gear, the underside of which is coated with a wear-resistant layer.
The aircraft's geometric characteristics and general appearance are shown in Fig. 1.
The basic flight characteristics and operational restrictions of the Robinson R44 II helicopter are the following:

DIMENSIONS

Length:	*459 in (11.66 m)*
Width hull	*50.5 in (1.28 m)*
Height	*129 in (3.28 m)*

MAIN ROTOR

Articulation	*Free to teeter and cone, rigid inplane*
Number of Blades	*2*
Diameter	*33 ft (10,6 m)*
Blade Chord	*10,0 in (25,4 sm) inboard* *10,6 in (26,9 sm) outboard*
Blade Twist	*- 6°*
Tip Speed @ 102% RPM	*705 FPS (214,9 m/s)*

TAIL ROTOR

Articulation	*Free to teeter, rigid inplane*
Number of Blades	*2*
Diameter	*4,8 ft (1,5 m)*
Blade Chord	*5,1 inch (12,9 sm), (constant)*
Blade T	*0°*
Precone Angle	*1°*
Tip Speed @ 102% RPM	*614 FPS(187,1 m/s)*

DRIVE SYSTEM

Engine to Upper Sheave:	*Four double Vee-belts with 0.778:1 speed reducing ratio*
Upper Sheave to Drive Line	*Sprag type overrunning clutch*
Drive Line to Main Rotor:	*Spiral-bevel gears with 11:57 speed reducing ratio*
Drive Line to Tail Rotor:	*Spiral-bevel gears with 31:27 speed increasing ratio*

POWERPLANT

Model	*Lycoming IO-540-AE1A5*
Type	*Six cylinders, horizontally opposed, direct drive, air cooled, fuel injected, normally aspirated*
Displacement:	*541,5 in^3 (8,4 l)*
Maximum continuous rating (MCP)	*205 BHP at 2718 min^{-1} (102% on tachometer)*
Takeoff rating	*245 BHP at 2718 min^{-1} in 5 Minute*
Cooling system	*Direct drive squirrel-cage blower*

The Robinson R44 Raven II is designed for visual flight. Control is performed by one or two pilots. The load capacity is 408 kg. The empty mass of the helicopter is 696 kg. The maximum take-off mass is 1134 kg. Cruising speed is up to 116 kts, maximum speed is 130 kts. Flight range is 560 km, maximum flight altitude is 2700 m above ground level and 4300 m density altitude. Recommended fuel - aviation gasoline with low lead content 100LL. Volume of the main fuel tank - 120 L, volume of the auxiliary fuel tank - 70 L. The spraying system is "R 44 Helipod III Spray System". The loading limit in the system for R44 Raven II helicopters is 285 L or 285 kg. Spray arm length - 10 m. The operation of the helicopter with a spray system is only allowed within the limitations of the "Restricted" category, and the pilot must observe the mass and centring limitations, instrument speed limitations, emergency load dump, landing and take off specifics, etc.
The mass of the helicopter before flight is determined by:
- mass of an empty helicopter - 696 kg (Mass and Centring Log of 28.06.2021);
- mass of fuel loaded - 90 kg (120 litres with a density of 750/15ºkg/m3);
- mass of the pilot - 90 kg;
- mass of the spraying unit - 84 kg.

Therefore, the helicopter commenced flight with a take-off mass of 960 kg, i.e. there was no exceedance of the maximum permissible mass, which is 1134 kg, as stated in the Noise Certificate and the R44 Pilot's Operating Handbook.

Manoeuvring restrictions
1. The execution of aerobatics is prohibited.
2. Cyclic deflections of the control handle to create approximately zero or negative overloads are prohibited - risk of the carrier propeller striking the tail spar, risk of Mast Bumping.
3. Flight in icing conditions is prohibited.
4. Solo flight shall be performed from the right pilot's seat only. In this case the seat belts of the front left seat must be tightened.
5. Minimum number of crew members - 1.
6. Maximum number of passengers - 4.
7. Only daytime flights on the VFR are allowed.
8. Night flights on the VFR are permitted only when landing lights, navigation lights, instrument panel lighting and flashing collision avoidance lights are installed and in working order.

9. Night flight orientation is maintained by visual contact with objects on the ground surface illuminated by artificial and/or natural (sky) lighting.
10. IFR flights are not permitted.

2.6.3. Information on the fuel used and its condition.

Fuel quality was not a causally related factor in the aviation accident which occurred because there were no impairments found in the normal operation of the engine.

2.7. Meteorological information

2.7.1. Weather conditions

Report on weather conditions on the route from the village Garmen to the village Tsalapitsa in the period 03:00 - 05:00 UTC on 22.09.2023.
On the previous day - 21.09.2023 over the western part of the country developed significant cumulus clouds, along which thunderstorms and intense local precipitation in the area of the villages of Garmen and Tsalapitsa. The observed meteorological conditions are due to warm and humid air moving from the Mediterranean Sea into the eastern part of the cyclone.

On the morning of 22.09.2023, this air mass has largely moved eastwards, with cloud formation processes significantly weakened, and the influence of the extensive cyclone located over the northwestern part of the continent is beginning to be felt (albeit weakly) over the country. This influence translates into a break in the transport observed during the previous day and a lack of conditions for the development of hazardous weather.

Due to suitable orographic conditions, the latest active atmospheric processes will diminish over the southwest of the country and in some places in the Danube Plain on the morning of 22 September. For south-western Bulgaria, the last reported precipitation was at 09:00 local time (Fig. 2), which is evident from both radar and satellite meteorological information (Fig. 3a and Fig. 3b).

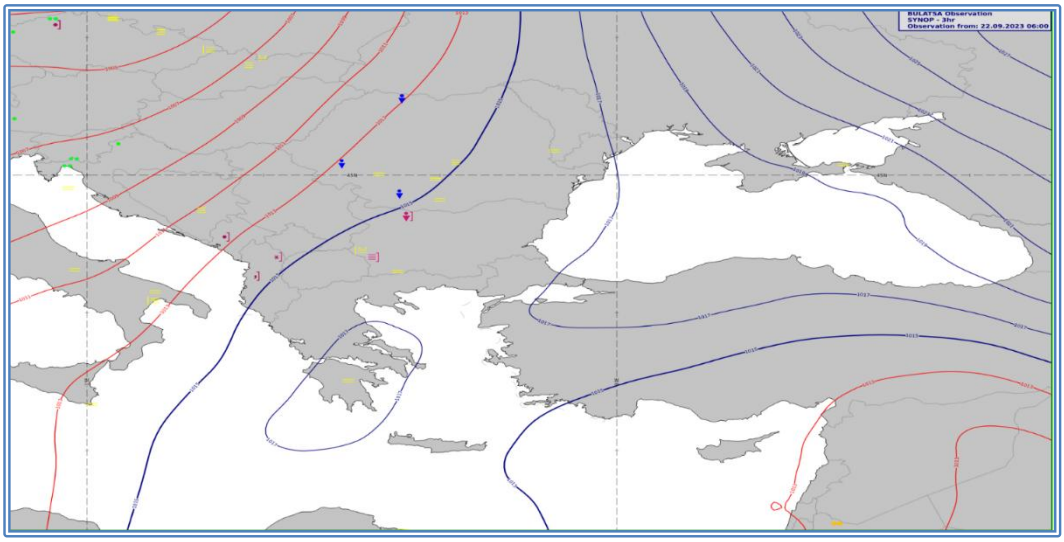


Fig.2 Field of sea level atmospheric pressure, according to synoptic observations at 06:00 local time on 22.09.2023.

