FINAL REPORT

ACCIDENT 2020/1581

State Commission on Aircraft Accidents Investigation

UL. CHAŁUBIŃSKIEGO 4/6, 00-928 WARSAW | EMERGENCY NUMBER 500 233 233

FINAL REPORT

on the investigation into an aviation occurrence involving an aircraft of the maximum take-off weight of 2,250 kg or less.

ACCIDENT

OCCURRENCE NO. – 2020/1581

AIRCRAFT – Guimbal Cabri G2, SP-NCA helicopter

DATE AND PLACE – 2 July 2020, Nowe Miasto nad Pilicą, EPNM

The Report is a document presenting the position of the State Commission on Aircraft Accidents Investigation concerning circumstances of the air occurrence, its causes and safety recommendations. The Report was drawn up based on information available on the date of its completion.

The investigation may be reopened if new information becomes available or new investigation techniques are applied, which may affect the wording related to the causes, circumstances and safety recommendations contained in the Report.

Investigation into the air occurrence was carried out in accordance with the applicable international, European Union and domestic legal provisions for prevention purposes only. The investigation was carried out without application of the legal evidential procedure, applicable for proceedings of other authorities required to take action in connection with an air occurrence.

The Commission does not apportion blame or liability.

In accordance with Article 5 paragraph 6 of the Regulation (EU) No 996/2010 of the European Parliament and of the Council on the investigation and prevention of accidents and incidents in civil aviation […] and Article 134 of the Act – Aviation Law, the wording used in this Report may not be considered as an indication of the guilty or responsible for the occurrence.

For the above reasons, any use of this Report for any purpose other than air accidents and incidents prevention may lead to wrong conclusions and interpretations.

This Report was drawn up in the Polish language. Other language versions may be drawn up for information purposes only.

WARSAW 2022

Occurrence reference number	**2020/1581**			
Type of occurrence	ACCIDENT			
Date of occurrence	2 July 2020			
Place of occurrence	Nowe Miasto nad Pilicą, EPNM			
Type and model of aircraft	Guimbal Cabri G2 Helicopter			
Aircraft registration marks	SP-NCA			
Aircraft/User Operator	Akademickie Centrum Szkolenia Lotniczego Lotniczej Akademii Wojskowej w Dęblinie (ACSL LAW)			
Pilot in Command	CPL(H) Flight Instructor			
Number of victims/injuries	Fatal	Serious	Minor	None
	-	-	-	2
Domestic and international authorities informed about the occurrence	ULC, EASA, BEA			
Investigator-in-Charge	Wyszogrodzki Mieczysław			
Investigating Authority	State Commission on Aircraft Accidents Investigation (PKBWL)			
Accredited Representatives and their advisers	NOT APPOINTED			
Composition of the Investigation Team	Mieczysław Wyszogrodzki, Krzysztof Błasiak, Tomasz Makowski			
Document containing results	FINAL REPORT			
Safety recommendations	NONE			
Addressees of the recommendations	NOT APPLICABLE			
Date of completion of the investigation	31.03.2023			

1. Type of occurrence

Accident.

2. Investigating authority

State Commission on Aircraft Accidents Investigation (SCAAI - PKBWL)

3. Date and time of the occurrence

2nd of July 2020, approx. 14:40 hrs[1].

4. Place of take-off and intended landing

Nowe Miasto nad Pilicą (EPNM) aerodrome.

[1] All times specified in report: LMT. On the date of the occurrence LMT = UTC + 2h

Fig. 1. Traffic circuit of the Nowe Miasto nad Pilicą airfield and location of incident [source: ACS LAW, background: Google Earth]

5. Place of occurrence

Nowe Miasto nad Pilicą (EPNM aerodrome)

6. Type of operation

Aerodrome traffic circuit

7. Phase of flight

Landing with auto-rotation simulation.

8. Flight conditions

VMC, day-time, acc. to VFR.

