

AIR ACCIDENTS INVESTIGATION
INSTITUTE
Beranových 130
199 01 PRAHA 99

Ref. No. CZ - 12 - 131

FINAL REPORT

**Investigation of the air accident
involving the Safari helicopter, registration N 557XS,
at the village of Litvínovice - Šindlovy Dvory,
14 May 2012**

Prague
February 2013

This investigation has been carried out in accordance with European Parliament and Council (EU) Regulation No. 996/2010, Act No. 49/1997 Coll., on Civil Aviation, and Annex 13 to the Convention on International Civil Aviation. The sole objective of the investigation is the prevention of future accidents and incidents without determining blame or responsibility. The Final Report, findings and conclusions therein concerning air accidents and incidents, and possibly systemic shortcomings endangering operational safety, are only of an informative nature and cannot be used otherwise than as a recommendation for the implementation of measures in order to prevent further air accidents and incidents with similar causes. The creator of the Final Report explicitly states that the Final Report cannot be used to determine blame or responsibility in connection with determining the causes of an air accident or incident and cannot be used for enforcing claims in the event of an insurance claim.

Symbols and abbreviations

°C	Temperature in degrees Celsius
AAII	Air Accidents Investigation Institute
ACC	Area Control Centre
AFIS	Aerodrome Flight Information Service
AGL	Above ground level
AIP	Aeronautical Information Publication
AMSL	Above mean sea level
ATZ	Aerodrome traffic zone
BASE	Cloud base
BKN	Broken
CAA	Civil Aviation Authority
CHMI	Czech Hydro-meteorological Institute
CPL(H)	Commercial pilot licence (helicopter)
CU	Cumulus
CZ	Czech Republic
E	East
FAA	Federal Aviation Administration (USA)
FB	Fire Brigade
FEW	Few
FIR	Flight information region
ft	Feet (unit of length - 0.3048 m)
h	Hours
hPa	Hectopascal
kg	Kilogram (unit of weight)
km	Kilometre
kt	Knot (unit of speed - 1.852 km.h ⁻¹)
LAA	Light Aircraft Association
Lbs	Pounds (unit of weight – 0.45359 kg)
LKCS	Public domestic, private international airport České Budějovice
LKHS	Public domestic aerodrome Hosín
m	Metre
MIFM	Military Institute of Forensic Medicine
min	Minute
MR	Main rotor
MSL	Mean sea level
NIL	None
N	North
PPL(H)	Private pilot licence (helicopter)
QNH	QNH Atmospheric pressure (barometric pressure adjusted to mean seal level using the standard pressure setting, used for setting the altimeter pressure scale to show the altitude)
SC	Stratocumulus
SFD	Sport Flying Device
FRG	Federal Republic of Germany
SYNOP	Report on surface synoptic observations at a ground weather station
TR	Tail rotor
UL	Ultralight
UTC	Coordinated Universal Time

A) Introduction

Operator:	Private individual
Aircraft type:	Canadian Home Rotors Inc., Safari kit
Builder:	Private individual
Registration:	N 557XS
Location of accident:	The village of Litvínovice - Šindlovy Dvory
Date and time:	14 May 2012, 12:16 h (All times are UTC)

B) Synopsis

The helicopter pilot with another person on board planned an approximately one hour flight into the area southwest of the town of České Budějovice in order to verify the behaviour of the helicopter after it was serviced. After briefly flying over LKHS, the pilot flew away from the aerodrome towards the southwest. He entered the ATZ of LKCS at the western edge of the town of České Budějovice and continued in the original direction of the flight at an altitude of approximately 50 m AGL. The helicopter crashed onto a grassy area west of a water tower. The impact into the ground and subsequent fire completely destroyed the helicopter. The pilot and the passenger of the helicopter sustained injuries incompatible with life.

Witnesses reported the accident on the emergency telephone number 112. A patrol of the Police of the Czech Republic, a FB unit and AAI inspectors came to the crash site and carried out a detailed examination of the site and the wreckage of the helicopter. The wreckage of the helicopter was transported to a workplace of the AAI for further detailed examination.

The cause of the accident was investigated by an AAI commission comprising of:

Investigator in charge:	Ing. Josef BEJDÁK
Members:	Ing. Lubomír STRÍHAVKA Col. MUDr. Miloš SOKOL, Ph.D., MIFM Prague

The Final Report was released by:

AIR ACCIDENTS INVESTIGATION INSTITUTE
Beranových 130
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On 4 February 2013.

C) The Final Report includes the following main parts:

- 1) Factual information
- 2) Analysis
- 3) Conclusions
- 4) Safety recommendation
- 5) Appendices

1 Factual information

1.1 History of the flight

A witness at the aerodrome of take-off and people who watched the helicopter shortly before the critical phase of the flight reported the following information about the history of the flight.

Information from witness No. 1

The witness who observed the activities of the helicopter at LKHS said that he spoke with the pilot before he refuelled the helicopter. The pilot mentioned that he needed to refuel the helicopter for a flight and that he plans about an hour-long flight to check the balancing of the MR. The pilot also stated that he will carry out a short flight over LKHS, and if everything goes well, then he will fly away from the aerodrome for an hour-long flight and return. The witness then watched the helicopter as it performed manoeuvres at low altitude in the area south of the office building and according to the witness, he did not see anything unusual in the way the helicopter behaved.

Information from witness No. 2

The witness, when looking out of the window from his flat on the seventh floor of a building in the Máj housing development in České Budějovice, saw a red helicopter flying low over the forest. The helicopter caught his attention at first sight because he had never seen such a small helicopter fly. With interest he watched its flight over the horizon of the forest. The flight did not seem unusual until he saw “*something*” fall off of the helicopter. The helicopter then continued to fly in the same direction and moderately descend, until it disappeared behind the treetops of the forest. The witness at first thought that the helicopter normally landed behind the forest, but after a moment realized that this manoeuvre could have something to do with the object that fell from the helicopter and preferably he immediately called the emergency telephone number 112.