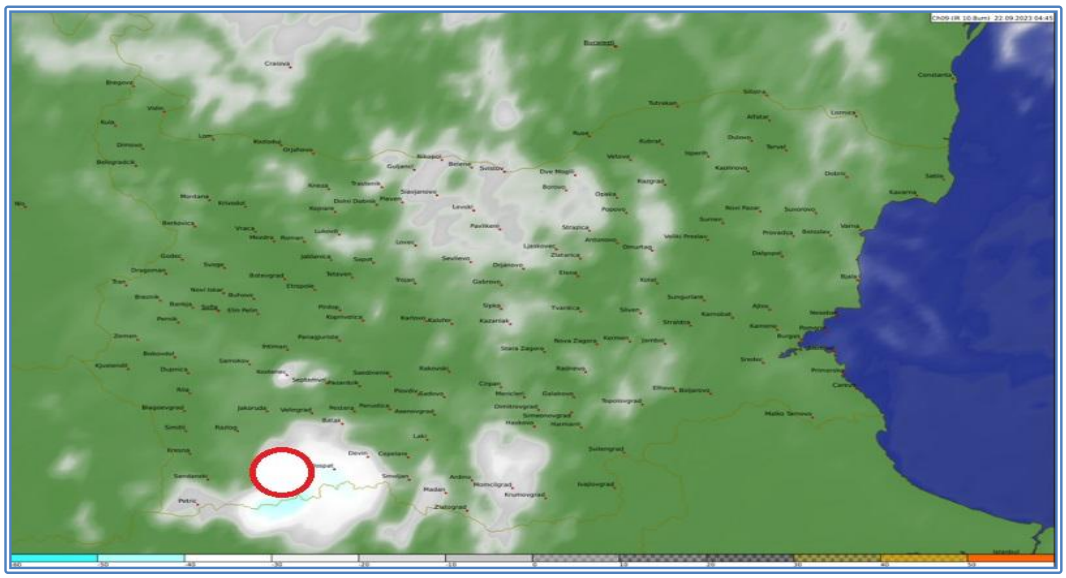


Fig. 3a Radar picture

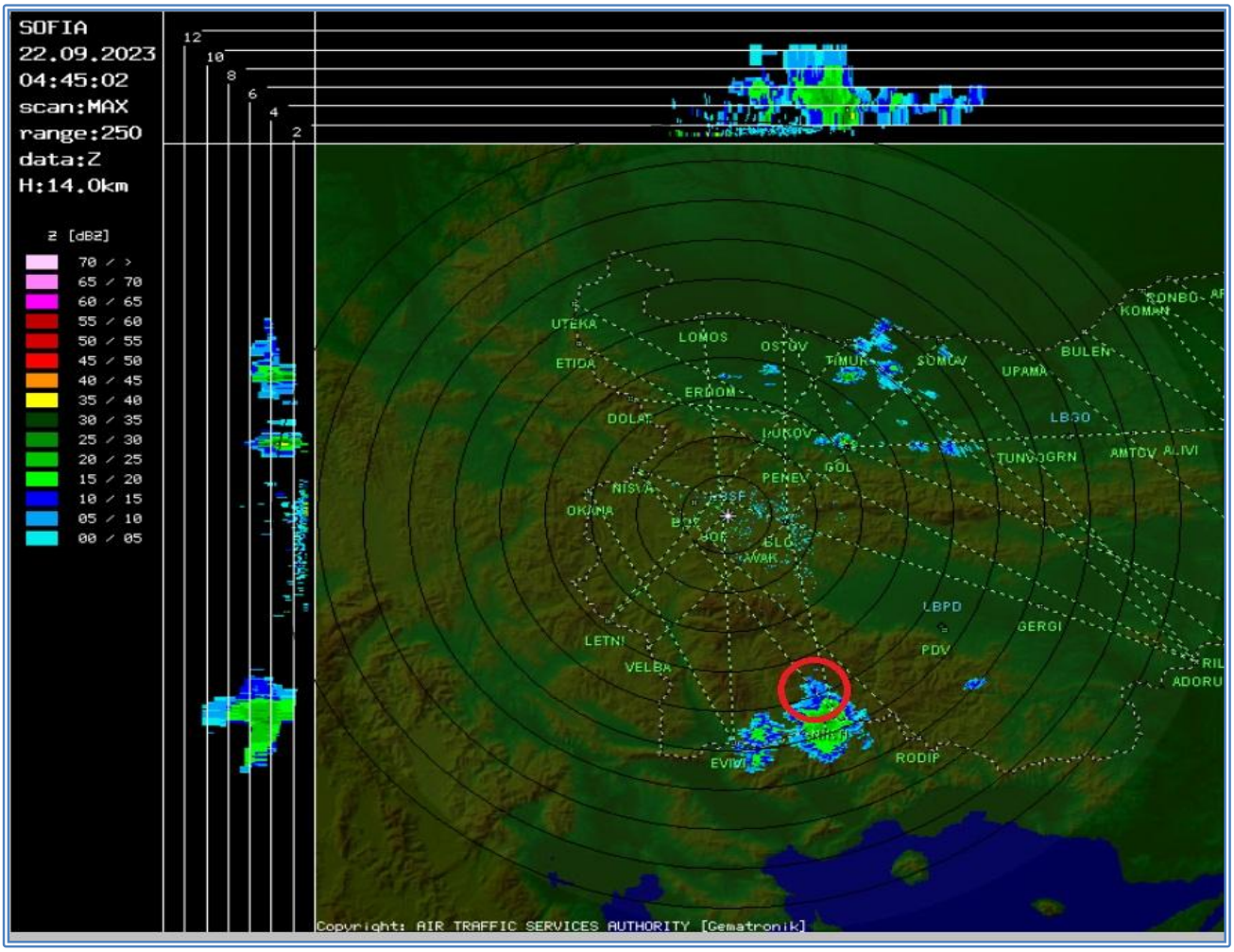


Fig. 3b Weather satellite for 07 :45 local time

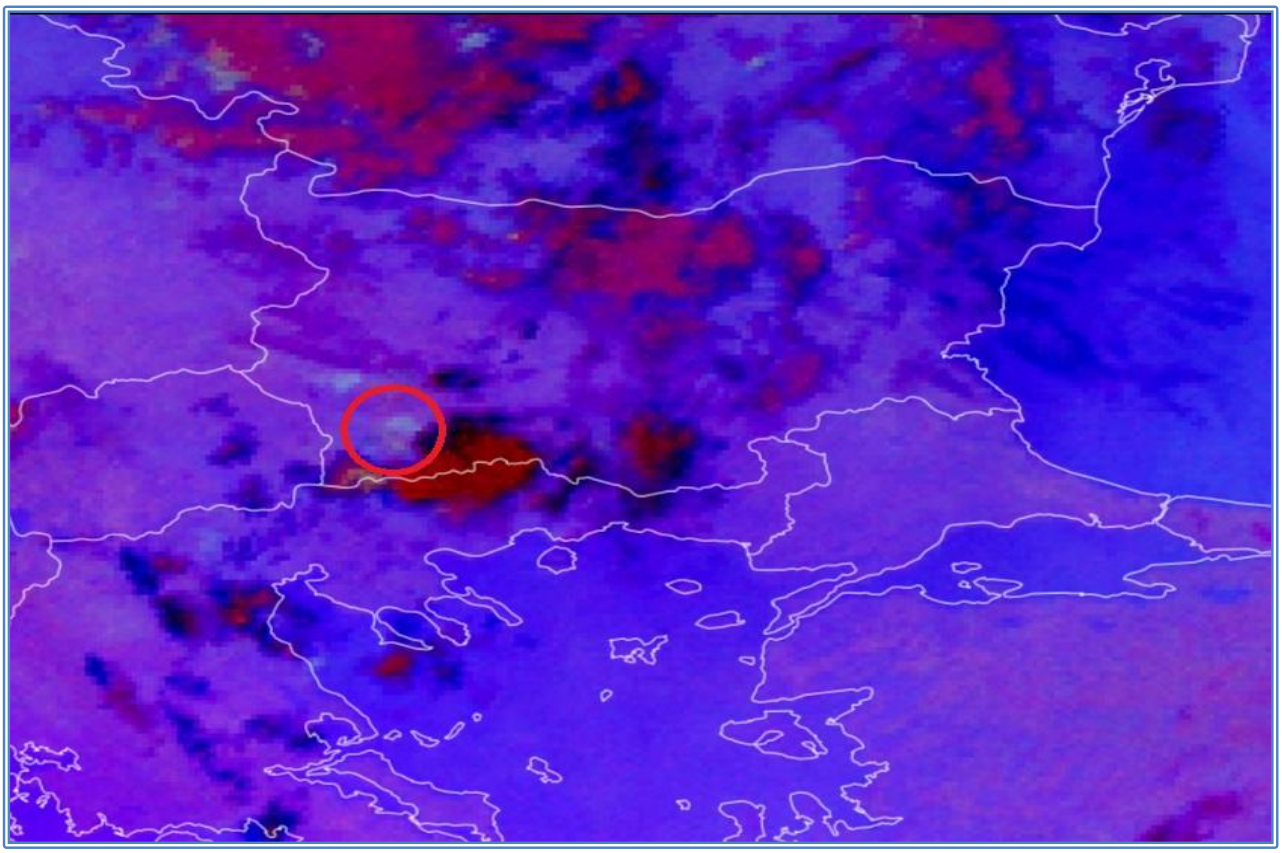


Fig.4 RGB composite image from MSG10 at 07:45 local time on 22.09.2023. The shaded area shows low clouds or fog

Meteorological data for the area between Garmen and Tsalapitsa

The data obtained from the EUMETSAT MSG11 meteorological satellite and from the weather radar networks of BULATSA show that in the region and period under consideration there is still rainfall cloud cover, which is withdrawing to the east, while also gradually beginning to dissipate (Fig. 3a and 3b).On the RGB FOG/LOW Cloud composite obtained from MSG10, clouds are observed, which according to EUMETSAT are interpreted as the presence of low cloud or fog (Fig. 4).

From the meteogram of temperature, humidity and wind in the area of the village of Garmen (Fig. 4) generated by the regional numerical weather forecast model BULATSA WRF in the period from 05:00 to 08:30 local time at a point with geographical coordinates approximately N41°36' E023°48' there are conditions for inversion and also indications of the presence of significant moisture in the lowest layers of the atmosphere, with little wind in the ground layer.

All these conditions, together with the appropriate orography and the previously observed precipitation, appear to be a prerequisite for the formation of a short-lived fog due to evaporation after the precipitation, which is indirectly confirmed by satellite observations and by the variations in visibility reported in the SYNOP synoptic data, although not as significant, at the nearest synoptic stations (Fig. 5).

