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Aircraft Accident Investigation Bureau AAIB

Final Report No. 2017 by the Aircraft Accident Investigation Bureau

concerning the accident

to the MDD 500N helicopter, HB-XYP

operated by Fuchs Helikopter AG

on 26 July 2007

Municipality of Eglisau/ZH

approx. 25 km north of Zurich

Aéropôle 1, Route de Morens, CH-1530 Payerne

Ursachen

Der Unfall ist auf eine Kollision des Helikopters mit zwei Kabeln auf 18 m/GND anlässlich eines Filmfluges zurückzuführen.

Faktoren, die zum Unfall beigetragen haben:

- Es fand keine Rekognoszierung statt.
- Die Gefahrenanalyse in Bezug auf Flughindernisse war ungenügend.

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 article 3.1 of the 9th Edition, applicable since 1st November 2001, of the 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 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, follow the coordinated universal time (UTC) format. At the time of the accident, Central European Time (CET) applied as local time (LT) in Switzerland. The relationship between LT, CEST and coordinated universal time (UTC) is: LT = CEST = UTC + 2 h.

Contents

Final Report

Owner	Robert Fuchs AG, Fuchs-Helikopter, CH-8834 Schindellegi, Switzerland
Operator	Robert Fuchs AG, Fuchs-Helikopter, CH-8834 Schindellegi, Switzerland
Aircraft type	MD HELICOPTER INC. (MDHI) MDD 500N Serial No. LN052
Country of registration	Switzerland
Registration	HB-XYP
Location	Eglisau/ZH
Date and time	26 July 2007, 08:54

Synopsis

During filming downstream above the Rhine, at a location just before the railway bridge to the south of Eglisau, a type MDD500N helicopter collided with a power line spanning the river. Two wires were severed. The pilot was able to land the damaged helicopter in a field on the north bank of the river. The occupants were not injured.

As a result of the damage to the power line, there was a power outage of about half an hour in Eglisau and in some neighbouring areas. Those involved in the operation included personnel from the Zurich cantonal police, the Eglisau fire brigade, the Zurich electricity company EKZ, the Eglisau municipal services and the Winterthur/Unterland public prosecutor's office.

Investigation

The accident took place at 08:54. The notification was received at 09:35. The Aircraft Accident Investigation Bureau opened an investigation on the same day at approximately 11:30 in cooperation with the Zurich cantonal police.

The accident is attributable to a collision by the helicopter with two cables 18 m AGL during a filming flight.

The following factors contributed to the accident:

- no reconnaissance took place,
- insufficient risk analysis in relation to flight obstacles.

1 Factual information

1.1 Flight preparations and history of the flight

1.1.1 General

The statements of the pilot and passengers were used for the following description of the flight preparations and history of the flight. The film taken during the flight as well as the recorded data from the navigation equipment and the obstacle warning equipment provided information about the flight path and height.

The flight took place under visual flight rules.

1.1.2 Flight preparations

Aerial photography of the landscape of Switzerland has been produced for a number of years as part of a television project by a private film producer. The producer, who was also the director, had already collaborated with the pilot on this mission on various occasions for three years. The participating cameraman had also worked with the pilot fairly often in the past on other film projects.

The pilot acquainted himself with the mission approximately two weeks before the date for filming. Film footage of the Swiss landscape was again to be shot to the new “high definition” standard.

Filming in eastern Switzerland had already been started on Monday 16 July 2007, but had had to be aborted due to a technical fault with the recording equipment.

According to the pilot, flight preparation the day before included KOSIF, chart material, approach charts (VAC) for Sitterdorf and St. Gallen-Altenrhein as an alternative, visual approach and landing charts for Zurich, because of the control zone (CTR), and the issuing of passenger tickets.

1.1.3 History of the flight

The cameraman and pilot met at the helicopter base in the early morning of 26 July 2007 at about 05:30. The pilot had carried out the technical check on the helicopter the previous evening. After the final camera test and flight preparations (NOTAM, weather, telephone agreement to filming inside Zurich CTR), the producer/director also arrived at 06:15.

There followed a mission briefing which lasted approximately 20 minutes. The producer/director explained the route which, according to his statement, he had planned meticulously. This schedule had already been looked at together with the pilot during an earlier planning session. The flight was to proceed from Schindellegi via Pfäffikersee, Kemptthal and Nürensdorf, through the lower Töss valley as far as Tössegg and from there via Diessenhofen towards Lake Constance. He pointed out how he saw the course of events and what was important to him. Camera settings, etc. were discussed in a dialogue with the cameraman. The pilot made comments about his planned manoeuvres within the control zone of Zurich aerodrome and on radiocommunication with air traffic control.

