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Aircraft Accident Investigation Bureau AAIB

Final Report No. 2007 by the Aircraft Accident Investigation Bureau

concerning the accident

to the Piper PA-28-181 Archer II aircraft, registration HB-PGC

on 16 September 2007

in Bocchetta di Föisc, municipality of Airolo/TI

approx. 4 km east north-east of Airolo

Ursachen

Der Unfall ist darauf zurückzuführen, dass das Flugzeug mit dem Gelände kollidierte, weil der Flug fortgesetzt wurde, obwohl keine ausreichenden Sichtreferenzen mehr vorhanden waren.

Folgende Faktoren haben die Entstehung des Unfalls begünstigt:

- Geringe Erfahrung des Piloten bezüglich des Fliegens im Gebirge bei anspruchsvollen Wetterbedingungen.
- Unvollständige Flugvorbereitung.
- Ungenügender Austausch von Informationen innerhalb einer *flying training organisation*.

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 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 local time (LT) for Switzerland, corresponding at the time of the accident to Central European Summer Time (CEST). The relationship between LT, CEST and coordinated universal time (UTC) is:
 $LT = CEST = UTC + 2 \text{ h.}$

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

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Final Report

Owner	Motorfluggruppe Zurich, 8058 Zurich, Switzerland
Keeper	Motorfluggruppe Zurich, 8058 Zurich, Switzerland
Aircraft type	Piper PA-28-181 Archer II
Country of registration	Switzerland
Registration	HB-PGC
Location	Bocchetta di Föisc, municipality of Airolo/TI approx. 4 km east-north-east of Airolo
Date and time	16 September 2007, 19:05 LT

Synopsis

On 16 September 2007, aircraft HB-PGC took off at 17:18 LT from Florence-Peretola (I) aerodrome with four persons on board for a flight via Milan and the Gotthard Pass to Zurich. Most of the passes over the Alps were in cloud. The aircraft flew in the Leventina almost as far as Airolo and was not able to cross the Gotthard Pass because of the cloud cover. At 19:05 LT the aircraft collided with the terrain to the west of Lake Ritom at an elevation of 2100 m AMSL.

Two of the occupants were fatally injured in the crash; the pilot and one passenger were seriously injured. The aircraft was destroyed.

There was insignificant cope damage.

At 20:25 LT the aircraft was recognised as being overdue and clarifications were then sought as to its whereabouts. In view of the poor weather conditions, only a ground-based search was possible overnight. At 10:04 LT on the morning of 17 September 2007, the crew of a search helicopter was able to locate the wreckage and the rescue of the surviving occupants of the aircraft was initiated.

Investigation

The investigation was opened on 17 September 2007 at approximately 12:30 LT in cooperation with the Ticino cantonal police.

The accident is attributable to the fact that the aircraft collided with the terrain because the flight was continued even though adequate visual references were no longer available.

The following factors contributed to the origin of the accident:

- the pilot's limited experience of mountain flying under demanding weather conditions.
- incomplete flight preparation.
- insufficient exchange of information within a flying training organisation.

1 Factual information

1.1 Pre-flight history and history of the flight

1.1.1 General

The recordings of radio communication, radar systems and the portable GPS¹ navigation device onboard the aircraft, the indications of the aircraft's instruments and the statements of eye witnesses and ear witnesses and informants were used for the following description of the pre-flight history and history of the flight.

The flight took place under visual flight rules.

1.1.2 Pre-flight history

In 2005, the pilot began further training with the "Ausserschwyzerische Fluggemeinschaft" (ASFG), based at Wangen-Lachen aerodrome, in order to convert his American licence to a licence complying with the joint aviation requirements (JAR). On the occasion various training flights as well as solo flights were made. In June 2006, accompanied by a flying instructor and together with other pilots, the pilot took part in a foreign country navigation flight to Corsica, Sardinia, the island of Elba and to the Tuscany.

Within the framework of this further training to acquire the licence conversion, it was on various occasions apparent that the pilot had difficulty with navigation and with appropriate mountain flying, among other things. According to the flying instructors who trained him, he also found it difficult to assess his own performance and capabilities realistically. Between 3 September 2005 and 25 November 2006, the pilot completed 35:59 flying hours on aircraft of the "Ausserschwyzerische Fluggemeinschaft". The manager of the ASFG flying school informed the pilot that in view of his experience and performance status in hand with regard to completing the licence conversion, a further 20 to 40 flying hours would be necessary.

After 25 November 2006 the pilot made no further flights with the ASFG and changed from Wangen-Lachen to Zurich Airport. On 22 June 2007, he continued further training to acquire the licence conversion at the "Motorfluggruppe Zurich" flying school. After 11:39 hours flying training with two different flying instructors of the "Motorfluggruppe Zurich", he passed the skill test for the private pilot's licence according to JAR on 13 August 2007.

On 25 August 2007, the pilot flew in aircraft HB-PGC from Zurich to Olbia in Sardinia (I). The flight was made without an intermediate landing and lasted for 4:05 hours block time and 3:41 hours actual flying time. The aircraft was then fully refuelled.

The return flight to Zurich took place on 27 August 2007. This flight was also made without an intermediate landing. The pilot arrived at Zurich Airport after 4:10 hours block time and 3:51 hours actual flying time.

On Saturday 15 September 2007 aircraft HB-PGC was fully refuelled and the pilot made detailed flight preparations using the Skyguide homebriefing system. At 09:06 LT, the aircraft took off from Zurich on a flight to Florence-Peretola (I)

¹ *GPS – Global positioning system*: a satellite-based system which can be used worldwide for position finding, navigation and chronometry, with corresponding receivers.

aerodrome. The pilot and two passengers were on board. The actual flight time was 3:02 hours and the pilot followed the route: Zurich – Gotthard Pass – Brig – Zermatt – Biella – Florence. The pilot's brother was in Florence and asked him to make a flight to the island of Elba and back the next day, with himself and two other acquaintances.

On the following day, 16 September 2007, the pilot arranged for the aircraft to be fully refuelled in Florence-Peretola (I). Refuelling with 133 l of AVGAS 100LL aviation gasoline was completed by 10:50 LT.

HB-PGC then took off at 11:12 LT on a flight to the island of Elba. The pilot, his brother and two of his brother's acquaintances were on board. After 45 minutes actual flying time, the aircraft landed at 11:57 LT at Marina di Campo aerodrome (Elba/I).

After the lunch break, the pilot made his way to the aerodrome office, paid the landing fees and reported that he would be flying back to Florence. Refuelling did not take place. At 15:30 LT the aircraft lifted off on the flight to Florence, where it landed 51 minutes later.

The pilot of HB-PGC asked on the aerodrome for meteorological information and received a computer print out with the meteorological aerodrome report (METAR) and terminal aerodrome forecast (TAF) of the aerodromes of Florence, Parma, Milan-Linate, Milan-Malpensa and Zurich.

This time, the flight plan specified the direct route *Galciiana-Parma-Voghera-Locarno-Gotthard-Zugerssee-W-Zurich*. Wangen-Lachen was entered as the alternate aerodrome. The pilot specified 2:15 hours for the planned flight time for this section and indicated an endurance of 3 hours.

As in Marino di Campo, no more fuel was taken onboard in Florence. For the return flight, the pilot, his brother and the two passengers who had accompanied the pilot on 15 September 2007 to Florence were on board.

1.1.3 History of the flight

Aircraft HB-PGC took off at 17:18 LT from Florence-Peretola (I) for the return flight to Zurich.

The highest permissible altitude over the Po plain is 1000 ft/GND. The aircraft followed the planned route to Parma, and then the pilot flew on over Trezzo in the direction of Lecco on Lake Como.

At 18:45 LT, the pilot left the 124.925 MHz Milan area control centre frequency. When he did so, he changed the transponder setting to code 7000, the code prescribed in Switzerland for visual flights. At this time, HB-PGC was over Lake Como at an altitude of approximately 2600 m AMSL, equal to 8500 ft AMSL. The aircraft then entered Switzerland via the Bocchetta di Paina.