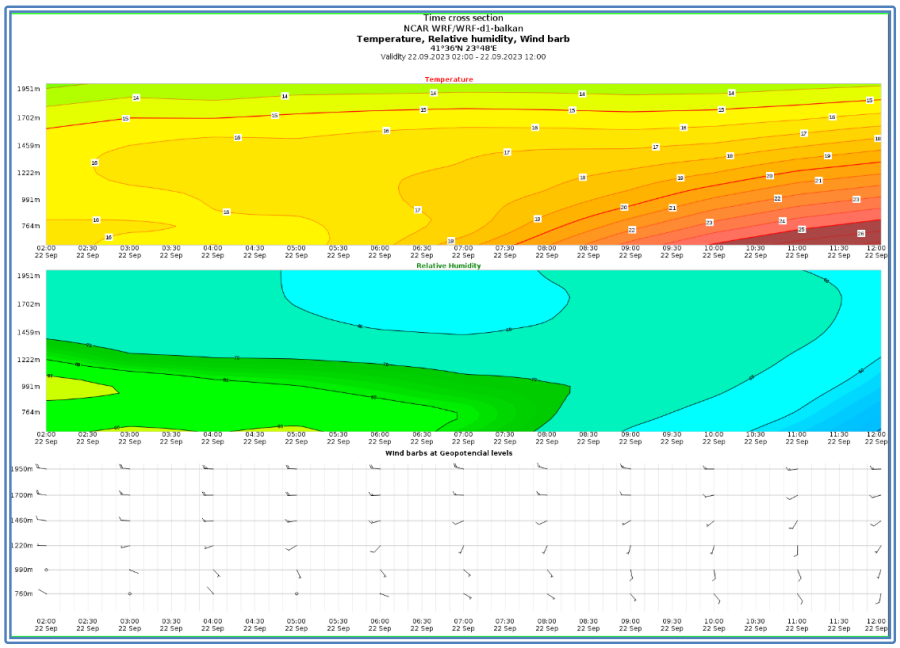


Fig. 5 Meteogram of temperature, humidity and wind in the area of Garmen village from the regional numerical weather forecast model BULATSA WRF

Based on the examination of the circumstances of the occurrence of the accident with the helicopter Robinson R44 II with registration LZ-RAD, MSN 12534, the Commission concluded that the weather conditions were extremely unfavourable for performing the planned flight.

2.8. Aids to navigation

The standard navigation and instrument equipment of the helicopter is designed for visual flight conditions with good visibility of ground references (under visual flight rules - VFR). There were no reports of equipment malfunction at the time of the accident prior to the ground impact.

2.9. Communications

Standard communication equipment of the helicopter.

2.10. Aerodrome information

The flight, in which the realized event is carried out, takes place from the stadium of Garmen village, which is not used for sport or other events during these days.

The point of departure is located in Class 'G' airspace, and flights in this airspace to and from uncontrolled aerodromes and airfields are not required to be cleared by air traffic control (ATC), provided they do not cross controlled areas and areas served by military ATC authorities, activated flexible airspace management structures, hail control ranges for which ATC needs to coordinate with the authority of the Civil and Military Common Airspace Management System. According to the current EU and Bulgarian regulations, these flights can be performed without sending a flight plan and without the requirement to maintain radio communication with the ATC authorities.