He also referred to timings with regard to refuelling stops and observing the midday break because of the operating times of Sitterdorf and St. Gallen-Altenrhein aerodromes. The pilot made the director aware that on this type of flight he reserved the right to terminate the flight after six hours' flying time.

The pilot was not aware of any anomalies of a human, technical or meteorological nature before the flight.

The pilot had equipped himself with the obstacles chart for the intended flight route. Obstacles such as cables were not subject of the briefing.

Take-off took place at 06:54. At various locations on the route, use was made of the good light conditions for detailed photography from different directions. According to the pilot and the director, spontaneous changes to the route occurred fairly often during such filming.

In the planned section along the Töss in the lower Töss valley, filming took place a few metres above the river bed between the trees. Just before the municipality of Freienstein, according to the film which was shot, the helicopter flew under a cable (see figures 1 and 2).

According to his statement, the pilot had been aware of this. The pilot stated: *"On the morning in question, when we reduced altitude to do some low-level filming, I informed the client/director of the fact that a cable crossed the flight path. If I had been flying solo, we would have climbed and flown over the cable. At the request and insistence of the client, I flew under the cable in question."*

The cameraman did not notice anything in this regard.

According to the statements of the pilot and director, the 1:100,000 obstacle chart was consulted before this section. No relevant obstacle had been found.

Near Tössegg, after a brief discussion with the cameraman and the pilot, the director decided, in view of the "superb" light conditions, to make a detour to Eglisau.

Before this section also, according to the director, no relevant obstacle could be detected on the obstacle chart.

The pilot went along with this proposal without any objections. At this moment of the change in the flight path, he opined that he had been thinking about the flying time and the effects on the planned refuelling stopover in Sitterdorf. He did not feel unconfident about the altitude. The topography seemed clear to him: *"...I was convinced that we ought to be able to see electricity pylons."*

The cameraman thought that the mood in the cockpit was "*almost spiritual"*, with expressions of elation concerning the beautiful reflections of the bridge on the calm surface of the water. The pilot said nothing in this phase; the director mentioned that he had previously shot an advertisement with rowers there.

The pilot described the collision with the cable:

"Suddenly I saw a cable directly in front of me approximately level with my eyes. At this moment the cameraman shouted out "Look out, cable". I decided to immediately reduce the collective pitch and to try to "avoid" it by flying underneath. At this moment there was a loud bang and I saw sparks fly in front of me. The low rpm horn sounded loudly and many warning lamps lit up."

The pilot remembered the rpm horn. The red “Engine Out” warning lamp also flashed and the amber “Re-Ign” lamp came on.

In the first instant I thought that I would have make an emergency landing in the water… I pushed the cyclic stick forward and felt that despite the huge imbalance and strong vibrations the helicopter was still coping/flying. At this moment I saw a field of stubble and a meadow just after the bridge over the Rhine, on the right bank. I decided upon a power-on landing, turned right and was able to land the helicopter relatively gently on the meadow. Then I switched everything off, closed the engine fuel shut-off valve, got out and checked the state of my two companions.” See figures 3, 4 and 5.

With regard to the FLARM device, the pilot stated: *The onboard FLARM unit was switched on but did not provide any warning. If it* [the cable] *had been registered, it* [the unit] *should have provided a visual warning – flashing red – well before the Rhine bridge*.”

1.2 Injuries to persons

Injuries	Crew	Passengers	Total number of occupants	Others
Fatal	---	---	---	---
Serious	---	---	---	---
Minor	---	---	---	---
None	1	2	3	---
Total	1	2	3	

1.3 Damage to aircraft

The helicopter was badly damaged. The visible damage was located in the following areas (see figures 6 and 7 Canopy):

- canopy: 2 plate-sized holes
- upper composite fuselage panels: locally dented
- all 5 main rotor blades: traces of friction, scratching and heat, surface dented over small areas

This damage was caused by the collision with the lines and a whiplash effect due to the briefly over-tensioned, and then severed, cable. Magnetisation of various metal components also occurred, because of the contact with the high-voltage line and a momentary high current flow.

After a detailed inventory in the maintenance workshop, the following parts were assessed as damaged and had to be replaced:

- all 5 M/R Blades
- M/R Drive Shaft
- Inlet Fairing
- Canopy L/H und R/H

- Windshield UPR L/H and R/H, Windshield LWR R/H
- Interconnect Shaft

The following components had to be overhauled:

- M/R Transmission
- M/R Hub Assembly
- Overrunning Clutch
- Fan Transmission
- Engine

1.4 Other damage

Two cables of the 16 kV "Rheinkreuzung" power line of the Zurich cantonal electricity board were severed in the middle of the river crossing and lay on both sides in the Rhine river.