At 18:56 LT, the pilot made contact with Zurich Information on the 124.700 MHz frequency and informed them, among other things, that he wished to continue his flight under visual flight rules via the Gotthard, Lake Lucerne and Lake Zug to Zurich. At this time, the aircraft was in the vicinity of Giornico TI, approximately 18.5 km (10 NM) south-east of Ambri aerodrome, at an altitude of approximately 2500 m AMSL, equal to 8200 ft AMSL.

Zurich Information then informed the pilot of the QNH for Zurich and instructed him to report again over the Gotthard Pass: *"Hotel Bravo Papa Golf Charlie, QNH one zero one seven, next report Gotthard"*.

Shortly afterwards, when the aircraft was in the vicinity of Faido, the pilot asked Zurich Information about the weather to the north of the Gotthard Pass. At 18:59:28 LT Zurich Information transmitted the following information to him: *"Erm, Hotel Golf Charlie, according the GAFOR, the routing Gotthard Pass, Goldau is closed"*. The pilot then answered: *"Okay, affirmative, here we have, erm, VFR conditions. I will proceed, in case, I will turn, er, rerouting to Lugand"*. A few seconds later, Zurich Information gave him additional information on the route over the Lukmanier Pass: *"Roger, and the other routing, Biasca, Lukmanier Pass, Bad Ragaz, this routing is marginal."*

HB-PGC then flew over Ambri aerodrome towards Airolo at an altitude of approximately 2500 m AMSL, equal to 8200 ft AMSL. Witnesses on the ground were able to hear the aircraft but it was not visible due to cloud cover. During the next two minutes, the aircraft descended approximately 100 m, equal to 300 ft, and made an approximately 200 degree right turn north of Airolo.

When HB-PGC was on an easterly heading, it descended approximately 300 m or 1000 ft within a few seconds and at 19:04:19 LT was at an altitude of 2100 m AMSL or 6900 ft AMSL. At this time, the pilot again reported to Zurich Information, informing them that he wanted to fly to Lugano because of the prevailing meteorological conditions: *"Hotel Bravo Papa Golf Charlie, we are doing a rerouting to Lugano, because of meteorological conditions"*.

The Zurich Information controller wanted to know the current position and altitude of HB-PGC, whereupon the pilot answered at 19:04:35 LT: *"Abeam Ambri, you know, is there another pass open? Here close or is everything closed?"* At this time the aircraft was on a heading of approximately 80° over ground and was in the process of flying into the Valle di Büi in a gentle climb.

Shortly afterwards, at 19:05:13 LT, the pilot received the desired information on the meteorological situation from Zurich Information: *"According the GAFOR, the routing from Lugano to Domodossola is difficult, and from Domodossola to Brig is marginal and then is open. After Brig, the routings are open"*.

This radio conversation ended at 19:05:28 LT. According to the recordings of the portable GPS, at this time HB-PGC came into contact with the rising terrain approximately 20-25 m below the Bocchetta di Föisc Pass.

The occupants who were sitting on the right side of the aircraft suffered fatal injuries when the aircraft crashed. The pilot and the passenger sitting behind him were seriously injured.

When the pilot of HB-PGC did not confirm the last radio message, Zurich Information attempted in vain to re-establish contact with the aircraft until 19:44:10 LT.

When HB-PGC did not arrive in Zurich as planned and was more than 30 minutes overdue, the "incertitude phase" (INCERFA) was declared.

No signals from an emergency transmitter were received. However, there was a radar trace which could be allocated to the missing aircraft. The last signal of this trace was recorded at 19:04 LT to the north of Ambri.

At 21:32 LT, the Zurich Rescue Control Centre (RCC) declared the distress phase (DETRESFA). In view of poor weather conditions, only a ground-based search was possible overnight.

On 17 September 2007, shortly after 10:00 LT, the crew of a Federal Office of Civil Aviation (FOCA) helicopter spotted the wreckage of HB-PGC through a gap in the cloud and were able to initiate the rescue of the surviving occupants of the aircraft.

1.2 Injuries to persons

Injuries	Crew	Passengers	Total number of occupants	Others
Fatal	---	2	2	---
Serious	1	1	2	---
Minor	---	---	---	---
None	---	---	---	---
Total	1	3	4	

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

There was insignificant crop damage.

1.5 Personnel information

1.5.1 Pilot

1.5.1.1 General

Person	Swiss citizen, born 1973
Licence	Private pilot's licence, issued on 21.09.1996 by the U.S. Department of Transportation's Federal Aviation Administration (FAA). Private pilot's licence PPL(A) according to joint aviation requirements (JAR), first issued by the FOCA on 16.08.2007, valid till 16.08.2012
Ratings	Single-engine piston (SEP) aircraft, valid till 13.08.2009
Radiotelephony	The following entry was in the licence: <i>The holder of this licence has demonstrated competence to operate R/T equipment on board aircraft in English.</i>
Medical fitness certificate	<i>Medical Certificate USA 3^d class with the following restriction: Holder shall wear lenses that correct for distant vision and possess glasses that correct for near vision</i> Swiss medical certificate Class 2, without restrictions, issued on 10.05.2007, valid till 10.05.2012

The myopia was put down in the medical examiner's examination form but the restriction VDL (*shall wear corrective lenses and carry a spare set of spectacles*) was not entered into the Swiss medical certificate.

Due to his considerable myopia the pilot had always worn glasses and complied with the VDL restriction.

Last medical examination	10.05.2007
Commencement of pilot training	1996

1.5.1.2 Flying activity in the United States of America

The pilot began his pilot training on 8 August 1996 in the United States of America. After 66.2 flying hours², mostly completed in Florida on the Cessna C-152 aircraft, he passed the examination to acquire the American private pilot's licence on 21 September 1996. Up to 20 November 1996, the pilot then flew a further 10.3 hours in Florida. Over the following years, the pilot did not practise any flying activity.

From 27 June to 29 June 2005 the pilot made training flights in the United States with different flying instructors and completed a check flight. The total flying time for these three days until the check flight was 12.1 flying hours. Subsequently, up to 7 July 2005 he completed a further 29.1 solo flying hours in the United States and then began to fly in Switzerland (cf. chapter 1.17).

1.5.1.3 Flying experience

Total	184:18 hours
of which as pilot in command	100:19 hours
of which on dual controls	83:59 hours
on the accident type	50:25 hours
during the last 90 days	29:01 hours
of which on the accident type	27:27 hours
Landings, total	410
Landings during the last 90 days	41
Landings, total, on the accident type	90
Landings during the last 90 days on the accident type	36

² The entries in the pilot's American logbook are indicated in decimal hours.

1.5.2	Passengers	
	P1 (front right):	British citizen, born 1981 No pilot's licence or ratings
	P2 (rear right):	New Zealand citizen, born 1970 No pilot's licence or ratings
	P3 (rear left):	Swiss citizen, born 1982 No pilot's licence or ratings
1.6	Aircraft information	
1.6.1	General	
	Registration	HB-PGC
	Aircraft type	Piper PA-28-181 Archer II
	Characteristics	Single-engine aircraft, full metal construction with four seats, built as low-wing aircraft with fixed landing gear in nose-wheel arrangement.
	Manufacturer	Piper Aircraft Corp., Vero Beach, Florida, USA
	Year of construction	1981
	Serial number	28-8190172
	Owner	Motorfluggruppe Zurich, 8058 Zurich, Switzerland
	Keeper	Motorfluggruppe Zurich, 8058 Zurich, Switzerland
	Engine	Textron Lycoming O-360-A4M - Rebuilt 1995 S/N RL-34559-36A, 180 HP
	Propeller	Two-bladed fixed propeller Sensenich 76EM8S5-0-62 S/N 30331K
	Equipment	Basic VFR equipment, 1 ADF, 1 DME, 2 NAV (VOR) 1 Garmin GPS-100 1 Transponder mode C
	Operating hours, airframe	Total since manufacture: 7333:57 hours
	Operating hours, engine	Total since manufacture: 3042:14 hours Total since overhaul: 864:08 hours
	Operating hours, propeller	Total since manufacture: 3042:14 hours Total since overhaul: 864:08 hours
	Max. permitted take-off mass	1157 kg
	Mass and centre of gravity at the time of the accident	The mass of the aircraft at the time of the accident was approximately 1130 kg. Both the mass and centre of gravity were within the permitted limits according to the aircraft flight manual (AFM).