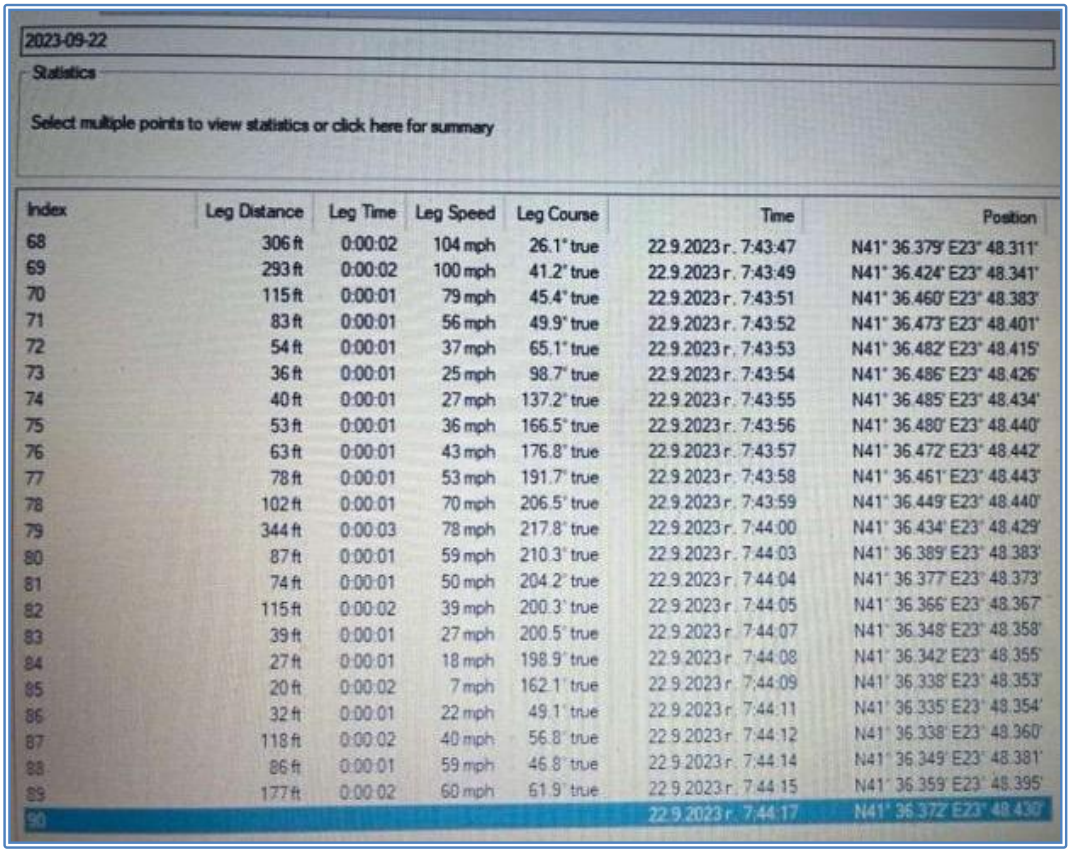
In accordance with the current Regulation No. 22 of 21.07.1999 on the conduct of flights in the airspace and from/to the airports of the Republic of Bulgaria, the procedure was notified.

2.11. Flight recorders

Fig. 6 shows the heading and airspeed data from the logger device installed on the aircraft with registration marks LZ-RAD, provided by the aircraft operator:

- 07:27:00 h - switching on the power supply to the logger after which the pilot started the engine, performed the necessary engine warm-up and instrument and equipment checks.

- 07:42:08 h - the helicopter took off;
- 07:44:17 h - ground impact occurred.



2023-09-22

Statistics

Select multiple points to view statistics or click here for summary

Index	Leg Distance	Leg Time	Leg Speed	Leg Course	Time	Position
68	306 ft	0:00:02	104 mph	26.1° true	22.9.2023 г. 7:43:47	N41° 36.379' E23° 48.311'
69	293 ft	0:00:02	100 mph	41.2° true	22.9.2023 г. 7:43:49	N41° 36.424' E23° 48.341'
70	115 ft	0:00:01	79 mph	45.4° true	22.9.2023 г. 7:43:51	N41° 36.460' E23° 48.383'
71	83 ft	0:00:01	56 mph	49.9° true	22.9.2023 г. 7:43:52	N41° 36.473' E23° 48.401'
72	54 ft	0:00:01	37 mph	65.1° true	22.9.2023 г. 7:43:53	N41° 36.482' E23° 48.415'
73	36 ft	0:00:01	25 mph	98.7° true	22.9.2023 г. 7:43:54	N41° 36.486' E23° 48.426'
74	40 ft	0:00:01	27 mph	137.2° true	22.9.2023 г. 7:43:55	N41° 36.485' E23° 48.434'
75	53 ft	0:00:01	36 mph	166.5° true	22.9.2023 г. 7:43:56	N41° 36.480' E23° 48.440'
76	63 ft	0:00:01	43 mph	176.8° true	22.9.2023 г. 7:43:57	N41° 36.472' E23° 48.442'
77	78 ft	0:00:01	53 mph	191.7° true	22.9.2023 г. 7:43:58	N41° 36.461' E23° 48.443'
78	102 ft	0:00:01	70 mph	206.5° true	22.9.2023 г. 7:43:59	N41° 36.449' E23° 48.440'
79	344 ft	0:00:03	78 mph	217.8° true	22.9.2023 г. 7:44:00	N41° 36.434' E23° 48.429'
80	87 ft	0:00:01	59 mph	210.3° true	22.9.2023 г. 7:44:03	N41° 36.389' E23° 48.383'
81	74 ft	0:00:01	50 mph	204.2° true	22.9.2023 г. 7:44:04	N41° 36.377' E23° 48.373'
82	115 ft	0:00:02	39 mph	200.3° true	22.9.2023 г. 7:44:05	N41° 36.366' E23° 48.367'
83	39 ft	0:00:01	27 mph	200.5° true	22.9.2023 г. 7:44:07	N41° 36.348' E23° 48.358'
84	27 ft	0:00:01	18 mph	198.9° true	22.9.2023 г. 7:44:08	N41° 36.342' E23° 48.355'
85	20 ft	0:00:02	7 mph	162.1° true	22.9.2023 г. 7:44:09	N41° 36.338' E23° 48.353'
86	32 ft	0:00:01	22 mph	49.1° true	22.9.2023 г. 7:44:11	N41° 36.335' E23° 48.354'
87	118 ft	0:00:02	40 mph	56.8° true	22.9.2023 г. 7:44:12	N41° 36.338' E23° 48.360'
88	86 ft	0:00:01	59 mph	46.8° true	22.9.2023 г. 7:44:14	N41° 36.349' E23° 48.381'
89	177 ft	0:00:02	60 mph	61.9° true	22.9.2023 г. 7:44:15	N41° 36.359' E23° 48.395'
90					22.9.2023 г. 7:44:17	N41° 36.372' E23° 48.430'

Fig. 6 Data from the logger device

From the review of the flight data during the last 30 seconds of the flight, it can be concluded that the pilot for the first 8 seconds reduces the helicopter's ground speed from 167 km/h to 40 km/h, for the next 7-8 seconds the speed increases to 126 km/h in the third series of 8 seconds the speed decreases to 11 km/h, then increases again and at a speed of about 100 km/h the recording stops. The impact with the ground occurred at a step speed of about 100 km/h. From these sudden fluctuations in the rate of descent, it appears that the helicopter was periodically climbing (speed decreasing) and descending (speed increasing).

Flight in the vertical plane has a sinusoidal character. The flight heading data record indicated that for the first 16 seconds the heading changed from a heading of 26° to a heading of 217°, and in the subsequent 10 seconds the flight reversed direction and from 217° the helicopter reduced heading to 162° at the time of recording, when the airspeed is at its lowest (11 km/h) there is an abrupt change in heading from 162° to 049°, at which point the helicopter rotates on its vertical axis 113° for exactly two seconds, then for the last 5 seconds the heading changes direction again and increases to about 062°, at which rate the main rotor collides with the trees.

The total duration of the logger is 17 minutes and 17 seconds, the flight from take-off to ground impact is 2 minutes and 09 seconds.

Fig.7 Flight pattern according to the data in the logger.

2.12. Wreckage and impact information

The initial impact of the aircraft with the ground was made in a right bank with the main rotor in a lonely pine on a hill with an altitude of 600 m, 800 m north of the stadium of the village of Garmen with geographical coordinates: LAT 41°36'22.35" N; LON 23°48'25.77" E. The helicopter plunged into a ravine and successively hit trees, bushes and rocks, losing its structural integrity. As a result of the collision, fuel leaked, causing a fire and the aircraft caught fire and burned. Numerous heavily charred wreckages were observed at the site and were scattered near the helicopter (Figure 1 of Annex 1); A detailed inspection of the helicopter was carried out after its relocation to the garage cell of the Border Police - Gotse Delchev.