The network operator's report stated that at the Rhine crossing between concrete pylons No. 57 and 58 two Cu cables 95 mm^2 with a diameter of approx. 12 mm conductor of phases 1 and 3 had been severed or torn apart.

From 08:54, between Flaach-Eglisau and Rheinsfelden-Eglisau, this caused a power cut until 09:35, 09:45 and 10:00 respectively in different sections.

Additional information on the damaged overhead line:

Height of the wire at the site of the accident: approx. 18 m above water level

Span 151.5 m, sag 5.3 m, assembled tension 5 kg/mm^2

Conductor 464 kg

1.5 Personnel information

1.5.1 Pilot

Person	Swiss citizen, born 1973
Licence	Commercial pilot's licence (CPL(H)ICAO based on Canadian CPL), first issued by the FOCA on 13.09.2000, valid till 03.11.2007
	Private pilot's licence for helicopter (PPL(H)ICAO), issued by the FOCA on 03.07.1996, valid till 03.11.2008
Ratings	Registered helicopter classes/types
	AL II, AS350B2, B206/206L, HUGHES300, MD520N, MD600, MD900/902, SA33
	Rating for mountain landings
	MOU (H)
	International radiotelephony for visual flight RTI (VFR)
Last proficiency check	21.07.2006 checkflight MD900

Medical fitness certificate	Class 1, without restrictions Valid until 03.11.2007
Last medical examination	25.10.2006
Commencement of pilot training	02.03.1995

1.5.1.1 Flying experience

Total	1236 hours
on the accident type	305 hours
during the last 90 days	97 hours
of which on the accident type	38 hours
during the last 24 hours	4:08 hours
of which on the accident type	0:00 hours
Single-engined turbine-powered helicopter	985 hours
Single-engined piston-powered helicopter	182 hours
Multi-engined helicopter	69 hours

1.5.1.2 Crew times

According to the pilot's statement, after a free week-end, the Monday and Tuesday were working days as part of the normal rota. On Wednesday 24 July 2007, he made filming flights in Valais with several fairly long interruptions.

Start of duty (on the previous day)	On 25.07.2007, at 05:30 LT
End of duty (on the previous day)	On 25.07.2007, at 17:30 LT
Flight duty time on 25.07.2007	11 hours
Rest time	11 hours
Flight duty time at the time of the accident	4.5 hours

1.5.2 Passengers

Producer/director:	Swiss citizen, born 1951, no flying experience
Cameraman:	Swiss citizen, born 1978, no flying experience

1.5.3 Low-level flying authorisation

The Fuchs Helikopter AG company was in possession of an authorisation to fly below the legal minimum altitudes for photographic purposes (photographs, film, TV, etc.) in helicopters on commercial flights, dated 6 December 2006.

1.6 Aircraft information

1.6.1 General

Type	MDD 500N FAA model designation is Model 500N FAA/ICAO aircraft type designation is MD52 MDHI commercial designation is MD 520N
Characteristics	Five-seater helicopter, alloy construction, tailboom and thruster are primarily a graphite composite
Year of construction / serial number	1992 / LN052
Engine	DDA 250-C20R (Rolls Royce Corporation)
Rotor system	Fully articulated five-bladed system, anti-torque is provided by the NOTAR system: An enclosed fan driven by the main rotor transmission, a circulation control tailboom, direct jet thruster, and horizontal stabilizer with two vertical stabilizers.
Equipment	UltraMediaHD GyroCAM, nose mounted Camera controls, displays and recorders 21 USG auxiliary fuel system
Certification	VFR day commercial VFR night
Operating hours	2324.5 hours airframe 1565.0 hours turbine
Mass and centre of gravity	The maximum permitted take-off mass MTOM was 3350 lbs. The helicopter's mass at the time of the accident was approximately 2764 lbs. The centre of gravity was within the permitted limits.
Power	The maximum height of hover out of ground effect (HOGE), at over 10,000 ft pressure altitude (PA), was not restrictive at the time of the accident.
Airworthiness certificate	Issued on 13.10.2006 / No. 3 valid till revoked
Maintenance	The last 100/300/600/1200-hour check 1 and 2 annual inspections took place at TSN 2278 hours airframe and TSN 1519 hours engine on 25.04.2007.
Fuel grade	JET A1 kerosene
Fuel reserves	At the time of the accident there were 250 lbs of fuel on board, corresponding to a flying time of approximately 1.5 hours.

1.6.2 Additional equipment

The filming equipment included, on the cockpit side, two monitors which together with the Garmin 295 GPS unit and the FLARM unit were mounted in the direct field of vision of the pilot and the front-seat passenger (see figure 8).

The helicopter was not equipped with a cable cutter.

1.7 Meteorological information

1.7.1 General

The information in sections 1.7.2 to 1.7.4 was provided by MeteoSwiss.