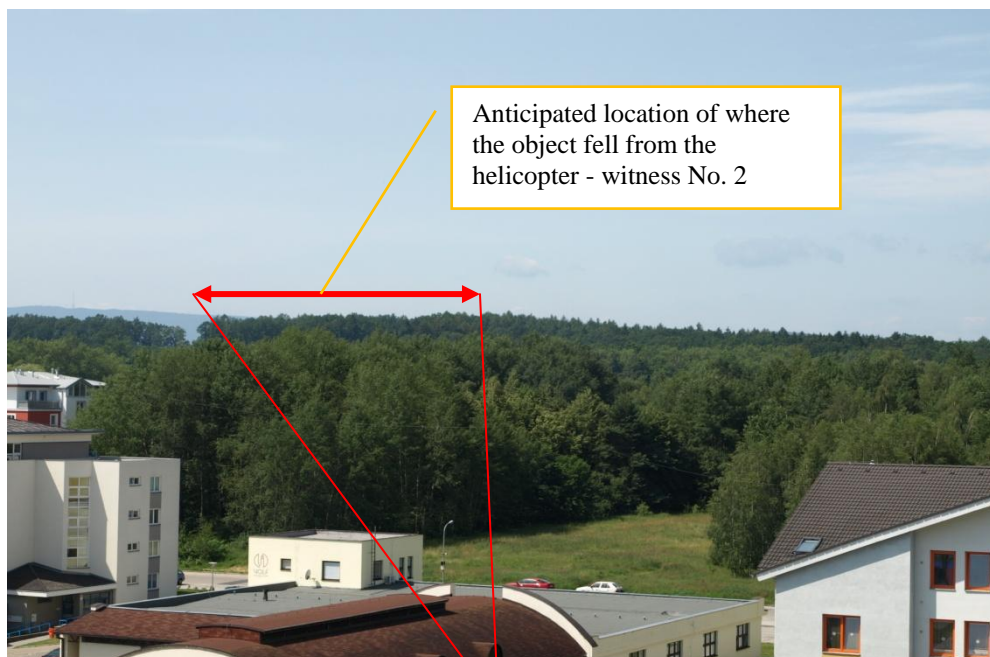


Fig. 1: View towards the location of the crash from the viewpoint of witness No. 2

Information from witness No. 3

The witness, at approximately 12:15 h, was in the yard of a waste collection point that is located at the edge of a golf course in the western part of České Budějovice. The yard is located approximately 1,300 m from the crash site. Here he was handling the waste that he brought. During this activity he heard the sound of a helicopter that was coming from the direction of the Máj housing development, i.e. from the north. He looked in that direction and saw a helicopter that was flying over the landscape at an altitude that he could not guess. The helicopter caught his attention due to its size, because he had never seen such a small helicopter. The witness stated that the helicopter was flying normally above the landscape at the time and there were no indications that it should crash. He then turned and returned to his work and heard the helicopter continue in its flight approximately to the west. Then he heard a sound that he described as the impact of two things hitting each other, and turned in that direction. He spotted the helicopter on the horizon to the west at a similar altitude as his prior observation. He then saw as a dark-coloured object fell from the helicopter. Simultaneously, the helicopter, while he was looking at its left side, began turning counter-clockwise so that the tail section turned to a position representing two o'clock. Subsequently, the helicopter began falling to the ground. It started falling nose first, not perpendicularly to the ground but in an arc. The helicopter disappeared below the horizon and the witness only heard it crashing into the ground. He reported the situation to the emergency telephone number 112 from his mobile phone.

Description of the critical flight

The pilot together with another person on board of the helicopter planned an approximately one-hour flight in order to verify the behaviour of the helicopter after the balancing of the MR using the VIBREX device. After preparing the helicopter for flight, the pilot refuelled the fuel tanks with aviation petrol. The record from the dispensing point at LKHS on 15 May 2012 at 11:59 h confirms the refuelling with 86.01 litres of AVGAS 100 LL petrol. Before refuelling, the pilot spoke briefly with witness No. 1 about the planned flight and the time of the planned return to LKHS. The pilot took off from the fuelling point at 12:02 h and by air taxiing moved to the area between RWY 06/24 and the aerodrome's office building. Here he carried out basic manoeuvres with the helicopter at an altitude of 1 – 2 m AGL. The helicopter behaved completely normally, and therefore the pilot continued his flight in a circuit in order to test the behaviour of the helicopter in individual flight modes. After carrying out a small southern circuit, the pilot, at 12:08 h, continued in his flight into the area of Hluboká nad Vltavou. The pilot, at 12:14 h, tried for the first time to establish contact with the AFIS dispatcher at LKCS on the frequency 135.925 MHz. However, he did not hear the dispatcher, so he tried establishing contact a total of four times. Although he did not receive information about the traffic in the ATZ of LKCS, he entered the ATZ to the west of the Máj housing development and continued to fly in the direction of LKCS. It was here that witness No. 2 first saw the helicopter and he watched it from a distance of about 700 – 850 m and did not see anything unusual about the flight until something fell from the helicopter and the helicopter continued flying. It was at this time that witness No. 3 probably heard the helicopter and saw it flying from the north. The critical phase of the flight occurred at the moment witness No. 3 heard the sound of the impact of two things hitting each other and simultaneously saw a dark object separate from the helicopter. At the same time the tail beam of the helicopter started veering to the right, its nose veered towards the ground and it began to fall towards the ground in a curved path. After hitting the ground, the crashed helicopter burst into flames.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	1	0
Serious	0	0	0
Minor/None	0/0	0	0

1.3 Damage to the aircraft

The helicopter was completely destroyed by its fall to the ground and subsequent fire.



Fig. 2: The destroyed Safari helicopter

1.4 Other damage

None was reported.

1.5 Personnel information

1.5.1 Pilot

Personal data:

- Male, aged 71 years
- Pilot licence CPL (H)
- He held a type rating for a Safari helicopter valid until 31 May 2012
- Instructor until 31 July 2012
- He had a medical certificate Class 2 valid until 24 January 2013
- He had a valid general radiotelephonist's certificate of aeronautical mobile service.