9. Weather conditions

The EPNM airfield does not have its own meteorological station. According to the Aerodrome Operations Manual, meteorological support is provided through telephone consulting with the Central Office for Aviation Forecasts in Warsaw and acquisition of meteorological information from the websites of the Institute of Meteorology and Water Management – State Research Institute (IMGW – PIB).

During the training flights and at the time of the occurrence on EPNM aerodrome the following weather conditions prevailed:

- visibility exceeding 10 km;
- wind speed between 2 and 10 kt from varying directions;
- ambient temperature 26º C;
- QNH pressure 1,010 hPa;

- CB clouds were present in the aerodrome area, including light rainfall initially with subsequent heavy rainfall.

Meteorological data from the Tomaszów Mazowiecki aerodrome (EPTM) located 45 km from the accident place, time interval (7:00 hrs ÷ 14:30 hrs LMT) as of 2 July 2022, are presented below.

EPTM aerodrome:

2020-07-02 15:00	SAPL99 021500	METAR EPTM 021500Z 14004KT 9999 SCT050 BKN200 24/18 Q1010 RMK 243 068 6/4=
2020-07-02 14:30	SAPL99 021430	METAR EPTM 021430Z 14004KT 9999 BKN050 25/18 Q1010 RMK 246 067 7/7«
2020-07-02 14:00	SAPL99 021400	METAR EPTM 021400Z 15008KT 9999 BKN040 25/19 Q1010 RMK 247 070 7/7«
2020-07-02 13:30	SAPL99 021330	METAR EPTM 021330Z 12008KT 9999 BKN040 25/18 Q1010 RMK 249 066 7/7«
2020-07-02 13:00	SAPL99 021.300	METAR EPTM 021300Z 22004KT 150V217 9999 SCT030TCU BKN040 26/18 Q1010 RMK 257 061 7/3 =
2020-07-02 12:30	SAPL99 SOTM 021230	METAR EPTM 021230Z 33008KT 9999 SCT030TCU BKN040 26/17 Q1010 RMK 263 056 6/3 =
2020-07-02 12:00	SAPL99 SOTM 021200	METAR EPTM 021200Z 34010KT 9999 SCT030TCU BKN040 26/18 Q1009 RMK 262 059 6/3 =

Weather data at 14:30 LMT for: EPTM (45 km away from the place of accident), EPWA (88 km away from the place of accident) and EPMO (195 km from the place of accident), 10 minutes before the accident.

Airport	Ambient temperature	Dew point	Dew point decline	Air humidity
EPTM	26°C	17°C	9°C	56%
EPWA	27°C	19°C	8°C	65%
EPMO	26°C	17°C	9°C	61%

10. Flight organiser

Akademickie Centrum Szkolenia Lotniczego (ACSL).

11. Crew data

Helicopter commander: Flight Instructor, male, aged 29, holder of:

- CPL(H), issued on 4 April 2019 by the Civil Aviation Authority;
- TR (Type Rating) for Cabri G2 helicopter, valid until 31 December 2020;
- FI Restricted rating, valid until 30 September 2022;
- General Radiotelephone Operator's Certificate, issued on 16 April 2015 by the President of the Office of Electronic Communications;
- Class 1 aero-medical certificate, valid until 17June 2021.

Instructor's flight experience:

Flight time as instructor - approx. 160 hours, total - 552 hours, including:

- airplanes (Cessna 152) - 52 hours;
- helicopters (Robinson R-44, Cabri G2) - 500 hours;
- Cabri G2 helicopter – approx. 490 hours, including Cabri G2 SP-NCA (accident aircraft) - total 98 hours (54 hours in 2020).

Student pilot: male, aged 24, holder of:

- Class 2 aero-medical certificate, valid until 17June 2022.

Student's pilot flight experience:

- Total flight time 14:21 hours (exclusively on Cabri G2 helicopter).

12. Injuries to persons

None.