As a result of the fire that occurred after the helicopter impact it was found:

- the structure of the piston aircraft engine and components of its electrical system were heavily burned (Figure 2 of Annex 1);
- all spark plugs on the engine are fitted and fastened correctly. The spark plug electrodes have a relatively clean, shiny and smooth surface, free from oiling and soot deposits (Figure 3 of Appendix 1);
- there is no other mechanical damage to the engine intake and exhaust manifolds, except for deformation caused by the collision (Figure 5 of Annex 1);
- as a result of the impacts, the main gearbox, the upper shaft with the upper pulley, the mast with the shaft to the main rotor and the blades of the main rotor were completely destroyed (Fig. 4 and Fig. 6 of Annex 1);
- one blade of the main rotor is torn off the hub and the other has impact traces (probably in wood) (Fig. 6 in Appendix 1);
- a relatively large angle of blade position on the propeller is observed, probably due to the pilot's trying to increase the thrust and lift generated by the propeller in ordered to increase the altitude of the flight;
- The tail spar is deformed, and there are scorch marks on its skin. The tail shaft is torn from the helicopter fuselage (Figure 7 of Appendix 1);

- the tail rotor and tail reducer are detached from the tailshaft. The control drive of the tail rotor is broken. There is no structural damage to the tailshaft, front roller bearing and spur gear of the tail gear (Figure 10 of Appendix 1). Both tail blades are 'sheared' and one is bent, perpendicular to the plane of rotation of the propeller (Fig. 8 of Appendix1);
- Deformations are observed on the horizontal stabilizer and on the attacking edge of the vertical stabilizer (Fig. 9 of Appendix 1);
- the spraying system has been destroyed (Figure 11 in Appendix 1);
- All dashboard instruments except the magnetic compass have significant scorch marks (Figure 12 in Appendix 1).
-

2.13. Medical and pathological information

On 01.11.2023, the Commission received the official statement of NMTB-"King Boris III" on the pilot's health condition until the fatal event. Annual medical examinations since the beginning of his career have not revealed any deviations related to professional requirements. He received his medical certificate for first class pilot on 09.01.1997 without restrictions.
During the subsequent annual (and after the age of 60 years, every 6 months) aeromedical examinations for recertification, extended tests were carried out in relation to age, and the results were within normal limits.

On 20.01.2009, during the periodic aeromedical examination for re-certification, a decrease in near vision was detected and a restriction was placed on his medical certificate of fitness - VNL (corrective glasses must be available and a spare pair of near vision glasses must be worn).

At his last aeromedical examination on 05/09/2023, the pilot declared no other health problems and no change in his medical condition on his application forms. The forensic report following the examination and subsequent autopsy stated that the pilot's instantaneous death was caused by combined high energy severe craniocerebral and thoracic trauma.

The forensic chemical examination concluded that testing for the possible presence of alcohol, narcotics and/or drugs did not indicate the presence of such agents.
Copies of the formal medical and forensic examinations are attached to the record in Investigation No. 05/22/09/2023.

2.14. Fire

During the event, a fire has occurred, and the aircraft was almost completely burnt out. The fire resulted from impact on the ground.

2.15. Factors for Survival

At 11:50 h local time on 22.09.2023 the Search and Rescue Coordination Centre at DG CAA received a notification from Flight Information Centre (FIC)about a Robinson helicopter with registration LZ-RAD, which at 07:42 h local time took off from the stadium in the village of Garmen, Blagoevgrad district. In previous days the aircraft had been spraying the forests in the area, and on that day after take-off it was to base directly at Tsalapitsa airport, but by noon the helicopter had not landed there. There was no information about the flight at FIC. The information that no landing had been made at Tsalapitsa was given by the helicopter technician who provided the helicopter when it took off from Garmen.

The FIC gave the Search and Rescue Centre the pilot's phone number 088 ... but the operator failed to make contact. He was given the phone number of the manager of the company that owns the searched helicopter. He confirms the take-off and gives him the latest GPS coordinates: 41°36'372"N 023°48'430"E, and the color of the aircraft - red (burgundy). It was found that the helicopter was equipped with an Emergency Locator Transmitter (ELT), which did not work, so that the Centre only

had the latest coordinates. At 12:10 h the coordinator of the Search and Rescue Coordination Centre reported to Director of DG CAA and informed them of the situation. the coordinator of the Search and Rescue Coordination Centre has received permission to begin a search and rescue operation.

At 12:13 p.m., he notified the Chairman of the Aircraft, Maritime and Railway Accident Investigation National Bord. At 12:25 h began notification of all participants of the search and rescue system Military Command Centre, Operational Centre of Ministry of Interior, Operational Centre of Fire Safety and Civil Protection, Mountain Rescue Service, Centre for Emergency Medical Care - Blagoevgrad, Krumovo Airbase and BULATSA. The prepared a request for the involvement of the Military Air Force from Krumovo (military helicopter Cougar) in an area with coordinates 41°36'372" N 023°48'430" E, and a radius of 10 km, and sent to the Military Coordination Centre at 13:20 h. A request for a NOTAM over the designated area to FL 80 was made via BULATSA at 13:26 h, broadcast at 14:00 h under No. 0953. At 14:01 h a helicopter with call sign AFB 711A took off from Krumovo airbase.

No evidence of the searched aircraft was found on the first flight. Private light aircraft participated voluntarily in the assistance, a helicopter of the Border Police AUGUSTA A109E with call sign 515E was also involved, which took off from Plovdiv at 16:10 h, equipped with a thermal camera. The helicopter carried out a search along the presumed flight path from Tsalapitsa back to Garmen, but again to no avail and landed in Bezmer at 20:05 h, as there was not much time before sunset. The centre decides to involve ground teams from the Military Coordination Center and the Fire Safety and Civil Protection in a land search. The terrain is divided into two parts in a straight line from the stadium of Garmen to the village of Leshten.

From Fire Safety and Civil Protection in Gotse Delchev 15 people were assigned to join the search and immediately started at 17:15 h on the transmitted coordinates of the searched helicopter. At 16:52 h a telephone conversation was held with the head of the Mountain rescue Service, who formed another group, and they left without delay, arriving on the road at 17:45h.

With the permission of the Air Force Commander, a second flight of a Cougar helicopter was made from Krumovo Air Base, taking off at 18:25 h. Reconnaissance in the area again did not yield the expected result and the helicopter landed at Krumovo at 19:27 h. At 18:50 h, the teams of DG Fire Brigade are at the place with the indicated coordinates but find nothing. Around 19:35 h, the Centre received a phone call that the wreckage had been found, with the helicopter most likely impacting a landslide and breaking apart. As a result of the impact, a fire occurred, which subsequently extinguished itself. The area is inaccessible, and clearings had to be cut on the steep and overgrown slope to reach the wreckage. The arriving ambulance team ascertained the death of the pilot, whose body was found at the scene.

2.16. Tests and research

For the purposes of the safety investigation, the Safety Investigation Commission were carried out:

1. Search and Rescue operation carried out.

2. Inspection of the wreckage of a Robinson R44 II helicopter, registration LZ-RAD, at the accident site.

3. The further inspection of the aircraft wreckage at the storage site.

4. Interviews with witnesses of the realized occurrence.

5. Research and analysis of helicopter technological and operational documentation.

6. The analysis of documents related to the registration and airworthiness of the aircraft.

7. Assessment of aircraft flight performance.

8. The survey and analysis of documents related to the flight training and qualification of the pilot.
9. Logical-probabilistic analysis of possible causes of the aviation event.

10. Assessment of the meteorological conditions in the area and in the route.

On the first item, the results of the search for the missing helicopter are given in paragraph 2.15.

On the second item, the results of the inspection of the helicopter after the event are reflected in paragraphs 2.1.2, 2.1.3, 2.3 and 2.12.

On the third item, the results of the inspection of the helicopter at the location of storage are reflected in paragraphs 2.3 and 2.12.

On the fourth item, the results of the interviews conducted with witnesses of the occurred event, aviation operator officials and persons relevant to the accident are reflected in paragraphs 2.1.2, 2.5, 2.6.1, 2.7, 2.15 and 2.17.