1.7.2 General meteorological situation

A ridge of the Azores high-pressure area was temporarily weakening somewhat in the area of the Alps but continued to determine our weather, with very dry and warm air.

1.7.3 Weather at the time and location of the accident

The following information on the weather at the time and location of the accident is based on a spatial and chronological interpolation of the observations of different weather stations.

Weather/clouds	*- / no clouds*
Visibility	*about 20 km*
Wind	*variable at 2 kt*
Temperature/dewpoint	*17 °C / 12 °C*
Atmospheric pressure	*QNH LSZH 1018 hPa*
Hazards	*none detectable*

1.7.4 Astronomical information

Position of the sun	azimuth: 91°	elevation: 28°
Lighting conditions	daylight	

1.8 Aids to navigation

The helicopter was being operated according to visual flight rules. The pilot had a functioning GARMIN 295 GPSMAP for navigation support within his field of vision (see figure 8).

1.9 Communications

On the previous day, the pilot had registered by telephone with the ATC unit for filming within Zurich CTR. Radiocommunication between the pilot and the competent control unit took place in the correct form up to the time of the accident.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

Not prescribed and not installed.

It was possible to fully document the flight path, altitude and speed by means of the recorded waypoints on the GARMIN 295 GPS, the FLARM (see section 1.18) and the film sequences which were recorded.

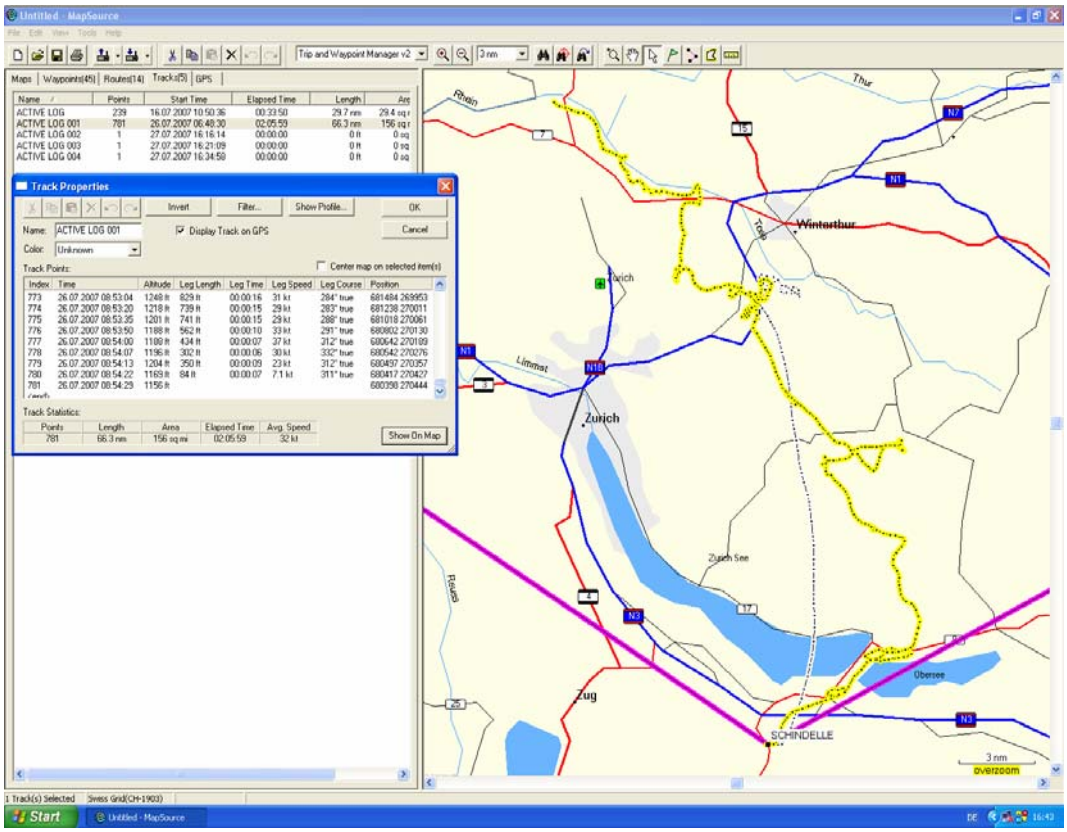
1.11.1 GPS data

The last recorded data from the Garmin 295 GPS:

Index	Time	Altitude	Leg Length	Leg Time	Leg Speed	Leg Course	Position
773	08:53:04	1248 ft	829 ft	00:00:16	31 kt	284° true	681484 269953
774	08:53:20	1218 ft	739 f	00:00:15	29 kt	283° true	681238 270011
775	08:53:35	1201 ft	741 ft	00:00:15	29 kt	288° true	681018 270061
776	08:53:50	1188 ft	562 ft	00:00:10	33 kt	291° true	680802 270130
777	08:54:00	1188 ft	434 ft	00:00:07	37 kt	312° true	680642 270189
778	08:54:07	1196 ft	302 ft	00:00:06	30 kt	332° true	680542 270276
779	08:54:13	1204 ft	350 ft	00:00:09	23 kt	312° true	680497 270357
780	08:54:22	1169 ft	84 ft	00:00:07	7.1 kt	311° true	680417 270427
781	08:54:29	1156 ft					680398 270444

Index 777 corresponds to the position shortly before the cable collision.