13. Aircraft

Airframe:

The Guimbal Cabri G2, registration marks SP-NCA, serial number 1152, is a light helicopter with a composite three-blade main rotor and fenestron-type tail rotor. Two-seater, single-engine, classic structure with a composite fuselage. The helicopter features a skid-type landing gear and an articulated main rotor head. The helicopter has a dual control system. Crew seats were designed to absorb high impact energy (corresponding to the vertical component of a landing speed of 2,000 ft/min.

Basic data:

The fuel tank capacity is 170 l.
Empty helicopter mass: 430 kg.
Maximum take-off mass: 700 kg.
The helicopter has the EASA.R.145 certificate issued acc. to the CS-27 requirements.
The helicopter is serviced by a certified service organisation.

Engine:

Lycoming O-360-J2A (with a maximum power of 180 HP reduced to 145 HP), horizontally opposed, four-cylinder with carburetor, aircooled.

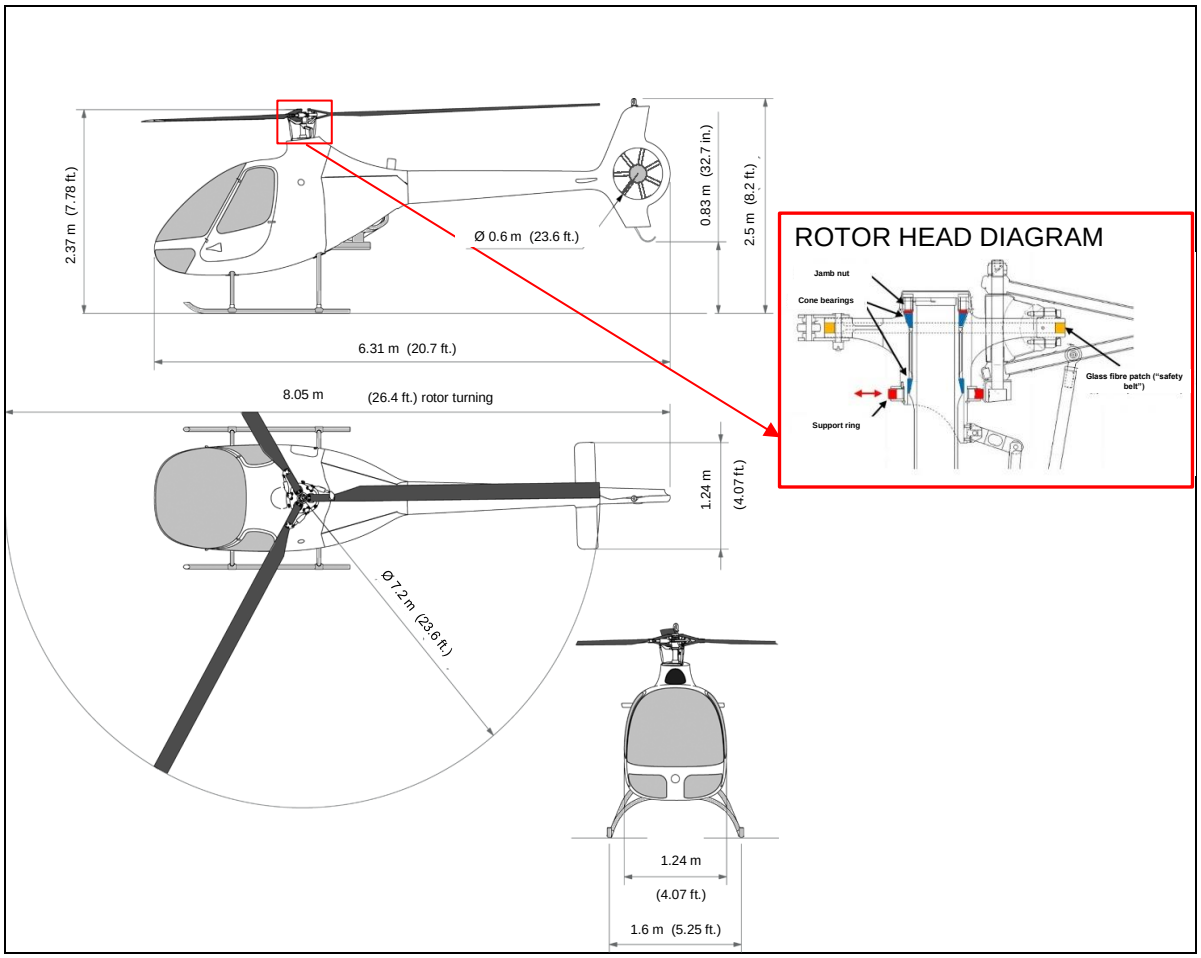

Fig. 2 Three-view drawing of the helicopter and the main rotor head diagram [source: Helicopters Guimbal]

14. Damage to aircraft