On the fifth item, the results of the survey and analysis of the helicopter's operational and technological documentation are reflected in paragraphs 2.6.1, 2.6.2 and 2.6.3.

On the sixth item, the survey and analysis of documents related to the registration and airworthiness of the aircraft are reflected in paragraphs 2.6.1.

On item seven, the results of an assessment of the flight performance of the helicopter relevant to the realised event are given in paragraph 2.6.2.

For item eight, the results of the surveys and analysis of documents related to the flight training and qualification of the pilot are given in paragraph 2.5.

On item nine, a logical-probabilistic analysis of possible causes of the accident is conducted in Chapter 3 of this report.

An analysis of the meteorological conditions for item 10 is given in paragraph 2.7 of this report.

2.17. Additional information.

2.17.1. Visual Flight Rules

In accordance with Regulation (EU) No 923/2012 and Section ENR 1.2-3 of the Aeronautical Information and Publication (AIP) of the Republic of Bulgaria:
Except when operating as a special VFR flight, VFR flights shall be conducted so that the aircraft is flown in conditions of visibility and distance from cloudsequal to or greater than those specified in Table 1 below.
Visual meteorological conditions (VMC) are defined by the following criteria:

(a) Altitude (or flight level).
(b) visibility.
(c) distance (horizontal and vertical) to/from cloud masses for the relevant classes of airspace.

Altitude band	**Airspace class**	**Flight visibility**	**Distance from clouds**
At and above 3 050m (10 000ft) AMSL	C G	8 km	1500m horizontally 300m (1 000ft) vertically
Bellow 3 050m (10 000ft) AMSL and above 900m (3 000ft) AMSL, or above 300m (1 000ft) above terrain, whichever is the higher	C G	5 km	1500m horizontally 300m (1000ft) vertically
At and below 900m (3 000ft) AMSL, or 300m (1 000ft) above terrain, whichever is the higher	C	5km	1500m horizontally 300m (1000ft) vertically
	G	5km (*)	Clear of cloud and with the surface in sight
(*) When so prescribed by the CAA: *a) flight visibilities reduced to not less than 1 500m may be permitted for flights operating:* *1) at speeds of 140kts IAS or less to give adequate opportunity to observe other traffic or any obstacles in time to avoid collision; or* *2) in circumstances in which the probability of encounters with other traffic would normally be low, e.g. in areas of low volume traffic and for aerial work at low levels;* *b) helicopters may be permitted to operate in less than 1 500m but not less than 800m flight visibility, if manoeuvred at a speed* *that will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.*			

In the event that during the en-route phase the weather conditions fall below the cloud base or visibility minima shown, helicopters certified for flights only under VMC shall discontinue the flight or return to base.

Helicopters equipped and certified for instrument meteorological conditions (IMC) operations may discontinue the flight, return to base or convert in all respects to a flight conducted under instrument flight rules (IFR), provided the flight crew are suitably qualified.

3. Analysis

Based on what has been stated so far in the report, the aviation event was the result of an aircraft impact with the ground.
In order to clarify the causes that led to its occurrence, the Commission considered the following main hypotheses:

1. A sudden change of weather conditions during the flight.
2. Effect of external factors - impact with bird(s) or sudden deterioration of the pilot's health.
3. Technical failure of the aircraft or its systems resulting in impossibility to continue the flight.
4. Violation of visual flight rules by the pilot.
5. A possible combination of circumstances and conditions associated with the first four hypotheses.

Regarding the first hypothesis:
The Commission considered the meteorological conditions on 22.09.2023 at the time of the flight in Garmen and along the route.

It should be noted that the clearest overview of the meteorological conditions at a location in a particular time slot is given by the thermodynamic diagram (distribution of temperature, humidity and wind at altitude).
At the Air Force Meteorological Centre (AFMC), such a chart was constructed pertaining to the area of c. Garmen on 22.09.2023, at 7:00 h in the morning.

The diagram (Fig. 8) clearly shows a ground temperature inversion (orange line) with a peak at 814 m (about 200 m above ground level). On this date, the sun was rising at about 07:12 h in this region (at an altitude of about 600 m). The surrounding hills are lit up before this. A process of rightward shift of the temperature line (warming) and gradual downward descent of the inversion peak has begun. This was followed by thinning of cloud cover, stopping of drizzle (reported by rain gauge stations) and then gradual breaking of cloud cover (reported by the AFMC weather station in Gotce Delchev) that had ended the inversion.

The most important consequence of the inverse lowering process thus described, in the presence of nearly 100% relative humidity at the ground and the surrounding cloud-covered hills in a nearly windless sky, has the important consequence that the clouds which have been "squeezed" by the inversion also descend. As a result, fog "falls" and doesn't form.

This conclusion allowed for the Commission to draw the following conclusions:
- The combination of meteorological, geographical and astronomical features has led to a short-term reduction of horizontal and vertical visibility in the area of Garmen, between 6:30 h and 8:00 h on 22.09.2023.
- It is practically not possible to predict this "fall" of fog forecast without being personally familiar with, understanding or having interpreted all the information reflected in the three meteorological reports.