Mass and centre of gravity on take-off	At the time the accident flight took off, the take-off mass was 1181 kg and was therefore above the maximum permitted take-off mass. The centre of gravity was at the rearmost permitted limit.
Maintenance	A 1000-hour check was carried out on 31.01.2007 at 7121:45 airframe operating hours. The last periodic maintenance, a 100-hour check, took place on 07.09.2007 at 7321:25 airframe operating hours. The last condition check by the FOCA took place on 15.11.2005.
Maintenance company	Motorfluggruppe Zürich, Switzerland
Technical complaints	The following point was entered in the logbook on 04.08.2007: <i>Fuel quantity L+R wrong!</i> <i>L remains @ 20 GAL, R @ 15 GAL</i> According to information from the maintenance company, the tank indication was subsequently checked and found to be in order.
Fuel grade	AVGAS 100LL aviation gasoline
Fuel remaining	At the time of the accident, the remaining fuel was sufficient for max. 45 minutes flying time (cf. chapter 1.6.2).
Registration certificate	Issued by the FOCA on 21.11.1995 / No. 1, valid till removal from the aircraft register
Airworthiness certificate	Issued by the FOCA on 21.11.1995 / No. 1, valid till revoked
Certification	VFR day / VFR night In commercial use VFR day

1.6.2 Fuel system and fuel consumption

The PA-28-181 Archer II aircraft is fitted with two wing tanks, which according to the aircraft flight manual (AFM) have a total capacity of 189 l, of which 181 l is usable. These tanks have a filler neck indicator, a small sheet steel angle which is fitted in the tank opening in such a way that visual determination of the tank contents is facilitated. The usable fuel on refuelling up to the lower edge of the filler neck indicator is 64 litres per tank. The fuel supply is via a tank selector which allows to select each tank individually. In addition, this selector has an "OFF" position which, however, can only be selected when a safety catch is pressed first.

Using the flying times recorded in the logbook and the amounts of gasoline which were taken onboard during refuelling at the different aerodromes, it was

possible to determine HB-PGC's consumption on two similar routes with the same pilot at the controls. The result was an average consumption of 0.7 l per minute of flying time, corresponding to 42 l per hour of flying time. According to the description in the AFM, a further 5 l per flight must be allowed for engine start, engine run up and taxi for take-off.

It was possible to reconstruct another flight which was made on 4 August 2007 on the same aircraft but by a different pilot. After deducting 5 l of fuel for engine start, taxi and engine run-up, this flight resulted in an average consumption of 0.69 l per minute of flying time or also approximately 42 l per hour of flying time.

HB-PGC was fully refuelled at 10:50 LT on 16 September 2007 in Florence. After refuelling, the aircraft flew a total of 203 minutes up to the time of the accident and made three take-offs. After deducting 15 l for three engine start and taxi sequences, 166 l of fuel were available; this would have been sufficient for nearly 4 hours of flying, given the established consumption of 42 l per hour of flying time.

If the 1:36 hours of flying time required for the Florence-Elba-Florence route are deducted, on take-off from Florence, HB-PGC still had a remaining endurance of 2:30 hours. At the time of the accident, the aircraft had been in the air for 1:47 flying hours since taking off from Florence. Therefore, a remaining endurance of 45 minutes was available at the time of the accident.

On two different photographs which were taken by an occupant of the aircraft at 18:13 LT and 18:52 LT, it is possible to see the fuel quantity indicator of the two fuel tanks. On the basis of the indicated fuel quantities, at the time of the accident there was a maximum of 35 l of gasoline in the tanks of HB-PGC, corresponding to an endurance of approximately 50 minutes.

Two fuel quantity indicators of different design were installed on aircraft HB-PGC. These indicators were removed and examined after the accident (cf. chapter 1.16.2).

1.7 Meteorological information

1.7.1 General

The information in chapters 1.7.2 to 1.7.7 was predominantly provided by MeteoSwiss.

The information in chapter 1.7.8 is based on eye-witness observations and that in chapter 1.7.9 is based on images from automatic cameras. Chapter 1.7.10 refers to video recordings made by one of the passengers in the aircraft involved in the accident.

The information listed in chapter 1.7.11 was found in the wreckage of HB-PGC.

1.7.2 General meteorological situation

The homogeneous but extensive area of high-pressure over southern Europe was determining the weather in Switzerland. In the lower strata of the atmosphere, it drove rather more humid air towards the south side of the Alps.

1.7.3 Meteorological conditions at the time and location of the accident

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

<i>Weather/cloud</i>	<i>7-8/8 at around 5500 ft AMSL Top of cloud according to Milano probe at approx. FL 110</i>
<i>Visibility</i>	<i>Outside the cloud, between 5 and 10 km</i>
<i>Wind</i>	<i>Southerly wind at around 10 kt, gusting to 20 kt</i>
<i>Temperature/dewpoint</i>	<i>09 °C / 08 °C</i>
<i>Atmospheric pressure</i>	<i>QNH LSZH 1017 hPa, LSZA 1019 hPa</i>
<i>Hazards</i>	<i>Low cloud base, diffuse visibility conditions just below the main cloud base, Alpine crossings from the south in cloud</i>

1.7.4 Astronomical information

Position of the sun	Azimuth: 268°	Elevation: 6°
Lighting conditions	Daylight	
End of civil twilight	20:11 LT	

1.7.5 Route meteorological forecast

The general aviation forecast (GAFOR) provides information on the expected visibility and expected main cloud base (ceiling) on the main visual flight routes in Switzerland. For the route 72 which was applicable to the flight involved in the accident, from Biasca to Goldau, with a reference altitude of 7200 ft AMSL, the forecast issued on 16 September 2007 at 10:51 UTC, with a validity from 12:00 to 18:00 UTC, read: XXX (*Closed, Closed, Closed*). At 14:31 UTC another route forecast was issued, with a validity from 15:00 UTC to 21:00 UTC. For route 72, this was unchanged at XXX.

In clear text this means that, between 14:00 LT and 23:00 LT, a visibility of less than 2 km and a main cloud base below 8200 ft had to be expected on the route.

1.7.6 Meteorological aerodrome report

On the afternoon of the accident, the following METAR (Meteorological aerodrome report) applied:

METAR Lugano:

*LSZA 161450Z VRB03KT 9000 FEW040 SCT070 BKN100 23/16 Q1020 NOSIG=
LSZA 161520Z 18004KT 9000 FEW040 SCT100 24/16 Q1019 NOSIG=*

In clear text, this means: on 16 September 2007, shortly before the 14:50 UTC, corresponding to 16:50 LT, issue time of the meteorological aerodrome report at the Lugano regional airport, the following meteorological conditions were observed:

Wind	Variable direction, 3 kt
Meteorological visibility	9000 m
Precipitation	None
Cloud	1-2/8, base at 4000 ft/AAL 3-4/8, base at 7000 ft/AAL 5-7/8, base at 10 000 ft AAL

Temperature	23 °C
Dew point	16 °C
Atmospheric pressure	1020 hPa, pressure reduced to sea level, calculated using the values of the ICAO standard atmosphere
Landing weather forecast	No substantial change in these conditions is expected for the next two hours.

The other listed meteorological aerodrome reports can be decoded by analogy with the above.