Flying experience:

He began flight training on the aircraft Zlín C – 105 in 1960. As a pilot, he flew on eight types of airplanes and seven types of helicopters. On these fifteen types of aircraft he flew a total of 6,638 hours 56 minutes and as pilot in command flew 6,257 hours 37 minutes.

He began piloting helicopters on the Mil Mi – 1 type, in which he flew as an instructor from 2 March 1968.

He became an instructor for the Mil Mi – 2 helicopter on 7 April 1977.

As PIC he flew the Ecureuil AS 350 B2 helicopter from 26 April 1991.

As PIC he flew the Bell 206 L helicopter from 19 November 1991.

As co-pilot he flew the Mil Mi - 8 helicopter from 28 March 1996.

He became an instructor for the Robinson R 22 B II helicopter on 11 September 2007.

He became an instructor for the Safari helicopter on 27 May 2009.

From 27 August 2007, he fully devoted his time to flying an R 22 Robinson type. He underwent requalification for a Safari type helicopter during 14 – 16 November 2008 in the USA. He flew a total of 5 hours 48 minutes. He acquired the qualification for instructor for a Safari type helicopter in the USA on 27 May 2009.

Pilot time:	24 hours	90 days	Total
This type of helicopter:	0:14	03:40	50:36
All types of helicopter:	-	-	6,190:43

Other flying experience:

Recently, the pilot was actively involved in the LAA of the Czech Republic. He flew UL airplanes as an instructor and UL helicopters as an instructor, inspector and test pilot. In 1994, he was licensed as the chief inspector of UL helicopters by the LAA of the Czech Republic. He had a valid type rating for Dragon Fly, Ultrasport 331, Ultrasport 496, and CH - 7 Kompres UL helicopters. He last flew with an Ultrasport 496 type helicopter on 8 April 2012.

1.5.2 Other person on board

It was ascertained that this person participated in the operation of the subject helicopter and was present in the helicopter as an observer. This person was directly involved in the building of another helicopter of the same type at LKHS.

Personal data:

- Male, aged 48 years
- Pilot licence PPL (H),
- Type rating for R – 22 valid until 31 December 2012
- He had a medical certificate Class 2 valid until 26 January 2013
- He had a valid restricted radiotelephonist's certificate of aeronautical mobile service
- He did not have other flying qualifications and maintenance technician qualifications.

Total pilot time on R 22 type helicopters, ascertained from the flight logbook, was 54 hours 04 minutes as of 21 December 2011.

1.6 Aircraft information

1.6.1 General information

The Safari helicopter, registration N 557XS, was a light, single-engine, two-seat, all-metal helicopter of a traditional design with fixed landing skids. The helicopter was powered by a Lycoming piston engine. The fuel tanks, with a total capacity of 106 litres, were refuelled with 86 litres of AVGAS 100 LL aviation petrol, which is 91% of the total capacity, before the critical flight.

Type:	Safari
Registration:	N 557XS
Manufacturer:	Canadian Home Rotors Inc.
Year of manufacture:	2001
Serial number:	BB2082
Certificate of airworthiness:	invalid
Total flight time:	approximately 205 hours
Liability insurance for damage:	valid until 12 February 2013

The manufacturer supplies the helicopter as a kit that can be assembled by amateurs. The helicopter, registration N 557XS, was assembled in the USA in 2001. According to the manufacturer's description, the helicopter is piloted from the left seat in the cockpit. For proper longitudinal trim, the helicopter is supplemented with a portable ballast weight (hereinafter weight) weighing 13.8 – 14.0 lbs. If only one seat is occupied, before a flight, the weight is secured in the holder on the front part of the right landing skid. If both seats are occupied, the weight is placed in the holder in the rear part of the truss near cross member No. STA 187.



Fig. 3: Overall view of the Safari helicopter and ballast weight holder

1.6.2 Power plant:

Type of engine:	Avco Lycoming O-320-B2B
Manufacturer:	LYCOMING
Serial number:	L-19412-39A
Year of manufacture:	Unknown
Total flight time:	Approximately 205 h
Main rotor:	Two-blade composite with metal spar
Manufacturer:	Canadian Home Rotors Inc.
Tail rotor:	Two-blade with metal blades
Manufacturer:	Canadian Home Rotors Inc.
Year of manufacture:	2001

1.6.3 Operation of the helicopter

The helicopter was purchased in 2009 by a natural person from the owner in the FRG and had flown 161 hours 12 minutes. It first flew in the Czech Republic on 12 June 2009. Until the accident, this was the only type of this helicopter operated in the Czech Republic. It was operated at LKCS and from 2010 at LKHS. During the winter season 2011/2012, the helicopter was parked on the premises of the new owner, not at LKHS. It was flown to LKHS on 10 April 2012. On the day of the accident, the helicopter made one flight lasting approximately 14 minutes.

On 10 March 2011, the operator had the helicopter inspected by an FAA certified mechanic with the result “Aircraft airworthy”. The validity of this inspection was set at 12 months (or 100 hours of flight time), i.e. up to 10 March 2012. The helicopter flew 11 hours 30 minutes after this inspection. The aircraft and engine log book had listed the following inspections of the helicopter and engine by an FAA certified mechanic.

Serial No./year	Total Flight Time:	Date of inspection:	Inspection carried out by:
1/2004	119 hours 36 minutes	15 June 2004	FAA certified mechanic ¹
2/2009	161 hours 12 minutes	19 April 2009	FAA certified mechanic ²
3/2010	175 hours 12 minutes	15 April 2010	FAA certified mechanic
4/2011	192 hours 48 minutes	10 March 2011	FAA certified mechanic
5/2012	204 hours 18 minutes	-	Not carried out

During the investigation of the accident, the commission found that the helicopter vibrated during flight causing oscillation of the instrument panel, making the data on the digital instruments difficult to read. That is why the MR was balanced on the VIBREX device a total of 3 times. The balancing work was carried out by an FAA certified mechanic.