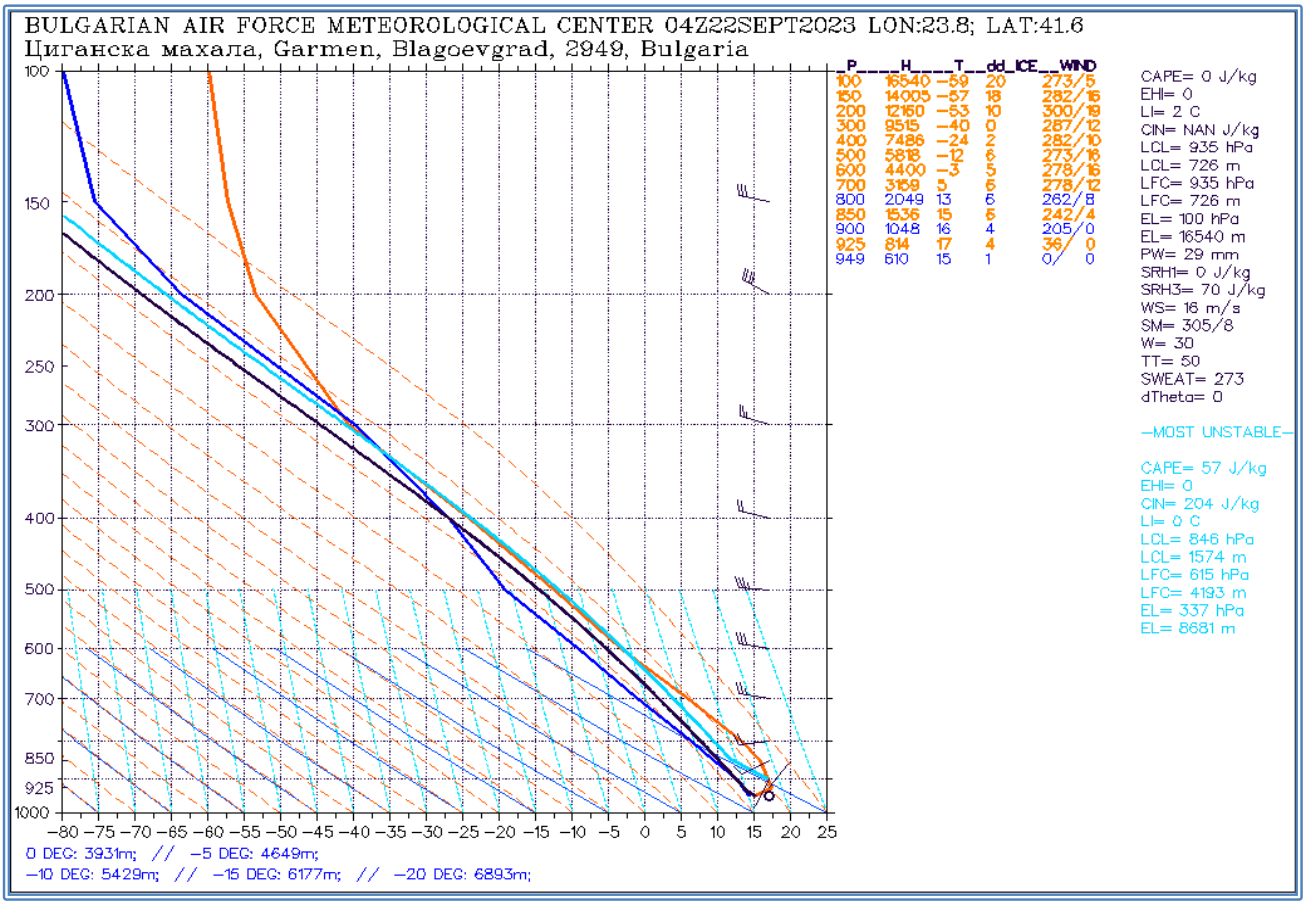


Fig. 8

Regarding the second hypothesis:
No evidence of bird strikes was found during the inspections. From the analysis of the periodic aero-medical examinations and the interviews with the accompanying team, no facts and circumstances of deterioration of the pilot's health were found, therefore the Commission considers it as practically not very probable.

Regarding the third hypothesis:
The Commission's inspection of the area of the accident clearly showed traces of the forward motion of the aircraft on the surface of the hill, slope and vegetation. Furthermore, along the slope there are numerous young trees cut in a regular shape and at a height of 1.0-1.5 m, which proved that at the moment of contact with the ground the helicopter's propeller was rotating at a high angular speed. It should be noted that all engine spark plugs were reliably installed and attached. Their electrodes have a relatively clean, shiny and smooth surface, free from oiling and sooting deposits.
Considering the above, it can be stated that the accident did not occur from hover, autorotation or emergency landing and the engine was running at the time of the aircraft's impact with the ground.
The foregoing allows the Commission to exclude the possibility of technical failure.

Regarding the fourth hypothesis, related to the execution of the flight under visual flight rules:

In accordance with the pilot's training and the aircraft equipment, the flight should be performed in accordance with the visual flight rules published in Regulation (EU) No 923/2012 and Section ENR 1.2-3 of the Aeronautical Information and Publication (AIP) of the Republic of Bulgaria. Based on the Visual Flight Rules there are several elements that constitute the framework within which the pilots operate.

The first of these factors is visibility. Pilots must be able to see a specific distance, which varies based on altitude and the type of airspace they are flying in. Clear visibility allows pilots to navigate by sight and maintain separation from terrain and other aircraft

The second key factor is cloud clearance. VFR requires that pilots maintain a specific distance from clouds. This distance also fluctuates based on altitude and airspace classification. Staying clear of clouds is crucial to ensure that pilots can keep visual reference with the ground and avoid entering Instrument Meteorological Conditions. (IMC)

The third element is the altitude above the ground and below the lowest layer of clouds. Pilots flying under VFR must maintain a flight altitude of not less than 150 meters AGL, depending on terrain. This provides adequate visibility and allows safe manoeuvring, ensuring that the aircraft always remains in visual meteorological conditions (VMC).

The third factor is the ceiling, which refers to the height above the earth’s surface of the lowest layer of clouds that are either broken or overcast. Pilots flying under VFR must have a certain minimum ceiling to ensure adequate vertical visibility. This allows for safe manoeuvring and guarantees that the aircraft remains in visual meteorological conditions.

Safety is the top priority when flying under Visual Flight Rules. A good practice is in-depth pre-flight planning. Pilots should collect all necessary information on the route and airports, weather conditions and airspace restrictions. This planning should also be in accordance with the aircraft's relevant equipment and airworthiness for the intended flight, with all systems, including navigation, functioning correctly.

Another good practice is to keep situational awareness during the flight. Pilots should continuously scan the horizon for other aircraft and obstacles, monitor their instruments to ensure they are on the

correct heading, and keep track of their distance to controlled airspace. This awareness helps to prevent disorientation and reduces the risk of a dangerous midair collision.
Compliance with flight rules (visibility, distance to clouds and having visual contact with terrain) and remaining in the airspace is the sole responsibility of the pilot of the aircraft.

When the ceiling and/or visibility falls below certain values, the pilot is in the situation of not seeing an obstacle and not having enough time to take action to avoid it. This obstacle may be natural (a hill, a tree, or simply the ground) or artificial - structures (a building, a tower) or another aircraft. This may create a risk of collision.

Reduced visibility and/or low clouds may also lead to loss of disorientation, including spatial disorientation.

Although the pilot's training to avoid adverse weather conditions required him for avoiding entering IMC (Instrument Meteorological Conditions) by slowing the speed of the helicopter and maneuvering or landing, there is no evidence that he attempted to do these procedures.

The actual encounter of an IMC during VFR flight, which may occur gradually or suddenly, has no easy procedural way out and is usually not actually performed in visual conditions during flight training conducted on helicopters. Fatal accident cases have shown that the changeover to using the helicopter's instrumentation to maintain flight profile awareness after loss of external Visual Reference can be difficult at times, especially for pilots qualified to fly IFR. Thus, training that avoids IMC and provides pilots with the decision-making training and skills to effectively avoid IMC is of crucial importance to safety.

It should be noted that when flight conditions change from visual to instrument, the pilot may be surprised at the sudden loss of visual reference. This is because following the loss of visual references in flight, pilots are susceptible to vestibular illusions that can lead to spatial disorientation and loss of aircraft control

In view of the foregoing, regarding the fourth hypothesis, the Commission considers that at the climb stage the helicopter started to enter the clouds, the pilot lost visual contact with the horizon and the ground. The loss of visual orientation was probably episodic at the start but probably became complete by the time the aircraft over the hilly area started to execute a right turn deviating from its route.

Regarding the fifth hypothesis, the Commission did not find evidence of a possible combination of dominant factors that contributed to the accident.

Considering the above paragraph, the following can be mentioned as probable causes of the accident:

Root Cause
The pilot’s incorrect decision to continue flight on the previously selected route, entering an area with reduced visibility due to fog and low ceiling, which resulted in the pilot’s spatial disorientation, loss of control of the aircraft and collision with the ground.

Immediate Cause
Ineffective preparation of the pilot in command for the execution of the flight, consisting in incomplete assessment of the actual and forecast meteorological conditions in the area of departure and along the route.

4. Conclusion

4.1. Findings

As result of the investigation, the Commission made the following conclusions:

1. The helicopter R-44 Raven II, registration LZ-RAD, serial number No 12534 was manufactured on October 21, 2008 by Robinson Helicopter Company.

2. The aircraft holds Certificate of Registration No. 2247 issued by the General Directorate of Civil Aviation Administration of the Republic of Bulgaria on February 2, 2009.

3. The helicopter was purchased by Авиоотряд Varna Ltd. in 2020.

4. The Авиоотряд Varna Ltd. holds a Certificate of Aviation Operator № BG. CAO. 0443.

5. The helicopter holds Certificate of Airworthiness No. 2247 and Airworthiness Review Certificate No. BG-ARC-2247, issued by Авиоотряд Varna Ltd. on June 20, 2023, and valid until July 2, 2024.

6. From the beginning of operation until the last airworthiness review, on June 20, 2023, the helicopter has flown 1680:00 h.