Recoded flight path of the GARMIN 295 GPS:



1.11.2 FLARM data

The FLARM logged the current position, height and speed every four seconds. Storage of the points took place every 120 seconds. The last stored position was at 06:53:39 UTC approximately 310 m or approximately 22 seconds in front of the cable. Ground speed was then approximately 52 km/h.

1.12 Wreckage and impact information

1.12.1 Wreckage

Undergoing pronounced vibrations, the damaged helicopter was able to land approximately 500 m further ahead in the direction of flight, on the north bank of the Rhine.

1.12.2 Impact

The collision with the two cables occurred frontally at a speed of approximately 60 km/h. The helicopter was descending. The main rotor blades collided with the cables. Arcing occurred.

1.12.3 Site of the accident

1.12.3.1 General

Accident location	Eglisau railway bridge, municipality of Eglisau
Swiss coordinates	680 650 / 270 200
Geographical latitude	N 47° 34’ 35”
Geographical longitude	E 008° 34’ 45”
Elevation	360 m AMSL, approximately 18 m AGL
	1188 ft AMSL (GPS altitude)
Landing site on the bank of the Rhine	680 400 / 270 445
National map of Switzerland	Sheet No. 205, sheet name Schaffhausen, scale 1:25,000

1.12.3.2 Special points

A military aircraft accident occurred 27 years previously at the same location. A Swiss Air Force Alouette III was flying up-river from the west, at a low altitude, around mid-day, under good visibility conditions. Shortly after flying under the railway bridge, the helicopter severed two cables on the same power line. The pilot was able to land the damaged aircraft on the bank. The investigation showed that the cables over the Rhine were very difficult to see against the variously dark and wooded background of the bank of the Rhine. This power line was not shown on the pilot’s obstacle chart in the area below the high railway bridge.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

Fire did not break out.

1.15 Survival aspects

1.15.1 General

The particular circumstances of the cable collision permitted a normal landing without any adverse effects on the health of the occupants.

1.15.2 Emergency transmitter

The aircraft was equipped with an emergency transmitter (emergency location beacon aircraft – ELBA). The ELT function was not triggered.

1.15.3 Equipment

The pilot was wearing a helmet. The helmet mounted clear visor was in the up position. The pilot was wearing lightly tinted sunglasses.

1.16 Tests and research

Not applicable.

1.17 Organisational and management information

1.17.1 Composition of the film crew

The commercial client and producer was also a member of the film crew as artistic director, taking the role of director. He sat in the front right cockpit seat in order to direct filming.

The cameraman sat in the rear seat, surrounded by technical recording equipment. He followed the director's instructions and guided the camera accordingly. During filming, his eyes were on his monitor; he did not look directly outside.

The pilot controlled the helicopter with regard to direction, speed and height according to the director's wishes, in so far as he considered these to be practical in aeronautical terms.

The pilot knew the director and cameraman from other missions. From his experience of cooperation with the pilot, the cameraman expressed the opinion that the latter preferred to fly as high as possible, if given the option.

The producer and director was known to be very animated and demanding during the work. The pilot opined: *"What's striking... about (the director) is the very clear idea of his film. (Artist)... With* [company name]*, it's a question of dynamic images, to achieve an artistic presentation."*

1.18 Additional information

1.18.1 FLARM

The helicopter was equipped with a FLARM. This is a collision and obstacle warning device.

This device is equipped with a WAAS 16-channel GPS receiver and an ISM band transmitter/receiver, which does not require a licence. It constantly transmits its own position and a speed vector and is ready to receive the same signals from other devices constructed to the same standard. Programmed movement algorithms calculate flight path conflicts with other devices and provide the pilot with a corresponding visual warning.

Warnings of obstacles such as cables are based on a stored database of obstacles.

The device had the serial number F70318 and had been provided with the ALPS2006 database on 28 February 2006.

This database included the FOCA obstacle listing UHV [1] dated 13 January 2004.

The telephone line near Freienstein was stored in this database.

The cable near the bridge over the Rhine involved in the accident was not included in this UHV.