Due to the occurrence the aircraft sustained damage to the tail boom, fuselage skin, tail rotor (fenestron) along with the drive transmission system, two out of three main rotor blades, blade dampers, swashplate scissors, rotor blade pitch control rods, oil pressure sensor. The locations of the helicopter's damage are presented in Figures 3 to 9.

Fig. 3. SP-NCA helicopter damage – general view [source: ACSL LAW]

Fig. 4. SP-NCA helicopter damage – main rotor head [source: ACSL LAW]

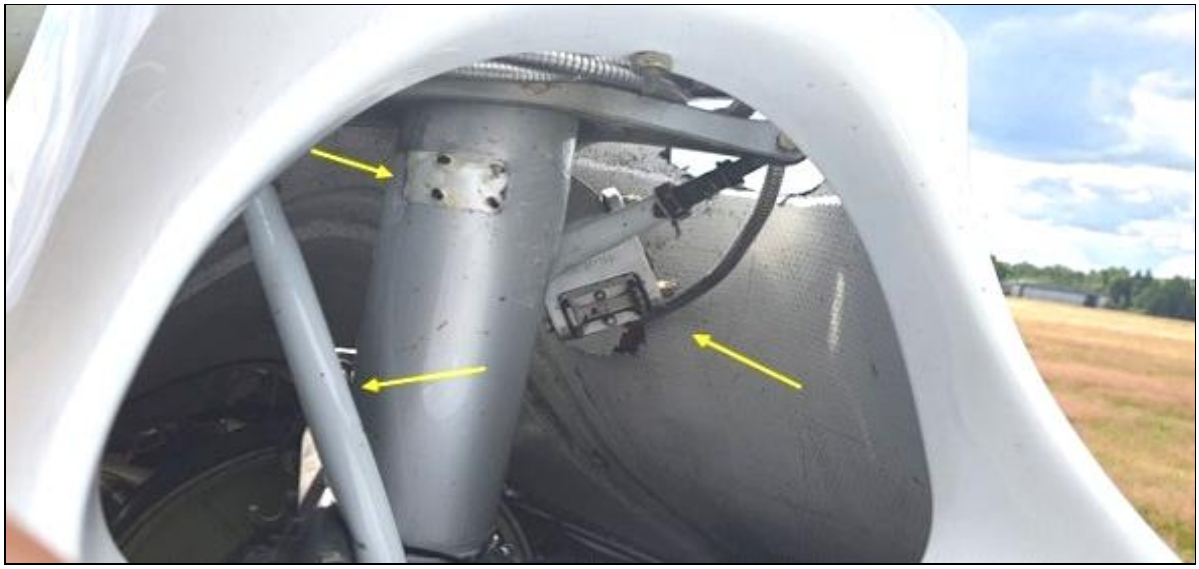

Fig. 5. SP-NCA helicopter damage – main rotor hub [source: ACSL LAW]

Fig. 6. Sheared tail boom [source: ACSL LAW]

Fig. 7. Sheared rear part of the tail boom with the fenestron [source: ACSL LAW]

Fig. 8. Middle part of the fenestron drive shaft torn out from SP-NCA helicopter tail boom [source: ACSL LAW]

Fig. 9. End part of the fenestron drive shaft [source: ACSL LAW]

15. Course and analysis of the occurrence

On the day of the accident, at the EPNM aerodrome, the crew was performing the exercise no. IV/17, acc. to the PPL (H) Training Program, ed. 2 of the ACSL LAW. The planned flights were intended to check the student pilot ability to perform exercise EX-1 “Pre-solo flight exam”. It was planned to perform 10 aerodrome traffic circuits.