METAR Zurich:

*LSZH 161450Z 24009KT 210V280 CAVOK 23/12 Q1017 NOSIG=
LSZH 161520Z 26008KT CAVOK 24/11 Q1017 NOSIG=*

1.7.7 Terminal aerodrome forecast

On the day of the accident, among other things, the following terminal aerodrome forecast (TAF) applied:

TAF Lugano:

*LSZA 160900Z 161019 20004KT 7000 SCT040 BKN080=
LSZA 161200Z 161322 20004KT 7000 FEW050 BKN070=*

In clear text, this means: on 16 September 2007, the following meteorological conditions were forecast for Lugano regional airport between 10:00 UTC and 19:00 UTC:

Wind	from direction 200°, 4 kt
Meteorological visibility	7000 m
Cloud	3-4/8 at 4000 ft AAL 5-7/8 at 8000 ft AAL

The other listed terminal aerodrome forecasts can be decoded by analogy with the above.

TAF Zurich:

*LSZH 160900Z 161019 VRB03KT 5000 BR BECMG 1013 24005KT CAVOK TEMPO
1316 9999 FEW045 T23/12Z T24/15Z=
LSZH 161200Z 161322 24005KT CAVOK TEMPO 1316 9999 FEW045 T23/15Z
T18/18Z=*

1.7.8 Perceptions of eye and ear witnesses

Only one eye witness briefly made visual contact with the aircraft; the other witnesses only heard the noise of the engine and later described the meteorological conditions. The witness locations are listed in Annex 1.

A (Pilot PPL): „Die Wolkenbasis schätzte ich circa auf der Höhe der Druckwasserröhre (auf Karte 1:25 000 ca. 1800 m/M). Unten hatte es keinen Dunst, aber weiter oben wurde es immer dichter“.

Translation: "I estimate the cloud base at about the altitude of the pressurised water pipe (on the 1:25,000 map approximately 1800 m AMSL). Underneath there wasn't any mist, but further up it got thicker and thicker."

- B (Glider pilot): *„Preciso che non era ancora buio, ma ad un'altitudine di ca. 1600 m vi era nebbia. (...) ... non sono riuscito a vederlo perché era nelle nubi“.*

Translation: "I'd specify that it was not yet dark, but at an altitude of approximately 1600 m it was foggy. (...) ... I wasn't able to see him, because he was in the clouds."

- C *„A quell'ora, saranno state le sette o poco prima, non era ancora buio. Avevo notato che le nubi erano ad un'altezza di ca. 1900 m. L'aereo, quando l'ho notato, era poco sotto le nubi. Posso dire che al di sotto delle nuvole è rimasto pochi secondi, ma non saprei dire se è l'aereo che si è alzato o se sono state le nubi a scendere“.*

Translation: "At that time, it might have been seven o'clock or just before, it wasn't dark yet. I had noticed that the cloud was at an altitude of approximately 1900 m. When I noticed the aircraft, it was just below the clouds. I can say that it only remained below the cloud for a few seconds, but I don't know if the aircraft climbed or if the cloud descended."

- D *„Devo dire che quella domenica, per quasi tutta la giornata, vi era nebbia in particolare da un'altitudine di ca. 1700/1800 m. Verso le ore 19:00 ho sentito il rumore di un aereo, tipo monomotore. Ho sentito sopraggiungere il rumore dalla zona del lago Ritom verso la zona Monte. Preciso che non ho potuto vedere il velivolo in quanto si trovava al disopra della nebbia, che in quel momento era a 1750 m. Posso dire questo con certezza in quanto da Monte vedo bene la mia cascina che si trova ad un'altezza di 1680 m“.*

Translation: "I have to say that on that Sunday, mainly at an altitude of approximately 1700/1800 m, it was foggy practically the whole day. At about 19:00 LT, I heard the noise of a single-engine aircraft. I heard the noise coming from the Lake Ritom area towards Monte. I'll make it clear that I could not see the aircraft, as it was above the fog, which at the time was at an altitude of 1750 m. I can say with certainty because my dairy farm is located at an elevation of 1680 m."

1.7.9 Webcams

Since images from webcams are generally saved for only a short time, only a few images of the region in which the accident occurred could be secured after the accident. However, the available images from the Catto webcam do show the development of weather conditions in the upper Leventina during the day of the accident (cf. Figure 1).



Figure 1 – Webcam images: Image from Catto, looking towards Piotta and Airolo on 16 September 2007. Ambri aerodrome can be seen in the foreground. For comparison, an image showing clear visibility conditions is shown top left.

1.7.10 Video recordings by aircraft occupants

It was possible to obtain photographs from the video camera which was being carried by one of the passengers on HB-PGC, showing the development of the weather during the flight in the direction of the Leventina from the point of view of the aircraft occupants (cf. figure 2).



Figure 2 – Stills from a video camera onboard the aircraft involved in the accident: The photos were taken at approximately 18:48 LT and show the locality of the Val Treversagna/GR. As was established after the accident, the video camera's clock was 6:54 hours fast.

1.7.11 Meteorological information for flight preparation

A printout was found in the wreckage of the aircraft with the METAR and TAF for the aerodromes of Florence, Parma, Milan-Linate, Milan-Malpensa and Zurich (cf. figure 3).

According to the employees of Florence-Peretola and Marina di Campo aerodromes, no further information for preparing the Marina di Campo – Florence – Zurich flight was requested by the occupants of HB-PGC.

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FLR /LIRQ * 1-FLORENCE/*AMERIGOVESPUCCI-KM4-MLS2-FLR/*ZMS
B. SA161420
  27005KT 240V300 9999 FEW030TCU BKN070 27/17 Q1019
F. FC161400   VALIDITY: 161524
  161524 VRB04KT 9999 SCT035 SCT080 TEMPO 1521 4000 TSRA
  SCT015CB BKN030
-----
PMF /LIMP * PARMA
B. SA161350
  06004KT CAVOK 28/15 Q1019
F. FC161400   VALIDITY: 161524
  161524 VRB05KT 8000 FEW030 SCT080
-----
LIN /LIML * LINATE-MILAN/FORLANINI
B. SA161420
  14004KT 6000 FEW025 SCT080 27/17 Q1019 NOSIG
F. FC161400   VALIDITY: 161524
  161524 14005KT 7000 SCT030 SCT050
-----
MXP /LIMC * MALPENSA-MILAN
B. SA161420
  35005KT 8000 FEW030 BKN080 24/15 Q1020 NOSIG
F. FC161400   VALIDITY: 161524
  161524 32004KT 7000 SCT030 SCT050
-----
ZRH /LSZH * ZURICH/APT
B. SA161420
  27005KT 200V330 CAVOK 24/13 Q1018 NOSIG
F. FC161200   VALIDITY: 161322
  161322 24005KT CAVOK TEMPO 1316 9999 FEW045 T23/15Z T18/18Z

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Figure 3 – Documents recovered from aircraft HB-PGC: the latest weather reports show an issue time of 14:20 UTC, corresponding to 16:20 LT.

1.8 Aids to navigation

A GPS navigation unit was permanently installed in the aircraft and the crew also had a portable GPS device.

1.9 Communications

In the course of the accident flight, the pilot was in contact with the following air traffic control and information units:

Duration	Unit	Frequency
17:05 – 17:22 LT	Aerodrome control Florence (Firenze Tower)	118.150 MHz
17:23 – 17:27 LT	Florence approach control (Firenze approach)	125.825 MHz
17:27 – 18:45 LT	Milan area control centre	124.925 MHz
18:56 – 19:05 LT	Zurich flight information centre	124.700 MHz

The radio communication took place in a usual manner and without any technical restrictions.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

Not prescribed and not installed.

A portable GPS navigation device was found in the aircraft wreckage. It was possible to read out and analyse data relating to the flights of 15 and 16 September 2007.

1.12 Wreckage and impact information**1.12.1 Wreckage**

The following findings were made on the wreckage:

The wreckage was situated in the middle of the small valley named Būital at an elevation of approximately 2100 m/AMSL. The Būital ends at the Bocchetta di Föisc at 2122 m/AMSL, a pass which connects the valley with the secluded area of the Lake Ritom.

The longitudinal axis of the aircraft was pointing in a direction of approximately 80 degrees. The right wing was torn off and lay about 30 metres in front and 10 metres to the left of the final position of the fuselage (cf. Annex 3). The right-hand side of the cabin was almost totally torn off. The engine was deformed to the right.

