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Aircraft Accident Investigation Bureau AAIB

Final Report No. 1986 by the Aircraft Accident Investigation Bureau

concerning the accident

to the Robinson R22 Beta II helicopter, registration HB-ZGH

on 27 February 2006

Neumatt, municipality of Bätterkinden/BE

9 km south-south-west of Solothurn/SO

Bundeshaus Nord, CH-3003 Berne

Ursachen

Der Unfall ist darauf zurückzuführen, dass während des Aufsetzens, im Anschluss an einen simulierten Triebwerkausfall im Schwebeflug, die Kontrolle über den Helikopter verloren ging und dieser umkippte.

Zum Unfall beigetragen hat

- Anwendung eines Notverfahrens, das nicht den Vorgaben des Herstellers entspricht.

General information on this report

This report contains the AAIB's conclusions on the circumstances and causes of the accident which is the subject of the investigation.

In accordance with Annex 13 of the Convention on International Civil Aviation of 7 December 1944 and article 24 of the Federal Air Navigation Law, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent future accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All times in this report, unless otherwise indicated, are indicated in the standard time applicable to the area of Switzerland (local time – LT), corresponding at the time of the accident to Central European Time (CET). The relationship between LT, CET and coordinated universal time (UTC) is: LT = CET = UTC + 1 h.

For reasons of protection of privacy, the masculine form is used in this report for all natural persons, regardless of their gender.

Final Report

Aircraft type	Robinson R22 Beta II			HB-ZGH	
Operator	Heli-West AG, Cordastrasse 391, 3212 Gurmels, Switzerland				
Owner	Heli-West AG, Cordastrasse 391, 3212 Gurmels, Switzerland				
Flying instructor	Swiss citizen, born 1962				
Licence	Commercial Pilot Licence, helicopter, CPL (H), issued by the Federal Office of Civil Aviation on 9.2.2006, valid till 2.8.2006				
Flying hours	**total**	570:53 h	**during the last 90 days**	27:38 h	
	on the accident type	317:55 h	**during the last 90 days**	18:26 h	
Pilot	Swiss citizen, born 1961				
Licence	Private Pilot Licence, helicopter, PPL (H), issued by the Federal Office of Civil Aviation on 20.6.2005, valid till 19.6.2007				
Flying hours	**total**	216:08 h	**during the last 90 days**	2:33 h	
	on the accident type	155:03 h	**during the last 90 days**	1:49 h	
Location	Neumatt, municipality of Bätterkinden/BE				
Coordinates	605 923/219 221		**Elevation**	465 m AMSL	
Date and time	27 February 2006, approximately 16:05 LT				
Type of operation	VFR training				
Flight phase	Landing				
Accident type	Loss of control				

Injuries to persons

Injuries	Crew	Passengers	Total numer of occupants	Others
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	2	0	2	---
None	0	0	0	---
Total	2	0	2	0

Damage to the aircraft	Considerably damaged
Other damage	None

1 Factual information

1.1 Pre-flight history and history of the flight

On 27 February 2006, the pilot had arranged a check flight with the flying instructor on the helicopter type Robinson R22 Beta II. Such a check flight is required annually by the operator. In the process, both the normal operation of the helicopter and current emergency procedures shall be checked.

At approximately 14:30 LT, the pilot arrived at Grenchen regional airport and prepared the R22 Beta II helicopter, registration HB-ZGH, for the check flight. The weather information was consulted together with the flying instructor and the flight was discussed.

At 15:46 LT, the pilot took off from Grenchen under the flying instructor's supervision in helicopter HB-ZGH and flew over departure point HE and the locality of Lüterkofen into the Limpachtal. In this area the flying instructor ordered him to make a landing at the model aircraft aerodrome of Neumatt, approximately two kilometres south-west of Bätterkinden. After two overflights of the area for reconnaissance purposes, the pilot chose an approach from the west, against the wind, and landed the helicopter on the grass area shortly before the beginning of the artificial runway of the model aircraft aerodrome.

The next item on the programme was to carry out a simulated engine failure while hovering. The flying instructor again asked the pilot how he thought he would react to the reduction in power which is supposed to represent an engine failure. The pilot answered that he would prevent rotation around the yaw axis by applying the right pedal; at the same time he would move the collective pitch first down and then up, to cushion the landing.

The pilot then brought the helicopter to hover at a height of approximately one metre above the ground and told the flying instructor that he was ready for the exercise. The flying instructor mentioned that he would count to three and then bring the throttle to the idle position. He then counted to three and brought the engine down to idle.

The pilot pressed the right pedal to prevent rotation around the yaw axis. At the same time he lowered the collective pitch and immediately pulled it up again, in order to stop the helicopter's vertical movement. In this phase, the crew noticed that HB-ZGH shifted laterally to the left, the left skid made contact with the ground and the helicopter began to tip over to the left. Although both of them immediately pushed the collective pitch full down, as they say, it was no longer possible to prevent the helicopter from tipping over to the left.

The pilot and flying instructor were able to leave HB-ZGH with minor injuries. The helicopter was considerably damaged.

Figure 1: Final position of the helicopter after the accident

1.2 Meteorological information

The following information on the weather at the time and in the area of the accident is based on a spatial and chronological interpolation of the observations of different weather stations. This interpolation was carried out by MeteoSwiss.