7. The helicopter is equipped with Lycoming type IO-540-AE1A5 engine, factory No. RL-21081-48E

8. The maintenance of the helicopter is carried out in accordance with the Maintenance Programme of the R-44 Raven II helicopter of Авиоотряд Varna Ltd., approved by the DG CAA on 06.04.2012 under reference No. 0443.MP.R44.

9. The last 50-hour inspection was carried out on 19.09.2023 in Satovcha at flown 1782 h.

10. At the time of the occurrence, the helicopter R-44 with registration marks LZ-RAD, the engine, the main rotor and the tail rotor mounted on it had the necessary resources to perform the flight.

11. As a result of the examinations and analyses carried out, no technical reasons were found relating to the functioning of the fuel and ignition system of the engine, nor any reasons relating to the compounding which could lead to a partial or total loss of power of the power unit.

12. Helicopter R-44 Raven II, registration LZ-RAD is equipped for daytime flights on the VFR

13. The helicopter is not permitted to fly under IFR;

14. The pilot in command possesses the required qualifications and medical fitness for flights in accordance with existing regulations.

15. There is no evidence of any health problems resulting in loss of capacity on the pilot in command before and during the event.

16. At the time of the flight in which the aviation event occurred, there was dense low inversion cloud north of the take-off landing site

17. The engine was working at the time of impact. It is not possible to establish the presence of mechanical failure in the helicopter engine due to its destruction.

18. During the flight, when the aviation event was realized, the visibility critically deteriorated and the aircraft entered an area of dense low cloud and ground fog, which changed the conditions from visual (VFR) to instrument flight (IMC), which was contrary to the pilot's training, the aircraft's equipment and the pilot operation handbook.
19. The actions of the pilot in command after the occurrence of the complex flight conditions, associated with reduced visibility and loss of spatial orientation, were chaotic, as evidenced by the variable flight profile when analysing the heading and speed parameters recorded in the flight recorder (logger).

4.2. Causes

Based on the circumstances set out in this report and the analysis of the above, the Commission points to the following as the probable causes of the accident:

Root Cause
The pilot’s incorrect decision to continue flight on the previously selected route, entering an area with reduced visibility due to fog and low ceiling, which resulted in the pilot’s spatial disorientation, loss of control of the aircraft and collision with the ground.

Immediate Cause
Ineffective preparation of the pilot in command for the execution of the flight, consisting in incomplete assessment of the actual and forecast meteorological conditions in the area of departure and along the route.

5. Safety Recommendations

Considering the cause of the accident, the Commission recommends the following measures to ensure flight safety:

BG.SIA-2024-06 The CAA DG of the Republic of Bulgaria to conduct a training workshop for aviation operators and pilot-owners operating aircraft from temporary landing and take-off sites, related to the sources, procedures and methods of obtaining adequate aeronautical and meteorological information - actual and forecast conditions, for the purpose of safe flight planning and execution.

BG.SIA-2024-07 The DG CAA of the Republic of Bulgaria to approve flight simulator scenario exercises in the initial and recurrent training programme for helicopter pilots to include elements of decision making, skills and procedures required to recognise and re-action to suddenly deteriorating weather conditions in flight.

The Investigation Commission reminds all organizations, to which flight safety recommendations are sent that, on the grounds of Article 18 of Regulation (EU) 996/2010 on Investigation and Prevention of Accidents and Incidents in Civil Aviation and Article 19, paragraph 7 of Ordinance No. 13 on the Investigation of Aviation Accidents is obliged to notify the Air, Maritime and Railway Accidents Investigation National Board in writing of the action taken on the recommendations made.

AIR, MARITIME AND RAILWAY ACCIDENTS INVESTIGATION NATIONAL BOARD

COMMISSION ON INVESTIGATION OF THE ACCIDENT

Sofia December 30, 2024

ANNEX 1

Fig.1

Fig.2

Fig.3

Fig.4

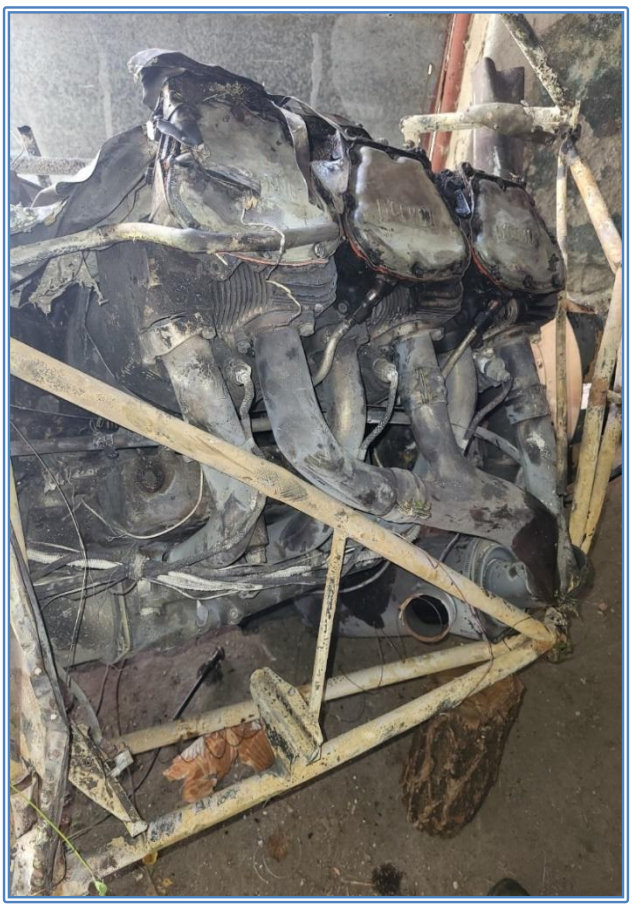


Fig. 5

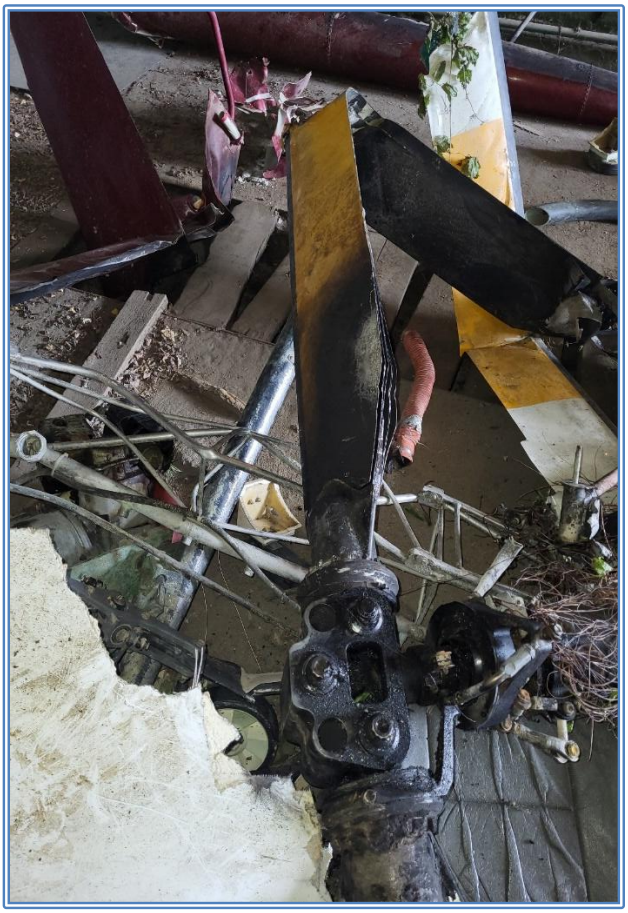


Fig.6

Fig. 7

Fig.8

Fig. 9

Fig. 10

Fig.11

Fig. 12