The flaps were extended and the trim was in the $\frac{3}{4}$ nose down position. The tank selector was half-way between "LEFT" and "OFF" position over the safety catch. The throttle lever was pushed forward approximately one quarter of its adjustment range and the mixture setting corresponded to a lean mixture. The transponder was set to code 7000 and switched on. The carburettor pre-heater was partly pulled out. In view of the deformation of the wreckage and the interventions required to recover the injured occupants, however, it is questionable whether these positions reflected the situation on impact.

A visual inspection of the rudder connections, connecting rods, bell cranks, cable linkages, turnbuckles and deflection rollers provided no indications of any pre-existing defects.

The lap and shoulder belts were being worn and resisted the deceleration forces, with the exception of the rear left shoulder belt, which was torn off.

The nature of the deformation of the propeller blades permits the conclusion that at the time of the accident the engine was producing only reduced power.

The tanks and fuel lines were damaged. There was no fuel in the tanks and neither the smell of fuel could be detected nor could traces of aviation gasoline be found on the terrain.

1.12.2 Impact

On the basis of the traces at the site of the accident and on the wreckage, it was possible to establish the following points: the aircraft first made contact with the ground with its right wingtip. The right wing separated from the aircraft, which continued to move some thirty metres up the valley before it came to a standstill. The right section of the cabin was torn off and deformed on impact.

1.12.3 Site of the accident

Accident location	Bocchetta di Föisc, municipality of Airolo/TI
Swiss coordinates	694 070 / 154 450
Geographical latitude	N 46° 32' 05"
Geographical longitude	E 008° 39' 53"
Elevation	2100 m AMSL 6890 ft AMSL
National map of Switzerland	Sheet No. 1252, Ambri-Piotta, scale 1:25,000

1.13 Medical and pathological information

The post mortem on the passengers who had died showed that their deaths are attributable to the serious injuries suffered on impact and was instantaneous.

During the accident, the pilot and the third passenger suffered serious injuries to the head and thorax, with impaired consciousness, which prevented them from freeing themselves from the wreckage. Despite temperatures of approximately 8 °C overnight, they withstood these and were able to be rescued about 15 hours after the accident. Among other things, the head injuries suffered in the accident caused retrograde amnesia.

The toxicological test on the pilot's blood and urine only produced evidence of Midazolam, which was applied by the emergency doctors.

1.14 Fire

Fire did not break out.

1.15 Survival aspects

1.15.1 General

The upper part of the Büital is steep and interspersed with mounds and stones. An emergency landing is difficult in such terrain.

1.15.2 Emergency transmitter

The aircraft was equipped with a Kannad 406 AF emergency transmitter (emergency location beacon aircraft – ELBA).

The device, installed in the rear section of the fuselage was not damaged by the impact. Despite the deceleration which occurred, the emergency transmitter did not transmit a signal (cf. chapter 1.16.1).

After the accident, the surviving occupants had to await rescue for more than 15 hours trapped in the wreckage.

1.15.3 Search and rescue

When the pilot of HB-PGC had not confirmed receipt of the last radio message, Zurich Information attempted in vain to re-establish contact with the aircraft until 19:44:10 LT.

According to the information in the ATC flight plan, HB-PGC should have arrived in Zurich at approximately 19:35 LT. At 20:25 LT, Zurich Area Control Centre (ACC) alerted the Zurich Rescue Control Centre (RCC) that HB-PGC was overdue. RCC Zurich then declared the incertitude phase INCERFA at 20:36 LT.

Enquiries with possible alternative aerodromes along the flight route did not result in any indication of the whereabouts of the missing aircraft. No emergency transmitter signals were received, either via the SARSAT/COSPAS satellite location system or via ground antennas.

It was decided at 21:00 LT to use a REGA helicopter for the search for one hour. A REGA helicopter stationed in Ticino then made search flights, which, however, were not successful because of the low cloud.

Subsequently, the person responsible in RCC Zurich made contact with the ACC Zurich duty manager and asked him to search the radar recordings in the presumed accident area for traces of HB-PGC. At approximately 21:30 LT, ACC Zurich reported that the missing aircraft had disappeared from the radar screen after making a reversal turn about one nautical mile north of Ambri aerodrome at an altitude of approximately 7000 ft AMSL. The last radar signal based on the response of HB-PGC's transponder was recorded at 19:04 LT. It identified a position a few hundred metres to the west of the accident site.

At 21:32 LT RCC Zurich initiated the DETRESFA distress phase and then made contact with the air force duty officer at 21:42 LT. The search area was regarded as having been defined and as the weather seemed too bad for the helicopter search, the person responsible of RCC Zurich asked the air force for an analysis of the military radar recordings in order to better delimit the search, if possible. The air force were unable to comply with this request because of a shortage of personnel. Shortly afterwards the duty air force officer informed the RCC that the search helicopter was in Payerne and that the crew were mobilized.

In view of the poor weather conditions, the search using helicopters had to be abandoned at 23:50 LT.

Via the mobile telephone service provider, it was possible to ascertain the mobile telephone network cell with which the pilot's mobile telephone had last been in contact. Overnight, this led to a narrower definition of the location of the accident site. The Ticino cantonal police and the Schweizer Alpenclub (SAC) rescue team's mountain guides were mobilised and deployed on the ground-based search.

On 17 September 2007, shortly after 10:00 LT, the crew of a Federal Office of Civil Aviation (FOCA) helicopter spotted the wreckage of HB-PGC through a gap in the cloud and were able to initiate the rescue of the surviving occupants of the aircraft.

1.16 Tests and research

1.16.1 Emergency transmitter

The emergency transmitter (emergency locator beacon aircraft – ELBA) was examined. It was found that the housing had not been damaged and that nothing inside it had been destroyed. The circuits and electrical connections were intact. The battery's time limit date was indicated as "08.2011".

In an initial test, the ELBA did not work because the battery was fully discharged. After it was removed, it was found that the off-load voltage was 2.17 V. According to the manufacturer's information, the emergency transmitter ceases to send distress signals if the battery voltage drops below 5 V. The voltage should not drop below this level for at least 72 hours of operation.

The discharged battery was replaced with a new one for the subsequent function tests.

During the self-test, the emergency transmitter's LED display showed error code "3+2", indicating a problem in the transmitter output. Evidence of this type of malfunction was confirmed by measuring the output power of the signals at the 121.5 MHz and 406 MHz frequencies. The output power at 121.5 MHz was 7.9 dBm, when a minimum power of 20 dBm is required. At a frequency of 406 MHz an output power of 30.5 dBm was achieved; in this case the minimum value is 35 dBm.

When an emergency signal was emitted, a maximum current requirement of 1.32 A was established; according to the specification, this was within the tolerance range, between 1.3 and 1.7 A. However, on conclusion of the self test, the highest permissible residual current requirement of 50 μ A in the armed mode was exceeded, at 843 μ A. According to the manufacturer's information, this approximately 17-fold higher power consumption could be attributable to a defective transmitter output stage.

Since the emergency transmitter's battery only had a voltage of 2.17 V and the emergency transmitter ceases to operate if the voltage falls below 5 V, it can be concluded that the ELBA had not transmitted.

The following is recommended in the Kannad 406 AF operation manual:

"The ELT is fitted with a self-test that enables to perform the "Operational Tests" required by certain Civil Aviation Authorities. It is recommended by the manufacturer to test the ELT as often as possible to detect any possible failure. The periodicity of the operational checks is at the operator's discretion. However, each self-test consumes energy from the battery which has been designed to allow an average of one self-test per month. Should self-tests be carried out more often than the maximum allowed, the battery life-time might be shorter than specified."

The emergency transmitter was fitted on 4 May 2005 and 16 self tests were registered in the subsequent 28 months. It was not possible to establish the date of the last self test.

1.16.2 Fuel quantity indication

Since a complaint regarding indication on the fuel quantity indicators had been entered in the logbook and since practically no fuel had been found at the accident site, the fuel indicating system was dismantled and subject to detailed examination.