1.7 Meteorological information

1.7.1 The CHMI Report

According to the report from the aeronautical meteorological service of the CHMI a weakening area of high pressure was over Central Europe. According to expert estimates, the following was the meteorological situation at the site of the air accident:

Surface wind: 310 – 360° / 4 - 8 kt
 Wind: 2,000 ft MSL 090° / 5 kt/+8°C, 5000 ft MSL 100° / 20 kt /+0°C
 Present weather: overcast, no rain
 Visibility: over 10 km
 Sky condition: BKN SC 4,500 - 5,000 / 6,000 - 7,000 ft AGL (inversion clouds)
 Turbulence: NIL
 Zero degree isotherm: 5,000 ft AMSL
 Icing: NIL

¹ Carried out before the sale of the helicopter by the operator in FRG.

² Carried out before the sale of the helicopter by the operator in FRG.

Extract from SYNOP reports from the Temelín (TEM) meteorological station:

Time	Sky condition	Wind direction/ Wind speed	Visibility	Weather conditions/ Occurrences in last hour	Cloud amount/ Height	Temperature
12:00	8	010° / 6 kt	40 km	-	8 SC / 5,000 ft	10.7°C
13:00	7	360° / 6 kt	45 km	-	7 SC / 5,000 ft	11.1°C

Extract from SYNOP reports from the České Budějovice (CSB) automatic meteorological station:

Time	Sky condition	Wind direction/ Wind speed	Visibility	Weather conditions/ Occurrences in last hour	Cloud amount/ Height	Temperature
12:00	NIL	300° / 6 kt	20 km	NIL	NIL	10.9°C
13:00	NIL	310° / 6 kt	20 km	NIL	NIL	11.6°C

1.8 Aids to navigation

Visual aids at LKHS correspond for the category of aerodrome pursuant to Regulation L – 14.

1.9 Communications

On the day of the accident, the AFIS at LKHS was activated in accordance with the AIP of the Czech Republic. The commission has a record of the radio communication between the helicopter pilot and the dispatcher of both AFIS workplaces.

The pilot first established contact with the AFIS dispatcher at LKHS on frequency 130.200 MHz at 12:02 h and subsequently requested *permission for hovering in front of the hangar*. After approximately 2 minutes he requested *takeoff and flight on left circuit of runway 24*, reported position *downwind of runway 24 and leaving runway 24*. The subsequent departure from LKHS in the direction of RWY 24 occurred at 12:08 h. He reported to the AFIS dispatcher at LKHS *after takeoff and will be flying to Hluboká and back*. Before entering the ATZ of LKCS, the pilot, at 12:14 h first stated, on the frequency 135.925 MHz, the phrase to establish contact, *Budějovice info, November five five seven x-ray sierra, good day*. The pilot tried four times to establish contact with the AFIS dispatcher at LKCS, who immediately responded to the crew's report. However, the pilot probably did not hear the broadcasting of the ground station. The AFIS dispatcher at LKCS, after this time, continued to broadcast on the main and then backup frequency with queries of the helicopter, which no longer communicated.

The record of the radio communication between the pilot and both AFIS dispatchers at LKHS and LKCS was recorded by ground-based equipment and the record was clearly legible

1.10 Aerodrome information

The aerodrome did not have an impact on the accident.

1.11 Flight recorders and other means of making records

No device was installed on board the helicopter whose recording could be used to analyze the flight. The instrumentation on board the helicopter was completely destroyed by the intensity of the fire.

The recording of the secondary radar of the ACC did not show any records at the given location and time.

1.12 Wreckage and impact information.

The helicopter crashed in a meadow in the village of Litvínovice - Šindlovy Dvory approximately 380 m west of a water tower. The surface of the crash site and where the wreckage was found was covered with a thick layer of tall grass and rapeseed growth. There were muddy and waterlogged inaccessible places among the growth.

Geographic coordinates:	N 48°58'13
	E 14°25'12
Altitude:	435 m

According to the traces on the ground, deformation of the fuselage and position of the wreckage, it was ascertained that the helicopter hit the ground nose first and ended up on its right side rotated by 180° from the probable direction of flight. The truss of the tail beam was deformed and from cross member No. STA160 the remaining part of the tail beam was missing, including the entire TR assembly. The TR drive and Bowden control were disconnected. The helicopter cockpit was deformed from the right to the left. The glazing of the cockpit was affected by the fire and was missing. The landing skids on the right side were separated and flattened under the fuselage. The engine mount was deformed to the left. The gearbox and driveshaft of the MR was torn out of its mount. The control elements of the MR were deformed and the control rods were disconnected. The rotor hub was located at the end of the MR shaft. One blade was connected to the hinge. The other blade was separated and lay about 20 cm from the hinge. Both MR blades, at 2/3 the distance from the rotor hub, were bent upward at an angle of 40 - 50°. The damage that was found occurred due to the helicopter's impact with the ground and the MR blades hitting the ground.

The bodies of the helicopter crew were wedged in the wreckage. The seat belt buckles were found under the bodies. One buckle was fastened and the other unfastened. Due to the heat damage to the belts, it was not possible to unambiguously determine to which victims they belonged and whether the crew had them fastened.

The helicopter cockpit and surrounding area was severely burned. The fire burnt an area having an oval shape with the dimensions of 7 x 20 m. The site had ingots of melted metal and plastics from the helicopter. The instruments and wiring were burned and completely destroyed. The hands of the face of the onboard AChS-type clock

showed the time of 14 hours 14 minutes. A detached magnetic compass in a liquid case was found near the wreckage.

The individual components that gradually separated from the helicopter from the moment of the first contact of the MR blades with the tail beam were found in the grassy growth and the field with grown rapeseed. A fragment broken off of the end of an MR blade with the dimensions of 30 x 20 cm was found farthest from the wreckage. Nearer to the wreckage, there were found several fragments of the cockpit glazing, the covering panel of the vertical fin with the registration number, the pilot's cap, and both cockpit doors. Papers with notes were also found. The separated TR and the rest of the tail beam were found at a distance of 12.6 m to the left of the starting point of measurement.