[1] The FOCA designation UHV (*Umstellung Hindernisverzeichnis*) was changed to OMS (Obstacle Management System) in April 2005.

1.18.2 Telephone line near Freienstein

The telephone line over the Töss on the obstacle chart at coordinates 686 880 / 264 780 is reported as having a length of 100 m and a maximum height above ground of 32 m.

1.18.3 Reporting requirements for flight obstacles

Extract from the Ordinance on Aviation Infrastructure[2] VIL 748.131.1 of 23 November 1994 (status as of 4 June 2002):

Art. 63 Construction and modification of aviation obstacles

The construction and modification of structures, installations and plantings is subject to an obligation to notify if the object:

a. Attains a height or a distance from the ground, measured perpendicularly, of 60 m or more in a built-up area;

b. Attains a height or a distance from the ground, measured perpendicularly, of 25 m or more in any other area;

c. Penetrates a critical area of an obstacle delimitation register.

The project documents, with drawings, are to be notified to the cantonal notification office.

1.19 Useful or effective investigation techniques

Not applicable.

[2] Since 18 March 2008, the SIL [*Sachplan Infrastruktur Luftfahrt* – Aviation Infrastructure Plan] has been in force.

2 Analysis

2.1 Technical aspects

There are no indications of any pre-existing technical defects which may have influenced the accident.

2.2 Human and operational aspects

2.2.1 Flight preparations

On the basis of the planned flight path, the pilot prepared the flight through the Zurich airport control zone and the planned refuelling stopover in Sitterdorf. He had also prepared an alternate aerodrome. He had checked the relevant Notice to Airmen (NOTAM) and the danger and firing areas (KOSIF) for restrictions, along with the general meteorological information.

The mission was discussed in a briefing with the persons involved once more before the flight. This was when the pilot made known his intentions regarding the essential re-fuelling stopover and his maximum duty time. He advised about his previously stated decision in this regard.

The director spoke mainly about the general route, with his intended special locations. Camera operation was discussed with the cameraman.

The key factors for a successful flight were discussed, in both aeronautical and cinematic terms. During the briefing, the three crew members had an opportunity to harmonise their concepts of the operation.

Despite the extensive flight preparation, it is clear that no systematic risk assessment of the mission was performed either by the pilot or by the experienced film crew. Consequently, because of the lack of analysis, too little attention was paid during this briefing to general flight safety.

The objective of the filming flight was to obtain “dynamic images”. The experienced crew were aware that in aeronautical terms this depends on the altitude, the distance from the object to be filmed and the speed of the helicopter, as this cannot be achieved using the camera’s features alone. No analysis of the associated risks was carried out. Flight obstacles such as cables were not a discussion topic before the flight, even though a major part of the flight was to take place at low altitude in the topography of the terrain.

It has to be assumed that this pilot and the director usually relied primarily on a timely visual detection of obstacles in flight. The installed cable warning device (FLARM) might have induced a deceptive sense of security.

2.2.2 Situational awareness

The pilot and the director were of the opinion that in the Mittelland they were not flying in an area where cables would be a hazard. On this flight the pilot did not feel unconfident; he did not feel that he was at acute risk from cables. To him, the topography seemed to be clearly visible and he was convinced that it would be possible to see pylons.

There was no awareness that the potential cable risk depends not on the general area in which they were flying but on their current altitude in the terrain in question and on the extent to which it can be spanned by cables. Thus a low-level flight above the course of a river with wooded banks, without prior reconnaissance covering the entire flight path, becomes a high-risk enterprise.

2.2.3 The Freienstein telephone line

A few minutes before the accident, the helicopter, which was still on the planned section of its flight path, flew under a telephone line (see figures 4 and 5).

On the flight obstacle chart they had with them, this cable was not highly visible, possibly because of its short length of approximately 1 mm, but it was marked in red. The pilot and director had occasionally consulted this chart during the flight but had obviously overlooked this obstacle. The functioning cable FLARM warning device had provided a flashing warning before this obstacle, in accordance with the stored data set.

The insufficiently detailed analysis of flight obstacles in the preparation resulted in an unintended pressure situation for the pilot during the flight. The pilot's statement (see section 1.1.3) is evidence for the difficulty of dealing with an insistent client, and the resulting effect on flight safety. A pre-flight discussion of flying tactics with regard to known critical obstacles would have made the pilot's job easier in corresponding situations in which decisions had to be taken.

2.2.4 Flight path changes

According to the concurring statements, deviations from the scheduled route occasionally occurred on this type of flight. On the morning of the accident this was the case. The people involved were not aware that a change to the route generally requires a new risk analysis. With spontaneous decisions, there is a lack of verification of the consistency of the mission and its goals,an adequate risk analysis, and the re-planning process. Spontaneous decisions must therefore be avoided.