The following components were installed in the aircraft:

Fuel quantity indicator left	P/N 5-90766	S/N not known
Fuel quantity sensor left	P/N 548671	S/N 7740309A92
Fuel quantity indicator right	P/N 819477	S/N not known
Fuel quantity sensor right	P/N 68101-02	S/N not known

The indicator and sensor on the right side correspond to the originals.

The indicator and the sensor on the left side were replaced by alternative types, as is permitted in the maintenance manual and airplane parts catalogue.

As a result of the impact, both indicators had suffered minor damage such as broken glass and miscellaneous contamination, but these had not adversely affected their operation. Both sensors were still operational after the accident.

The indicators measure the variable resistance of the sensor and are calibrated to these. The difference between the right and left indication system is the way in which resistance is used for the measurement. The right sensor delivers a resistance of 0 to 50 Ω ; 0 Ω corresponds to a display of 0 USG. The 50 Ω resistance results in a FULL indication. In the left system, 260 Ω corresponds to a 0 USG indication and at 29 Ω the indicator indicates a full tank.

It was possible to demonstrate the proper functioning of the two indicators by simulating the different resistances using a decade resistor. The indicators were then connected to the matching sensors, thereby reconstructing both installed systems and checking their operation. During both tests, neither defects nor inaccuracies were found.

In view of the different operating methods of the instruments, it can be assumed that the right system has a greater tendency to inaccurate indications. The low resistance may be increased by slight oxidation of the connections which causes an excessively high amount to be indicated for the right fuel tank. As tests showed, the resistance in the left system would have to increase by at least 30-40 Ω to produce a faulty reading. The result would be an excessively low indication, which is less problematic for flight operations.

As a result of the impact damage, it was possible to reliably check only the sensors and indicators. It was not possible either to confirm or refute the possibility of the wiring having defective conductivity before the accident which might have affected the indication in the manner mentioned above.

1.17 Organisational and management information

1.17.1 Motorfluggruppe Wangen-Lachen

1.17.1.1 General information concerning the flying club and school

The "Ausserschwyzerische Fluggemeinschaft" (ASFG) operates Wangen-Lachen aerodrome, leases out aircraft to its members and has a flying school, which is a member of the Swiss Pilot School Association (Swiss PSA). At the time of the accident the ASFG had a fleet of seven aircraft and employed three flying instructors.

1.17.1.2 Training of the pilot

In 2005 the pilot approached the ASFG flying school in Wangen-Lachen in order to gain the requirements for a conversion of his American licence into a Swiss licence³. After several training and check flights he was allowed to make flights

³ At this time the following demands were made for a conversion of a foreign pilot licence into a Swiss licence: Medical certificate Class 2 according JAR, pass the theoretical test for private pilots in "air law" and "human performance", proof of the competence for radiotelephony in English, minimum of 100 hours total flying experience and pass the skill test for private pilots.

from Wangen-Lachen in ASFG aircraft as pilot in command. However, the condition that he was not allowed to make stopovers at other aerodromes was imposed on him. For such flights he was assigned a flying instructor or another pilot with sufficient flying experience as a safety pilot.

From January to July 2006 he flew over the Alps three times in fine weather with a safety pilot or a flying instructor. During this training period, the flying instructors became aware that the pilot had various navigation problems, as in his earlier flying activity he was accustomed to flying straight routes using GPS. The validation period expired on 30 August 2006 and the pilot wanted to be registered for the skill test as quickly as possible in order to obtain a conversion of his licence. According to the statements of his flying instructors, his performance had not reached a level conforming to the standard required for a skill test and in their view a further training requirement of 20 to 40 hours was necessary. The pilot, on the other hand, was of the opinion that he could reach the necessary performance level with less training. As he was also convinced that the flying instructors in Wangen-Lachen were not appropriately available, he decided to carry out his flying activity with the Motorfluggruppe Zürich in future.

The training in Wangen-Lachen extended from the beginning of September 2005 to the end of November 2006. During this period, the pilot completed a total of 35:59 flying hours on aircraft of the "Ausserschwyzerische Fluggemeinschaft".

1.17.1.3 Alpine introduction

According to the information from the ASFG flying school, Alpine introduction is taught using the following three basic rules: the pilot should fly in the right-hand third of the valley, maintain cruising speed and cross passes or ridges with at least 1000 ft altitude difference.

Several training flights over mountainous terrain were made with the pilot involved in the accident. Flights were made to the aerodromes of Saanen, Samedan and Lugano. All these flights took place under good meteorological conditions. According to information from the flying instructors, the pilot preferred altitudes which made it possible to fly over the mountains and he had problems navigating in the valleys. From his previous training in the United States, he was accustomed to navigating using GPS and to flying over long distances in straight lines with few navigation points.

These deficiencies in relation to mountain flying were one of the reasons for the above-mentioned condition that the pilot may only fly into other aerodromes in the company of a flying instructor or a safety pilot.

In the pilot's logbook, only the first training flight in Wangen-Lachen is entered as Alpine introduction. This flight was considered by the flying instructor in question as orientation and was not designated as Alpine introduction in the flying school's documentation. On the other hand, the flying school has noted the flight from Wangen-Lachen to Samedan and back as Alpine introduction in its documents.

1.17.1.4 Flight preparation

According to information from the flying instructors responsible for training the pilot, a fuel calculation was performed for every flight. It was also usual to carry out a mass and centre of gravity calculation with the aid of a worksheet from the flying school.

1.17.2 Motorfluggruppe Zürich

1.17.2.1 General information concerning the flying club and school

Motorfluggruppe Zürich (MFGZ) is one of the oldest and largest flying clubs in Switzerland. It has its own flying school and a maintenance operation. At the time of the accident it had a fleet of 15 aircraft. The Motorfluggruppe Zürich flying school is a founder member of the Swiss PSA. It employed approximately 30 flying instructors, most of whom exercised this function as a secondary job.

1.17.2.2 Training of the pilot

Motorfluggruppe Zürich assigned the pilot a flying instructor who acquainted himself with the pilot's background from the latter's logbook. As a reason for switching flying schools, the pilot said that no flying instructors had been available in Wangen-Lachen.

After the first two training flights, the flying instructor informed the pilot that he was reckoning on a training requirement of 10 to 15 flying hours up to the skill test. Although the pilot had originally hoped to be able to pass this test with only a few flights, he agreed with this.

According to the statements of the flying instructor concerned, he repeated with the pilot the principles of radio navigation and the information in the aeronautical information publication (AIP). Among other things, the principles of flight preparation, flying procedures and working with checklists were also dealt with theoretically. The flying instructor also noted that the pilot could explain correctly flying a return curve or approaching a mountain pass. The practical training took place from Zurich; landing training mostly took place on Birrfeld aerodrome. Within the framework of the training, flights were made to the two aerodromes of Grenchen and Berne.

The training in Zurich extended from the end of June to mid-August 2007. Up to the skill test, a total of 11:39 hours block time of flying training were completed, 10:06 hours of which were after the first two training flights.

Shortly before the skill test, another MFGZ flying instructor made two training flights with the pilot. According to information from the flying instructor mainly entrusted with training the pilot, this constituted a quality assurance measure. Towards the end of the training, both flying instructors were of the view that the pilot demonstrated average performance and would be able to pass the skill test.

When the flying instructor wanted to enrol the pilot for the skill test he also made, among other things, a phone call to the chief flying instructor of the flying school ASFG in Wangen-Lachen, since the latter also was an examiner from the Federal Office of Civil Aviation (FOCA). Within this call the chief flying instructor asked how the pilot has progressed in the meantime regarding flying. The flying instructor of the MFGZ explained that he had noticed a slight increased training effort. No further discussion took place about the pilot. Only after the accident a flying instructor of the AFSG contacted again the flying instructor of the MFGZ and that was the time when the latter heard that the pilot had had some training problems in Wangen-Lachen.

On 13 August 2007, the pilot passed a skill test with an examiner from the Federal Office of Civil Aviation. The examination flight was from Zurich Airport to Birrfeld aerodrome and back again. According to information from the examiner, he was not aware of any anomalies.