A detailed examination of the main parts of the helicopter was carried out after the transport of the wreckage. The findings were compared with available documentation used in the construction of another helicopter of the same type. The findings showed no significant differences. Some parts differed in details during the application of amateur construction. The inspection revealed that the MR blades hit the tail beam between cross members No. STA187 and STA214. This is where the truss, Bowden control of the TR blades and the TR driveshaft were severed. The shaft was bent in an arc symmetrically on both severed ends. The bearing housings of the shaft were torn out of their fasteners and deformed in the direction of the rotation of the shaft. The Bowden double bandage was damaged and was torn out of the end mechanism for controlling the TR. The mechanism for adjusting the TR blades was deformed, the control rods were disconnected. The sliding sleeve of the TR hub was also damaged. Both TR blades were deformed. Their surface showed abrasion of a dark red colour from contact with the structure of the helicopter.

The engine was mounted vertically on the engine mount. The mount was deformed. Engine controls were connected. The rubber and plastic parts were burned by fire. Inspection of the main parts of the engine was carried out by partial disassembly and it was found that there was no mechanical or operational failure of the main parts of the engine. The engine was connected to the gearbox drive of the MR. It was separated at the place of connection. The case was so intensely burned that the wall of the case and the exposed gears melted.

It was ascertained that the left and right cockpit doors were almost undamaged after hitting the ground. Upon close examination, it was found that the hinges were not secured with any securing element.

When assembling the main parts, it was found that the ballast weight with the locking pin and the left part of the rear holder of the weight were missing.

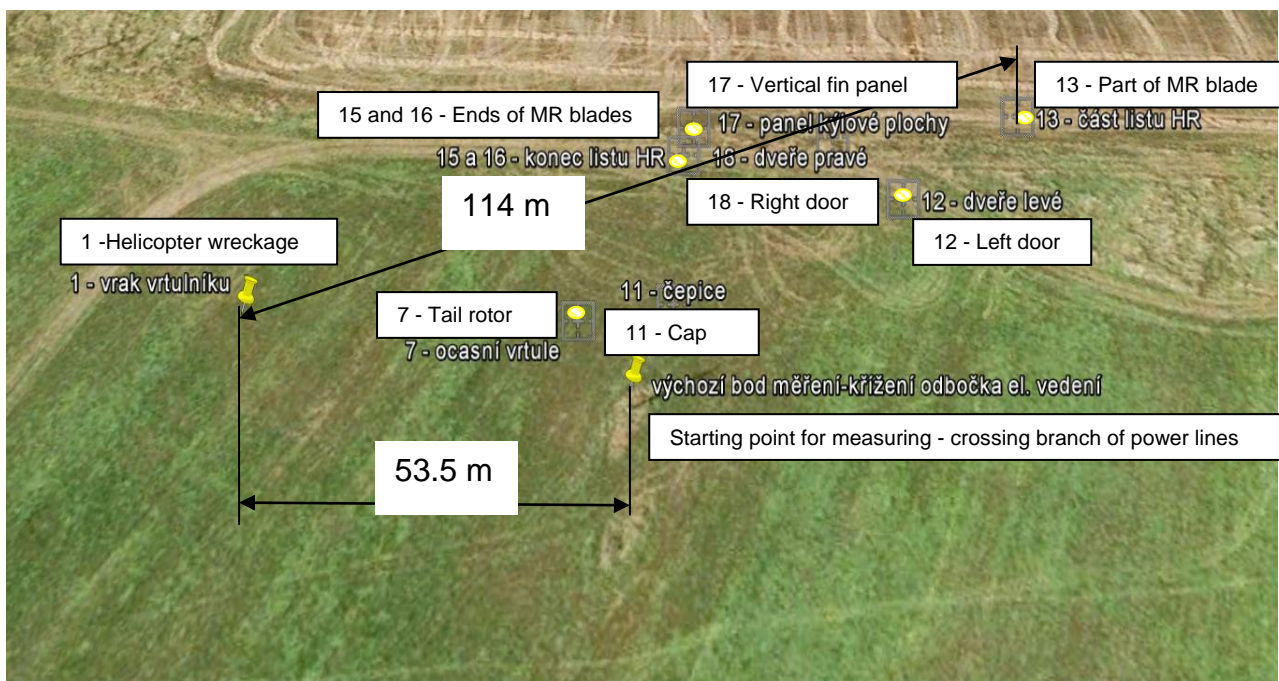


Fig. 4: Diagram of scattered wreckage – legend corresponds to the description of the Police of the Czech Republic

The AAI ,in cooperation with the Police of the Czech Republic and volunteers, organized two searches for the missing weight. The search teams searched in the area of the projected flight path as described by witness testimonies. The search ended with negative results and the weight was not found.