The take-off took place at 13:35 hrs. The student pilot gradually corrected his errors and correctly responded to the instructor’s commands. Light rainfall started on the aerodrome area during the ninth flight and its intensity outside of that area was substantially higher. Due to deteriorating weather conditions, the instructor decided to perform the last circuit with auto-rotation simulation to be terminated with a hover and air-taxiing to the helicopter stand.

Until the third turn of RWY26, the student pilot maintained constant flight parameters, i.e. 65 kt speed and 1,200 ft QNH altitude. After clearance for auto-rotation simulation, the student pilot achieved 1,500 ft QNH altitude in the third turn. Prior to the fourth turn, the instructor visually inspected the parameters and warnings displayed on the

instrument panel and said, “parameters normal, no warnings”. After the fourth turn, the student pilot shifted to level flight.

The student pilot completely lowered collective, the instructor decreased engine RPM to idle and the auto-rotation simulation was started. The student pilot stabilised the flight parameters, maintained the speed at 50 kt, main rotor speed within the range of 515-540 RPM, “ball” centred and descent at approx. 2,000 ft/min.

At the 850 ft QNH altitude, following information to the student pilot, the instructor increased the engine speed above 2,000 RPM. The governor took control over the engine speed (the signalling lamp flashed) without noticeable helicopter yaw. Due to deteriorating weather conditions, the instructor decided to start the “flare” at an altitude higher than usual as he intended to smoothly shift to a hover and air taxiing to the helicopter stand.

At an altitude of about 60-80 ft AGL, following the instructor’s command, the student pilot commenced the “flare” by pulling the cyclic to decrease the forward and descent speed. At that time, the main rotor speed suddenly increased to approx. 560 RPM, which is a normal phenomenon. After receiving a signal of higher RPM of the rotor, the governor reduced the engine speed to maintain the main rotor RPM within the operating range. Following descent and forward speed reduction, at an altitude of approx. 15 ft, when ordered, the student pilot pushed the cyclic forward to position the helicopter horizontally for landing.

When approaching the ground, secured by the instructor, the student pilot partially moved the collective upwards to halt the descent, while simultaneously pulling the cyclic to decrease the forward speed of the helicopter. At an altitude of approx. 8 ft., the helicopter unexpectedly started to yaw to the right.

After yawing by approx. 15^{o}, the instructor stopped the yaw by pressing the left pedal. Due to the helicopter continuous descent, the instructor moved the collective dynamically completely upwards to halt the descent.

At that time, the main rotor speed decreased to approx. 466 RPM and the low main rotor speed warning sound turned on.

Touchdown in airplane mode was made with a landing roll of approx. 3 metres. The crew heard and felt the impact in the rear part of the helicopter. The helicopter simultaneously yawed to the right and the crew saw the fenestron passing over the rotating main rotor. The fenestron, together with the tail gearbox and the rear part of the tail boom, fell several meters in front of the helicopter.

The rightward yaw occurred due to the dynamic movement of the collective and fenestron loss, preventing the proper control of the helicopter.

The instructor reported the helicopter’ damage and no injuries to the crew via radio. No one heard the message as the radio antenna also became damaged during the occurrence. After approximately one minute, the crew vacated the helicopter on their own.