2.2.5 Cooperation in the cockpit

The director was both the producer and the pilot's client. This combination involved the risk that the artistic ideas and possible resulting economic consequences could increase the pressure on the pilot to make a compromise with regard to flight safety (cf. section 2.2.2). As a particular feature of this filming flight, the pilot mentioned the fact that in many cases it was not entirely simple to meet the exacting demands. *"It's characteristic of ...* [the director] *– and the cameraman also confirmed this to me - that he already has the film he wants to make in his head beforehand".* In rare cases, there were divergences between the artistic and the aeronautical demands. However, the pilot apparently did not experience these moments as stressful.

2.2.6 Decision-making behaviour

Decision-making is influenced by the particular mood of the decision-maker. The extent to which the morning atmosphere, ideal for film work, affected the entire crew and in the final analysis also the pilot's risk-taking behaviour must remain an open question. The railway bridge over the Rhine, in the early morning light, was especially inviting for filming dynamic images.

2.2.7 Visibility of lines

The general visibility of obstacles such as cables and lines is very poor, regardless of flight visibility and the incidence of the light against a changing, somewhat dark background. The pilot of a military helicopter was similarly unable to detect the same line in the same location 27 years previously. The landscape behind the line, from a low flying altitude over the Rhine, is characterised by dark woods and bushes on the banks of the river both upstream and downstream. This produces an excessively low contrast between the obstacle and the environment.

The pilot's lightly tinted sunglasses had no significant influence on the visibility of the power line. Under similar lighting conditions, with the sun behind, the clear helmet visor would provide the best visibility.

The view from the cockpit of the helicopter involved in the accident was restricted by two monitor screens. However, since the altitude of the helicopter in both the Eglisau and Freienstein cases was lower than the line, the effect on a possible earlier detection can be excluded.

2.2.8 Additional aids and flying tactics

- Consultation of the obstacle chart and a detailed analysis of the flight path are indispensable for filming missions with a known flight path.
- The filming helicopter was not equipped with a digital chart display device. This device does not replace the flight preparation described above, but may considerably improve situational awareness during the flight. This aid must be used consciously with an awareness of the current data set and with regard to possible distraction from observation of the airspace.
- The installed FLARM cable warning device is designed only as an additional obstacle warning device. It must therefore be used with an awareness of the current data set and of the visibility of the warning lights.
- Scanning of the terrain for masts or pylons is an appropriate procedure when looking for cables or lines. However, this requires that the current reconnaissance flight path is safe in terms of cables.
- The ability to distinguish between a flight path which is free or not from cable risks is indispensable when flying a helicopter and must be practised.

2.2.9 Summary

There was a lack of any detailed analysis of the evident and latent hazards to this mission.

There was a lack of any discussion of flying tactics with regard to the risks identified in the analysis.

There was a lack of prior reconnaissance of the section of the flight which might have been spanned by cables. This could be undertaken on the ground or in the air. When it is carried out, the planned flight path must be examined meticulously for visible signs of lines and cables. If a section has been declared free from obstacles, it is indispensable to stay consistently in the obstacle-free zone.

In view of his flying tactics, the pilot was not aware that obstacles below 25 m AGL are not shown on the flight obstacle chart.

The situational awareness of the director and the pilot was excessively optimistic with regard to the general visibility of cables and lines.

The pilot and director relied, amongst other things, on a cable warning device database which had not been updated. They were not aware that the aid in this form is intended merely as an additional warning device.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The helicopter was certified for VFR operations.
- Both the mass and centre of gravity of the helicopter were within the permitted limits at the time of the accident according to the AFM.
- The investigation produced no indications of any pre-existing technical faults which might have caused or influenced the accident.
- The last 100/300/600/1200-hour check 1 and 2 annual inspection took place at TSN 2278 airframe hours and TSN 1519 engine hours on 25.04.2007.
- The last airworthiness review by the FOCA took place on 04.10.2006.

3.1.2 Crew

- The pilot was in possession of the necessary licences for the flight.
- There are no indications of the pilot suffering any health problems during the accident flight.
- The pilot had previously conducted filming flights with the director and the camera man.
- The director's behaviour had an unfavourable effect on the pilot's decision-making.

3.1.3 History of the flight

- The pilot's flight preparation was carried out with particular reference to airspace aspects and fuel planning.
- The pilot had equipped himself with the obstacles chart for the intended flight route.
- Cables or lines on the planned flight path were not discussed in the mission briefing.
- The helicopter's airspeed and position were controlled throughout the flight.
- Near Freienstein, the helicopter flew under a cable which was at a height of 32 m in order to facilitate dynamic aerial photography.
- In unplanned terrain, with no reconnaissance, the helicopter passed below the critical height of 25 m AGL in order to facilitate dynamic aerial photography.
- No risk assessment took place when transitioning from planned to unplanned sections of the flight.
- The crew relied on early detection of obstacles in flight.
- The crew relied on a cable warning device with a database which had not been updated.