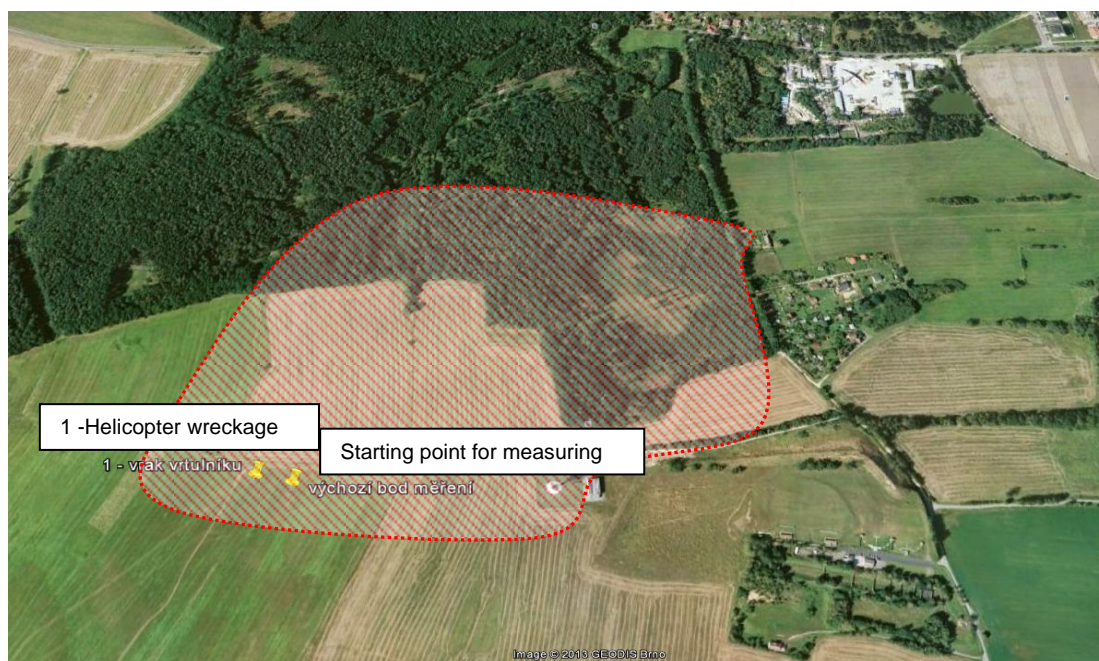


Fig. 5: Search area for ballast weights

1.13 Medical and pathological informations

The immediate cause of death of the helicopter pilot and the passenger was polytrauma – multiple injuries of several organ systems. The injuries in both were

devastating, incompatible with life, both died practically immediately after the helicopter hit the ground.

Based on the location of the bodies in the helicopter wreckage, it can be stated that at the moment of the crash the pilot was sitting in the cockpit in the seat on the left and the other person on the right.

From a forensic pathology and aviation medicine point of view, it can be stated that both bodies were affected by massive blunt violence on a large area with the vector of forces being mainly from the bottom and the front. The cause of the injuries can be explained well by the mechanism of the air accident – the fall of the helicopter and collision with the ground. Due to the injuries to the upper and lower limbs, and due to the massive burns, it is not possible to clearly judge their location on the control levers, and therefore who in the abovementioned helicopter was piloting the helicopter at the time of the air accident.

During the autopsies on both bodies, there were no signs of injuries that could not be explained by the mechanism of the subject air accident, such as a bullet wound or explosion, etc.

During the autopsies of both accident victims, no diseases were found that could have led to an emergency situation or that could have been causally connected with their death.

The toxicological examination found no ethanol in the blood of both deceased. The biological materials taken during the autopsies also did not show any toxicologically significant substances; therefore, both were not under the influence of illegal medicines or drugs during the flight.

Both deceased underwent a biochemical examination of their somatic – mental state. Based on the analyzed biochemical parameters and the context of other findings, after the statistical evaluation of the results of the examination, the conclusions can be interpreted to state that both died practically immediately after the helicopter hit the ground and during the entire flight they were conscious. The nature of the biochemical changes indicate that an intensive activation of the energy metabolism took place in the pilot shortly before his death. For this reason it can be deduced that he recognized the sudden emergency situation and reacted to it. However, the state did not grow into a stress reaction. The other person on board did not undergo an activation of the energy metabolism before death; therefore he did not recognize the emergency situation and react to it. From this, it can be deduced that at the time of the accident, the helicopter was piloted by the pilot.

1.14 Fire

A fire ensued after the aircraft hit the ground. The wreckage of the helicopter that burned was significantly damaged. Fuel was splattered in the immediate surroundings upon the helicopter's impact into the ground where it burned and thus did not cause any environmental damage. At the moment of the accident, there was approximately 80 litres of fuel in the tanks of the helicopter.

1.15 Search and rescue

Witnesses who observed the flight of the helicopter reported its fall on emergency telephone number 112. The AFIS dispatcher at LKCS, after unsuccessful attempts at

making contact with the helicopter flying in the ATZ of LKCS, called for a search for the helicopter on emergency telephone number 112. A fire brigade unit, the Police of the Czech Republic and a helicopter of the Air Rescue Service arrived at the site of the AA.

1.16 Tests and research

1.16.1 Verification of the testimony of a witness

A series of flights took place along the trajectory that simulated the critical flight during which witness No. 2 attempted to confirm the approximate location where he saw an object fall from the helicopter. A Robinson R 44 was used for the attempt. Gradually the altitude of the flight was decreased from 150 m to 50 m AGL. The flights were coordinated by radio contact with the helicopter pilot and a member of AAll commission next to witness No. 2. The witness described with certainty the altitude of the flight, which was measured by the on-board altimeter and after conversion was determined to be 50 m AGL. The witness also described the approximate location where the object fell from the helicopter. Due to the distance, the witness could not determine the exact trajectory of the flight from the horizon of the forest.

Using previous and newly acquired information, a diagram was created that was used as a basis for searching for the lost object. The map that was created showed a view from east to west.