Fig. 10. Occurrence site – final flight phase route marked. [source: ACSL LAW, background: Google Earth]

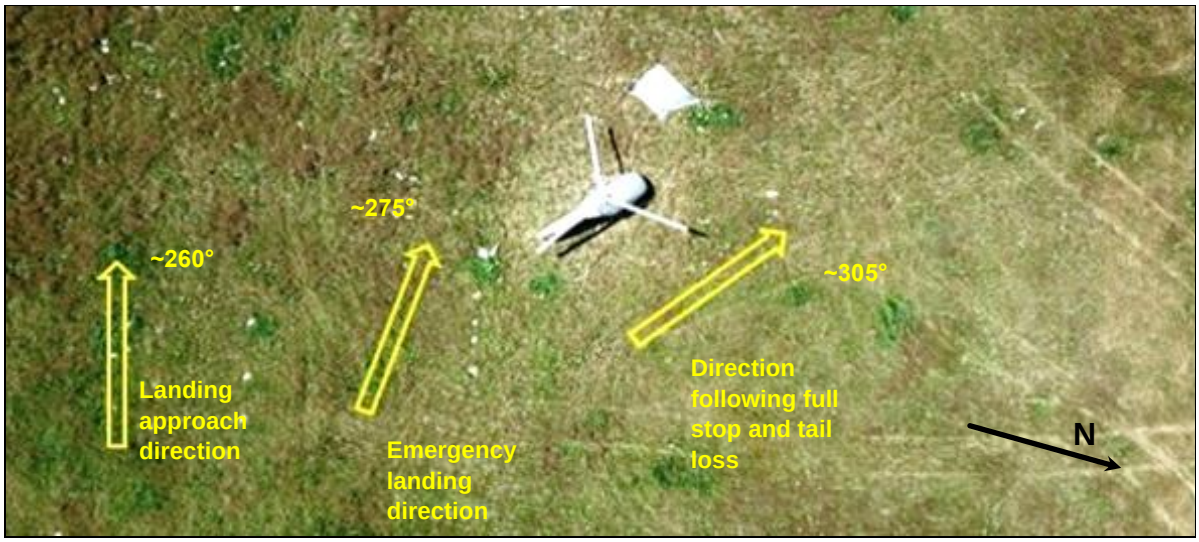

Fig. 11. Helicopter view at the occurrence site [source: ACSL LAW, background: Google Earth]

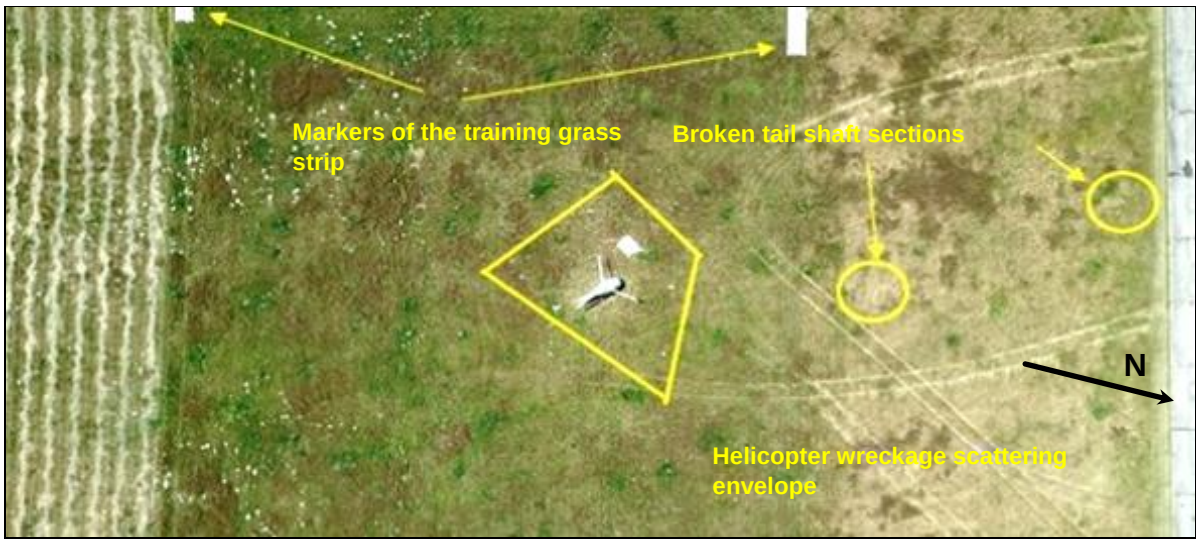

Fig. 12. Helicopter view at the occurrence site – scattering of wreckage [source: ACSL LAW, background: Google Earth]