1.17.2.3 Alpine introduction

Alpine introduction was deliberately omitted, as from the flying instructor's viewpoint this had already been carried out in Wangen-Lachen and a corresponding entry had been made in the pilot's logbook.

1.17.2.4 Flight preparation

With regard to flight planning, the flying instructor responsible for training the pilot provided the following information (translation from German): "*The principles of the Swiss PSA apply here: in our Swiss PSA navigation flight plan we have the headings "trip", "alternate" and 45 min reserve, which we allow for. Depending on mass and balance we also allow for "additional fuel". Taxi fuel is not taken into account at the PPL level. The standard alternate aerodromes for Zurich are Wangen-Lachen or Birrfeld. For these we enter 30 minutes flying time. We assume the same gasoline consumption for all flight phases. As far as mixture regulation is concerned, we teach "best power", i.e. 50 to 75 °F on the richer side of the peak, generally from the 75 % power setting. For shorter flights, e.g. to Birrfeld, if we were doing "airwork", the mixture regulation would be left on "full rich". The mixture regulation is operated within the framework of the navigation flights (demonstration and independent). For the PA28's airspeed we plan for 120 knots in the navigation flight plan.*

(...)

With reference to the examination flights, the following points were also dealt with: mass and balance and take-off and landing distance calculations...."

The instructor also stated that Motorfluggruppe Zürich uses calibrated dipsticks to determine tank quantity.

1.17.3 Pilot's procedures and principles

1.17.3.1 General

After the accident, the pilot provided the information below concerning the procedures and principles he applied and his previous flying experience.

1.17.3.2 Calculation of fuel required

The pilot split the envisaged route into appropriate sections for navigation. Then, using an aviation chart, he established the length of these sections. From the sum of the individual sections of the route, he determined the flying distance between his departure point and the destination. For the flight from the destination to the alternate aerodrome, he assumed the straight-line distance between these aerodromes. The pilot divided the sum of the flying distance between departure point and destination, plus the straight-line distance between the destination and the alternate aerodrome, by the airspeed, for which he used a value of 120 kt, for the Piper Archer II aircraft type. He then multiplied the resulting flying time by a consumption rate of 10 USG, corresponding to 38 l, per hour. In addition, he included 45 minutes reserve flying time and 10 minutes for take-off and landing, assuming the same fuel consumption.

1.17.3.3 Refuelling and checking of the tank contents

If the fuel calculation produced a value of less than 34 USG, the pilot had both tanks of the PA-28-181 filled up to the filler necks. This meant that there were 34 USG of fuel respectively, corresponding to 128 l, in the aircraft tanks.

If the result of the fuel calculation was more than 34 USG, he had the PA-28-181 fully refuelled.

According to his statements, he checked the tank contents visually and with the aid of the cockpit displays. According to his statements, he had never been taught how to use dipsticks.

After the accident, the pilot stated that as far as he could recall the fuel tanks of the PA-28-181 Archer II contained "200 l minus reserve", i.e. approximately 190 l of usable fuel.

1.17.3.4 Flight preparation and use of meteorological information

For flight preparation, the pilot used a calculation tool he himself had produced, enabling him to calculate performance and clarify mass and centre of gravity.

For clarification of the meteorological conditions, he was accustomed to analysing the METAR and TAF for the departure and destination aerodromes and for appropriate aerodromes along the route. He also knew how to use the GAFOR route forecast. As the pilot stated, the flying instructors who taught him had not required any further knowledge of meteorological information, nor had any specific meteorological conditions such as an "orographic barrier" or a "Föhn" situation been dealt with during his flight training in Switzerland.

1.17.3.5 Experience of flying in demanding weather conditions

As the pilot stated, in his previous mountain flying he had always encountered good or very good meteorological conditions.

In the United States, he had apparently occasionally flown in worse visibility conditions, in heavy precipitation or below extensive cloud. However, these flights never passed through mountain regions. With regard to his flying experience in the United States, the pilot also stated that he had mostly flown there in areas free from substantial rising terrain.

1.17.4 The Swiss PSA association of flying schools

1.17.4.1 General

The Swiss Pilot School Association (Swiss PSA) is a federation of six flying schools and constitutes a flying training organisation (FTO) according to the Joint Aviation Authorities (JAA) regulations. The individual flying schools work independently in financial terms and with different fleets of aircraft. However, by virtue of their membership of the Swiss PSA, all the flying schools have the same training licence, use the same training documentation and follow the same training principles. The training operation is managed by a head of training who, together with the chief flight instructor (CFI) of the FTO, monitors training and issues directives. The individual flying schools have a chief flying instructor, who also performs the functions of a deputy chief flight instructor (DCFI) of the FTO.

1.17.4.2 Exchange of information about pilots' flying background

Within the Swiss PSA there are regulations for qualification of pilots, in particular for those who were undergoing full training to achieve a specific licence. However, up to the time of the accident there were no binding regulations or principles for forwarding information on pilots' training and experience if they changed from one Swiss PSA flying school to another flying school within the same FTO.

In the present case, the pilot changed from the "Ausserschwyzerische Fluggemeinschaft" to the Zurich Motorfluggruppe flying school. When he did so, there was no detailed exchange of information regarding the training elements which had been completed or the training requirement which was outstanding.

1.18 Additional information

None.

1.19 Useful or effective investigation techniques

None.

2 Analysis

2.1 Technical aspects

The fuel quantity indicators were subjected to detailed examination, because a pilot had complained about their functioning a few weeks before the accident. The Motorfluggruppe Zürich (MFGZ) maintenance service had then checked the displays and found them to be in order. All the parts of the system for measuring the fuel quantity which could still be checked after the accident were found to be functioning perfectly. The fuel quantity indicators can be seen in two photographs taken by occupants of the aircraft during the flight. Based on the specific consumption values, the indicated quantities are consistent with the calculated amounts of fuel remaining in the tanks at the time the photographs were taken.

In conclusion, it can therefore be stated that HB-PGC exhibited no defects which might have contributed to the cause of the accident.

2.2 Human and operational aspects

2.2.1 Flight preparation

2.2.1.1 Fuel planning

If a comparison is made of the information from the MFGZ flying instructor and the planning principles outlined by the pilot, it is obvious that they are based on the same principles. In particular, the route, the flight to the alternate aerodrome and a reserve of 45 minutes were incorporated into the fuel calculation.

When one considers the pilot's flights from Zurich to Olbia (I) and back and the accident flight, it is noticeable that the pilot obviously did not follow the principles he had outlined. Concerning the flight involved in the accident, in particular, the following is mentionable: if, on the basis of the meteorological conditions, HB-PGC had been able to continue its flight as planned, over the Gotthard Pass, Lake Zug and the Whiskey approach route to Zurich, it would still have to fly at least 80 NM from Ambri. At least 40 minutes flying time would have been needed for this distance. As the calculation of the actual fuel consumption showed, at 19:01 LT, when it flew over Ambri, HB-PGC had an endurance of 50 minutes at most.

Even under favourable conditions, the aircraft would only have been able to reach its destination with a reserve flying time of 10 minutes maximum. Alternative routes under better meteorological conditions, such as, for example, the route from Ambri over the Lukmanier Pass, the Rhine valley and Lake Walen direction Zurich would not have been possible, given the fuel available, without an intermediate landing and refuelling. It must remain open whether the pilot came under additional pressure during the flight towards the Gotthard Pass as a result of the low fuel remaining, or whether he did not perceive the situation as in any way dangerous.

2.2.1.2 Meteorological information

The general meteorological situation was characterised by a homogeneous but extensive area of high pressure. To the north and south of the Alps, good visual flight conditions generally prevailed. However, the Alpine crossings were in cloud as a result of the weak airflow from the south. Flying over the Alps under these conditions was possible, but challenging. In any event, in such a situation, appropriate meteorological information on the weather conditions on routes featuring Alpine crossings is essential.