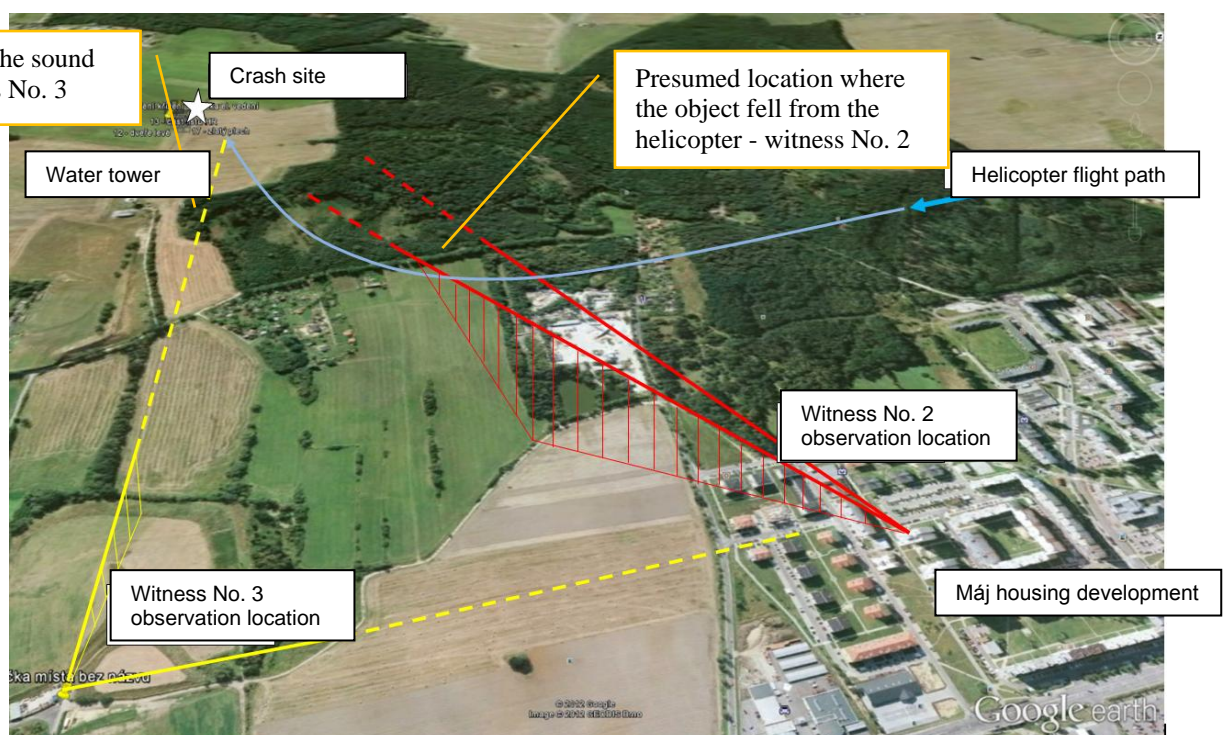


Fig. 6: Graphic rendition of the observation of the flight trajectory according to the testimony of witnesses

1.16.2 The effect of longitudinal trim on the flight characteristics of the helicopter

The commission contacted a specialist of the helicopter's manufacturer who was asked to comment on the situation that could occur if the weight is lost during flight. The

manufacturer confirmed that during the loss of the weight the longitudinal balance of the helicopter will change.

He said that the weight weighs 13.8 – 14.0 lbs. He also described the structural design and securing of the weight on the helicopter. The commission was not able to find evidence of how the weight was secured on the crashed helicopter. Presuming that it was the same as described by the manufacturer, the weight was secured by one locking pin into an opening on the left side of the holder. It can be presumed that the connection of the locking pin/hole could have been worn from operation of the helicopter, e.g. the ovality of the hole as a result of vibration of the tail beam during operation, or the ball mechanism of the locking pin could have been damaged thus losing its securing function.

Due to the fact that the pilot, after verifying the handling of the helicopter at LKHS, continued with his flight, it can be concluded that the weight was located at the specified location for a flight with two people. The findings resulting from the examination of the remains of the holder on the right side of the tail beam showed that the holder was not damaged or deformed. The paint, shape and welds remained intact and without damage. If the weight were in place at the moment the MR blade hit the tail beam, it is very probable that the inserted weight would have mechanically damaged the right holder. From the abovementioned, the commission came to the hypothesis that the weight was missing the moment the MR blades hit the tail beam. This fact is also supported by the observations of witness No. 2, who saw “some object” fall from the helicopter when the helicopter was steadily flying horizontally.



Fig. 6: Placement of ballast weight when occupied by two people



Fig. 7: Usual design of weight with locking pin (illustrative photo)



Fig. 8: Holder of the ballast weight on the right side of the tail beam

1.17 Organizational and management information

It was found that the Safari helicopter was, since 2001, recorded in the register of the FAA USA under registration N 557XS in the category “Experimental”. On 22 April 2009, the CAA of the Czech Republic issued the first permit for flights in the Czech Republic for the operator – natural person. The helicopter was operated and used by the owner for flights for his own needs. One pilot flew the helicopter. Airworthiness was verified by a FAA licensed mechanic at intervals specified by the manufacturer. The validity of the last verification of airworthiness was up to 10 March 2012. During the air accident this certification of the helicopter was expired.

On 30 July 2011, based on a concluded written contract, the owner of the helicopter changed. On 8 February 2012, the CAA of the Czech Republic issued a permit for flights in the Czech Republic valid until 31 December 2012. The permit was issued to the former owner.

The issued permit for flights contained the following restrictions:

- Densely built-up areas and gatherings of people in the open must not be flown over except when necessary to take off or land
- Operational restrictions issued by the country of registration must be adhered to and be an appendix as a special certification of airworthiness
- The helicopter can be operated solely in accordance with Section 77 of Act No. 49/1997 Coll., on civil aviation and amending and supplementing Act No. 445/1991 Coll., on trade licensing, as subsequently amended,
- Only approved aerodromes/heliports and areas specified in Section 35 of the Aviation Act can be used for take-off and landing
- The pilot of the helicopter can be only a person who was issued, or has recognized, an FAA qualification certificate for helicopters, a type rating for the given helicopter and relevant medical certificate,
- All documents listed in the AIP of the Czech Republic, section GEN 1.2.6.2 must be valid for the entire time the helicopter is operated in the airspace of the Czech Republic
- The operator is obligated to acquaint the pilot intended to fly the given helicopter with the abovementioned operating conditions.

1.18 Additional information

NIL

1.19 Investigation techniques used to find the cause

The cause of the air accident was investigated in accordance with Regulation (Annex) L 13.

2 Analysis

The most facts leading to the determination of the probable causes of the AA come from evidence found in the wreckage of the helicopter, from the results of an examination of the crash site, its surroundings and information from the testimony of witnesses.

2.1 Pilot's rating and experience

The pilot was rated to fly the Safari helicopter on which, from 14 November 2008, he had flown a total of 50 hours 36 minutes. For this reason it can be concluded that the pilot had sufficient flying time and experience with this type of helicopter.

2.2 The critical flight

The flight above the Hosín aerodrome, pursuant to a witness' estimate and the radio communication records, lasted approximately 6 minutes. Then the crew flew away from the aerodrome. The distance between the take-off of the helicopter and the crash site is approximately 16 km, provided that the pilot continued over the Hluboká Chateau. In order to cover this distance at the optimal cruising speed of 83 MPH (132 km.h⁻¹) for the maximum range of the Safari helicopter, stated in the aircraft flight manual,

approximately a 7-minute flight would be needed. In less than 14 minutes of flight, the engine of the helicopter consumed approximately 9 litres (6.5 kg) of aviation petrol. This consumption of fuel could not have significantly affected the centre of gravity of the helicopter and had no effect on the cause of the critical situation.