Fig. 13. Close-up – helicopter wreckage [source: ACSL LAW, background: Google Earth]

The Commission determined that the helicopter touched down with low forward speed and heading of approx. 275°. During landing roll, as a result of deceleration caused by the dynamic increase in the plane angle of the rotating rotor, the main rotor blades collided with the tail boom an cut off its rear part together with the fenestron. Those elements were located approx. 5 m away from the helicopter fuselage.

None of the helicopter parts separated prior to touchdown. The aircraft damage resulted from the cut-off of the tail boom by the main rotor blades and the destructive action of the separated fenestron drive shaft and the fenestron blade pitch control cable. The Bowden cable ruptured the fuselage skin and got entangled in the main rotor hub which was destroyed.

16. Investigation Team findings

1. The helicopter commander had valid documents and ratings: CPL(H), Cabri G2 type rating, FI rating, General Radiotelephone Operator's Certificate and aero-medical certificate.
2. The student pilot met the conditions required to take part in flight training for the PPL(H).
3. The helicopter was insured and had proper documentation required to perform flights.
4. The helicopter was airworthy prior to the flight.
5. The helicopter weight and centre of gravity were within the limits prescribed in its flight manual.
6. The deteriorating weather conditions contributed to the accident occurrence and course.
7. Two-way radio communication was assured before the radio antenna damage in the accident.
8. The student pilot and instructor were rested.

9. The student pilot and instructor were not intoxicated nor under the influence of psychoactive drugs.

17. Cause of the accident

Error in the aircraft control consisting in a dynamic movement of the collective to its maximum upward position combined with high angle of the main rotor disc inclination, which resulted from pulling the cyclic to its extreme rear position.

18. Factors contributing to the occurrence

1. Commencing the “flare” manoeuvre at an altitude higher than usual.
2. Intention to terminate the exercise with a hover and air taxiing to the helicopter stand.
3. Time deficit due to the deteriorating weather conditions.
4. The crew’s concern about unintentional landing outside the flight area.

19. Preventive measures implemented by the operator

After the occurrence, the helicopter operator (ACSL) developed the following guidelines for autorotation simulation:

1. Perform auto-rotation simulation only in a two-man crew (instructor and student pilot or instructor and instructor);
2. Each time after a longer break in performing auto-rotation simulation, perform control flights with a pilot in continuous training;
3. In the vicinity of the aerodrome, the engine failure simulation should be performed over a place enabling a possible safe touchdown in case of real failure (avoid muddy, waterlogged, uneven and untested places);
4. Start auto-rotation simulation with power recovery at an altitude of at least 1000 ft AGL, so that the power recovery process on the engine ends not lower than 300 ft AGL;
5. In auto-rotation descent turn on carburetor heating manually in conditions conducive to carburetor icing;
6. Pay attention to changes in meteorological conditions (wind speed and direction, ambient temperature and pressure) and the helicopter balance, maintaining the correct forward speed, main rotor rotations with particular attention to the behaviour of the “governor” (it should not be lighted);
7. If it is found that in auto-rotation gliding after regaining power (engine speed above 2000 rpm) there is a visible desynchronization of the engine and main rotor revolutions – increase the overall pitch slightly to synchronize the revolutions;
8. Do not make abrupt (dynamic) rotor braking during flare to prevent overspeed of the main rotor and excessive desynchronization.
9. Familiarize all ACSL helicopter pilots with the guidelines.

20. Safety recommendations

Not formulated.

21. Annexes

None.

END

Investigator-in Charge

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(Signature on original)