3.1.4 General conditions

- The visual conditions were ideal for filming.
- The height above the terrain affects the dynamics of the images obtained and therefore their attractiveness.

3.2 Causes

The accident is attributable to a collision by the helicopter with two cables 18m AGL during a filming flight.

The following factors contributed to the accident:

- no reconnaissance took place,
- insufficient risk analysis in relation to flight obstacles.

Payerne, 9 April 2009 Aircraft Accident Investigation Bureau

Annexes

Figure 1: Camera view above the Töss just before Freienstein. Telephone line visible only against light background (sky).

Figure 2: Camera view just before flying under the cable near Freienstein. Telephone line at top edge of image.

Figure 3: Camera image from a position approximately 6 seconds or 100 m before the cable obstacle near Eglisau.

Figure 4: Camera image from a position approximately 1 second or approximately 18 m before the cable obstacle

Figure 5: Camera image from a position immediately before the collision with the cable obstacle

Figure 6: Helicopter after emergency landing on the north bank of the river.

Figure 7: View from cockpit, Garmin GPS seen pilot side left, one camera monitor each for pilot and director.

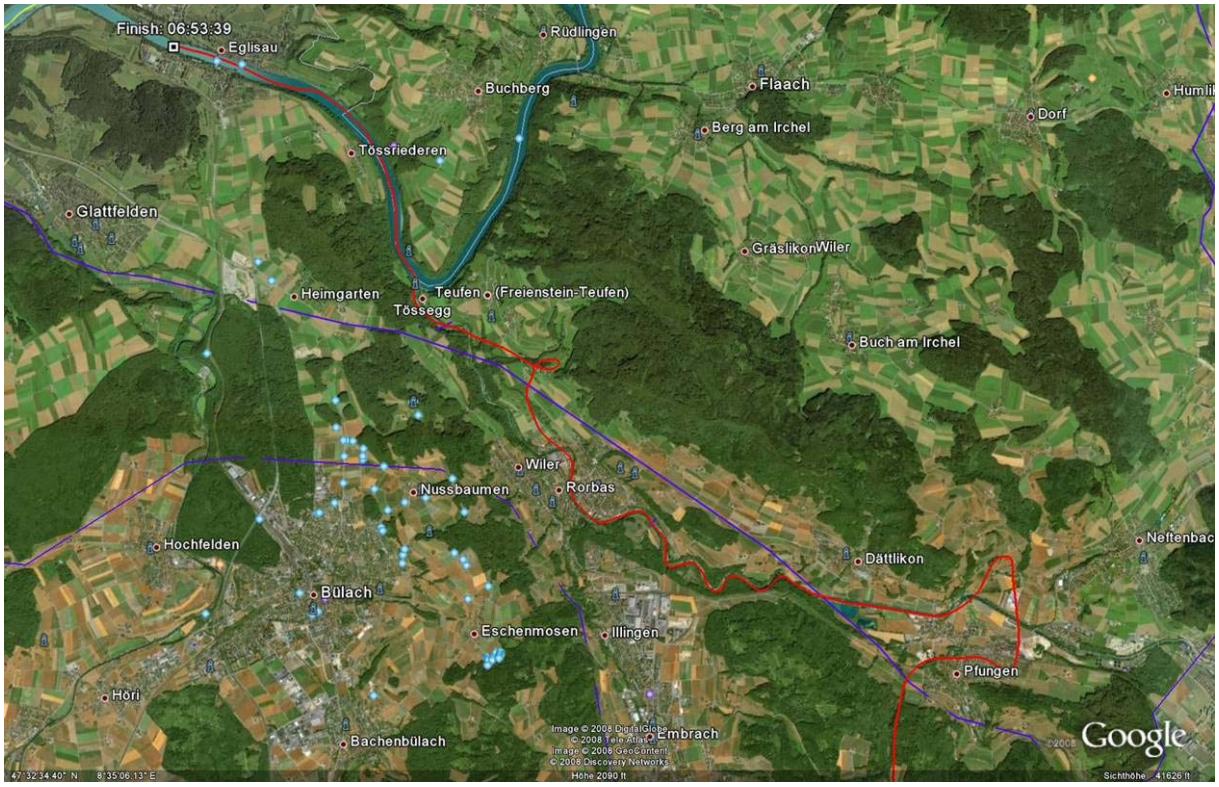


Figure 8: Flight path via the Töss and Rhine shown in red.