Cloud	*1-2/8, base at approx. 5500 ft AMSL*
Weather	*-*
Meteorological visibility	*about 20 km*
Wind	*North-easterly wind 8 to 10 kt, gusting to 15 kt*
Air temperature	*0 °C*
Dew point	*-9 °C*
Atmospheric pressure	*QNH LSZH 1013 hPa* *QNH LSZG 1013 hPa* *QNH LSGG 1012 hPa*
Position of the sun	*Azimuth 235°* *Elevation 18°*
Hazards	*Turbulence due to the 'bise' wind not excluded*

1.3 Aircraft information

The Robinson R22 Beta II is a two-seater helicopter of lightweight construction which is widely used for flying instruction. It is powered by a piston engine and is fitted with landing skids. The R22 Beta II has a semi-articulated two-blade rotor which rotates counter-clockwise, viewed from above. The necessary torque compensation is provided by a twin-blade tail rotor. Owing to its low mass, the rotor system offers only a very limited reserve of kinetic energy, and in the event of an actual or simulated engine failure this demands a rapid and precise reaction on the part of the pilot.

The manufacturer provides the following instructions in the pilot's operating handbook (POH) for the case of an engine failure in hovering flight:

POWER FAILURE BELOW 8 FEET AGL

1. *Apply right pedal as required to prevent yawing*
2. *Allow aircraft to settle*
3. *Raise collective just before touchdown to cushion landing.*

2 Analysis

2.1 Technical aspects

There are no indications that technical defects or restrictions were present which might have influenced the accident.

2.2 Human and operational aspects

Everything indicates that the flight preparation and the discussion of the flying mission between the flying instructor and the flying student took place diligently and in detail. The weather conditions were taken into consideration so that the helicopter was aligned in hovering flight for the simulated engine failure in such a way that the exercise could be carried out with a head wind.

During the planned exercise, the helicopter is stabilised approximately one metre above ground in hovering flight. The flying instructor then reduces engine power, simulating an engine failure. The pilot carrying out the exercise must then land the helicopter safely using the kinetic energy of the rotor system. In the case of helicopters such as the Robinson R22 Beta II in particular, which have a low-mass rotor system, only a few seconds are available for the entire landing procedure. Within this short time, the pilot must ensure, by means of control inputs, that the helicopter does not begin to rotate around its yaw axis, as after engine power is reduced the tail rotor provides excessive torque compensation. On helicopters whose main rotor rotates counter-clockwise, viewed from above, when power drops the helicopter's nose tends to rotate to the left, from the viewpoint of the pilot, and the pilot must prevent this by applying the right pedal appropriately. This control movement reduces the pitch of the tail rotor and thereby reduces its thrust, resulting in the desired reduction in torque. The reduction in tail rotor thrust, acting to the right when viewed in the direction of flight, means that the helicopter tends to drift to the left, as the equilibrium of forces in direction of the lateral axis, in stabilized hovering flight, is then disturbed. The lateral movement to the left observed by the pilot and flying instructor is probably attributable to this effect.

If the helicopter then touches down with a lateral movement on terrain which offers resistance to the skids, a tipping movement around the leading skid may result. Since the collective pitch is pulled by the pilot in this phase to reduce the descent rate, the main rotor is providing a large lift force. The line of action of this force is such that torque results with reference to the stationary skid. A correction using the cyclic stick alone, affecting the inclination of the main rotor plane, does not stop the rotation. Even given the changed inclination of the main rotor, the line of action of the lift still leads, in relation to the axis of rotation, in such a way that the rotation is accelerated. Only a reduction in the collective pitch and hence a reduction in main rotor thrust would be able to stop the impending dynamic rollover. If a critical roll angle that depends on the dynamics of the overall situation is exceeded, even lowering the collective pitch will have no effect and the helicopter will tip over.

In the present case, the collective pitch was obviously reduced too late.

It is conspicuous that the crew executed the emergency procedure in a slightly different way from that prescribed by the manufacturer: the pilot lowered the collective pitch after the power reduction. This reaction is not described in the pilot's operating handbook (POH). Rather, the POH states that the pilot should allow the helicopter to descend and shortly before contact with the ground should cushion the landing by pulling on the collective pitch.

It cannot be excluded that this initial lowering of the collective pitch favoured the occurrence of the dynamic rollover: this control input resulted in a reduction in lift and therefore a faster descent of the helicopter. In order to reduce a fast rate of descent immediately before contact with the ground, a fairly large increase in lift, i.e. pulling more strongly on the collective pitch, is necessary. As outlined above, however, a high main rotor thrust has an unfavourable effect on the development of an incipient rollover.

3 Conclusions

3.1 Findings

- The crew were in possession of the necessary licences. The flying instructor in particular was in possession of a flying instructor's licence which was valid until 15.09.2008.
- There is no indication that the state of health or capabilities of the crew were impaired during the flight involved in the accident.
- The Robinson R22 Beta II helicopter, registration HB-ZGH, exhibited no technical defects or restrictions which could have had favoured, or could have caused, the accident.
- The helicopter's mass and centre of gravity were within the permitted limits.
- An engine failure in hovering flight was simulated at a height of approximately one metre above ground.
- The pilot lowered the collective pitch briefly and then pulled it up again, in order to stop the descent of the helicopter.
- The helicopter touched down with a slight lateral movement to the left.
- Part of the left skid dug into the grass.
- The helicopter tipped over to the left.
- The nose of the helicopter was pointing approximately in the 080° direction.
- At the time of the accident, a north-easterly wind was blowing at 8 to 10 kt and gusts up to 15 kt were to be expected.

3.2 Causes

The accident is attributable to the fact that during touchdown following a simulated engine failure while hovering, control over the helicopter was lost and it tipped over.

The following factor contributed to the accident

- application of an emergency procedure which did not correspond to the manufacturer's instruction.

Berne, 6 May 2008 Aircraft Accident Investigation Bureau