2.3 Critical situation

The critical situation evidently occurred as a result of the pilot's reaction to the change in the flight characteristics of the helicopter, which started to manifest itself after the probable loss of the weight. The pilot probably first responded by changing the pitch of the helicopter by gradually pulling the lever of the cyclic control and he compensated for the increased airspeed by slightly decreasing the collective pitch lever. However, these measures had only a short-term effect, which not only did not stop the dropping of the nose, but caused a transition from level flight to a descent. Due to the helicopter's location above a forest, the pilot was forced to implement measures that would prevent an impact with the mature trees at the edge of the forest. Due to the further development of the situation, he was forced to perform such a manipulation of the cyclic and collective controls of the helicopter that led to the waving of a MR blade and its contact with the tail beam. The evidence shows that the MR blade literally cut into the truss of the tail beam between cross members No. STA187 and STA214. This not only caused a sound effect, which was referred to by witness No. 3, but the end of the blade knocked off the covering panel of the vertical fin, which the witness saw.

The blade also hit the Bowden, which contained the cable for controlling the pitch of the blades of the TR. This violent impact on the directional control system led to the abnormal configuration of the TR blades in excess of limits and the turning of the tail beam to the right by more than 90°. The extreme change in the pitch of the TR blades caused them to wave and make contact with the truss of the tail beam.

After hitting the tail beam, the MR blade caused damage to the transmission shaft and the subsequent interruption of the TR drive. This resulted in a further drop of the nose and the gradual turning of the helicopter by approximately 180°. From this moment the helicopter became virtually uncontrollable, and along a curved trajectory, with a relatively high forward speed, fell to the ground.

The significant damage to the helicopter caused vibration, during which individual components started to fall off of the helicopter. They were then found in the area over which the helicopter was during its fall. The helicopter was completely destroyed when it impacted the ground and the wreckage was further damaged by the subsequent fire. After the fall of the helicopter, the crew sustained injuries incompatible with life.

2.4 The helicopter

When flying above LKHS, the pilot apparently did not notice anything wrong with the control of the helicopter or the engine and its performance. That is why after a short flight above LKHS, he continued flying away from the aerodrome, from which can be concluded that the balancing of the MR resulted in eliminating the unwanted vibration. From the technical inspection of the engine after the air accident and the condition of the TR driveshaft, it can be concluded that the engine was running until the helicopter fell to the ground. The analysis of identified damage showed that rotating elements and the truss of the tail beam suffered considerable damage when they came into contact while still in the air. The comparison and reconstruction of the broken off ends of the MR

blades confirmed that only one blade hit the tail beam. The individual mechanically separated parts started falling off of the helicopter the moment after the MR blade came in contact with the tail beam. The subsequent imbalance of the entire system caused extreme vibration, which caused the destruction of the canopy of the cockpit and its gradual falling off during the fall of the helicopter.

The total destruction of the cockpit, landing gear, power plant, and elements serving to drive and control the MR and TR occurred as a result of the impact of the helicopter with an immovable obstacle.

The commission found a list of procedures that was probably made by the pilot but not entirely in accordance with the aircraft flight manual (Section 5, Normal Procedures), which describes mandatory procedures during a pre-flight inspection of the helicopter when starting and stopping the engine. The pre-flight inspection states: *securing the weight to the tail beam or skid* and the start-up section stipulates: *pre-flight inspection carried out, weight secured*. However, it was not possible to verify whether the pilot carried out these checks. Therefore, it is not possible to prove that the securing of the weight was fully functional.

2.5 Influence of the weather conditions

The meteorological conditions had no effect on the flight.

3 Conclusions

3.1 The commission came to the following conclusions:

3.1.1 The pilot:

- Was licenced for the flight and had a valid medical certificate
- Had a valid general radiotelephonist's certificate of aeronautical mobile service
- In terms of skills, had sufficient experience piloting this type of aircraft
- Decided to make a short flight over LKHS in order to verify the handling of the helicopter after balancing work to eliminate vibration
- Did not fly over built-up areas
- Due to the relatively low altitude of the flight above the landscape, he did not hear the information broadcast by the AFIS dispatcher at LKCS
- Reacted to an extraordinary incident, which had a significant impact on an up to then steady flight, with an adequate adjustment of the controls
- Probably could not explain the cause of the unusual behaviour of the helicopter during a steady level flight
- Could not immediately put the helicopter into autorotation and land because he was above hostile surroundings (forest)

- Was probably forced by external circumstances to perform such energetic and simultaneous movements of the cyclic and collective control levers that caused the waving of the MR blade and its subsequent impact with the tail beam
- Was not able to make an emergency landing with such a significantly damaged and virtually uncontrollable helicopter.

3.1.2 The helicopter:

- Was registered with the FAA of the USA in the category “experimental” and the FAA’s requirements of regular yearly technical inspections was not fulfilled by the operator
- Did not have a valid certificate of airworthiness and was not airworthy
- Had valid statutory insurance
- Had been refuelled before the flight with fuel necessary for the flight
- Most likely the securing of the weight failed, resulting in the subsequent loss of the weight during flight
- The described damage to the truss shows that the MR blade came into contact with the tail beam
- As a result of the contact of the MR blades with tail beam, it became uncontrollable
- Was destroyed by the forces of impact into the ground and the subsequent fire.

3.1.3 The operator:

- Did not carry out the yearly inspection by a FAA certified mechanic pursuant to the requirements of the manufacturer and the country of registration.

3.2 Causes

The cause of the accident was the forced, energetic manipulation of the controls of the helicopter that caused contact of the MR blade with the tail beam after the probable loss of the ballast weight.

4 Safety recommendations

With regard to the likely cause of the air accident and the very plausible hypothesis that during the flight the ballast weight was lost, a weight secured by a securing element of the so-called first level, and when after the loss of the securing function the weight can fall off, we recommend that the manufacturer of the helicopter carry out a change in the manner of securing the weight or a change in the design of the locking pin.