For his flight planning, the pilot used only the meteorological aerodrome report (METAR) and terminal aerodrome forecasts (TAF) for aerodromes which were located outside the cloudy area within the Alpine region. The information from these measurement stations therefore did not permit conclusions to be drawn about the weather conditions on the section between Ticino and the northern side of the Alps and did not indicate the features of an orographic barrier on the southern slopes of the Alps. Preparation of a VFR flight using only METAR and TAF, which are actually designed as limit value indications for IFR traffic, is insufficient. In the present case, such flight preparation very probably led to an excessively optimistic expectation by the pilot concerning the meteorological conditions on the route.

2.2.2 The flight

The flight progressed from Florence-Peretola (I) at low altitude over the Po plain and proceeded apparently without problems as far as the Leventina. The altitude recorded by the aircraft's portable GPS device shows that the aircraft was flying at approximately 8200 ft AMSL until it reached the Ambri region. This altitude corresponds to the minimum altitude recommended on the Swiss ICAO aviation chart for the route over the Gotthard Pass. The increasing cloud and the lower cloud strata evidently caused the pilot to contact Zurich Information and request meteorological information. When the aircraft was a few kilometres south-east of Ambri, the pilot received from Zurich Information the report that according to the general aviation forecast (GAFOR) the Gotthard Pass could not be crossed. The pilot reported that he was currently in visual flight conditions and if necessary would divert to Lugano. Zurich Information then mentioned that the route forecast for the flight from Biasca via the Lukmanier Pass to Bad Ragaz was "marginal". Such a forecast implies demanding meteorological conditions which can be handled only by a pilot very well trained in visual navigation and with accurate knowledge of local conditions.

When HB-PGC somewhat later flew over Ambri, it was above a stratum of cloud, since it could be heard from the ground but not seen. In view of the weather situation it can be concluded that there was also cloud above the aircraft and on the slopes of the mountains. In any event, the meteorological conditions induced the pilot to turn back when he was north of Airolo and to descend approximately 1000 ft in a short time. He expressed to Zurich Information his intention to continue his flight path to Lugano.

It is difficult to understand why the pilot did not consistently implement this comprehensible decision. In any event, shortly afterwards he asked Zurich Information whether any other pass was open. It must remain an open question whether he then flew into the valley named Bütal because he recalled the information about the Lukmanier Pass being possibly passable and therefore wanted to make his way to the secluded Lake Ritom area.

It is a fact that the aircraft finally struck the rising terrain. The engine's reduced power at the time of the impact may indicate an attempt to make an emergency landing.

2.2.3 Training of the pilot

When one considers the pilot's flying background, it is evident that he completed a substantial part of his training in the United States. After he had acquired a private pilot's licence in 1996 within one and a half months and completed a further few flights up to 20 November 1996, he interrupted his flying activity for almost nine years. He also reactivated his licence in the summer of 2005 in the United States. As is apparent from the pilot's statements, at that time he generally flew over flat terrain. Even when he occasionally encountered challenging meteorological conditions, this never happened in mountains.

The ASFG instructors who continued the pilot's training in Switzerland also found that he had a considerable requirement for training in navigation and mountain flying. These deficits could not be overcome because the pilot changed his flying activity from Wangen-Lachen to the MFGZ in Zurich.

In the MFGZ flying school, the emphasis was on the flying procedures which are examined in a skill test to acquire a private pilot's licence. No more flights in mountainous regions were made, because the first flight from Wangen-Lachen was designated "Alpine introduction" in the pilot's logbook. The fact that both this flight, which was made to Saanen, and the other mountain flights had indicated a further need for training remained unknown to the MFGZ flying instructors. The two flying schools of the ASFG and the MFGZ are within the same flying training organisation (FTO). Up to the time of the accident, however, no detailed exchange of information took place between the flying schools when a trainee changed training locations within the FTO. This fact contributed to the situation in which the pilot ended up making mountain flights with an inadequate level of training.

The fact that shortly before the accident the pilot passed the skill test to acquire a private pilot's licence without the examination expert noticing any anomalies can be explained as follows: firstly, such a test constitutes a 'snapshot' and secondly the test involved flying from Zurich to Birrfeld and therefore took place in an environment with which the pilot was acquainted.

2.3 Search and rescue

Two occupants of the aircraft were fatally injured when the aircraft impacted. The two other occupants were seriously injured, lightly dressed and were in a wreckage which offered little protection from inclement weather. It is obvious that this situation demanded swift assistance and rescue. In fact, the wreck was not located until 15 hours after the accident. This delay was due to the following reasons:

- A modern type of emergency transmitter (emergency locator beacon aircraft – ELBA) was onboard HB-PGC, but it was not working because its battery no longer had adequate capacity. According to the manufacturer the unit should be checked for operation, but each function test reduces battery life. Sixteen self tests had been carried out since the ELBA had been installed. It is unlikely that this relatively low number of function tests affected the capacity of the battery in the present case. However, it is obvious that the defective output stage of the transmitter, with the resulting increased residual power consumption, led to premature discharging of the battery.
- The poor weather conditions prevented effective search flights.
- The search area could not be adequately delimited for the ground-based search.

It should be noted that the use of the transponder for the secondary radar system enabled the transponder to be located to within the proximity of the site of the accident. A radar trace, which ended a few hundred metres before the location of the accident, was available to the managers of the search and rescue service within only two and a half hours of the accident. However, the reliability of the radar trace could not be assessed at that time. With regard to future accidents, however, more consistent use of such recordings should be made.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The aircraft was licensed for non-commercial use on daytime/night-time VFR traffic and for commercial daytime VFR traffic.
- At the time of take-off from Florence, the mass of the aircraft was above the maximum permissible take-off mass and the centre of gravity was at the rearmost permissible limit.
- At the time of the accident the mass of the aircraft was below the maximum permissible take-off mass and the centre of gravity was at the rearmost permissible limit.
- At the time of the accident the aircraft had a fuel reserve which would have been sufficient for max. 45 minutes flying time.
- The investigation produced no indications of any pre-existing technical defects which might have caused the accident.
- The emergency transmitter (ELBA) on HB-PGC was not operational.
- The last 100-hour check was carried out 07.09.2007.
- The last condition check by the FOCA took place on 15.11.2005.

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 flight involved in the accident.

3.1.3 History of the flight

- Aircraft HB-PGC took off on 16 September 2007 at 17:18 LT from Florence-Peretola (I) on a flight to Zurich.
- At 18:56 LT the pilot made contact with Zurich Information and then enquired about the meteorological conditions to the north of the Gotthard Pass.
- At 18:59:28 LT Zurich Information informed the pilot that according to GAFOR the visual flight route over the Gotthard was closed.
- At 19:02 LT HB-PGC flew over Ambri aerodrome towards Airolo at an altitude of approximately 2500 m AMSL, equal to 8200 ft AMSL. It was above a layer of cloud.
- Shortly after 19:03 LT HB-PGC made an approximate 200° right turn to the north of Airolo.

- At 19:04:19 LT, the pilot informed Zurich Information that he wanted to fly to Lugano because of the prevailing weather conditions.
- At 19:04:35 LT the pilot asked Zurich Information whether another pass was open.
- At 19:05:28 LT HB-PGC collided with the terrain. Two passengers were fatally injured at the accident location. The pilot and one passenger suffered serious injuries.
- When the aircraft was more than 30 minutes overdue, the "incertitude phase" (INCERFA) was declared.
- At 21:30 LT, the rescue coordination centre became aware that HB-PGC had disappeared from the radar screen at approximately 19:04 LT north of Ambri at an altitude of approximately 7000 ft AMSL.
- At 21:32 LT the distress phase (DETRESFA) was declared.
- In view of the poor weather conditions, only a ground-based search for the crashed aircraft was possible overnight.
- On 17 September 2007 shortly after 10:00 LT the crew of a FOCA helicopter spotted the wreckage of HB-PGC and the rescue was initiated.

3.1.4 General conditions

- The meteorological conditions did not permit a flight over the Gotthard Pass as planned.
- The meteorological information used by the pilot contained no information on meteorological conditions in the Alpine area.
- The pilot had completed his basic training abroad, where he had mainly flown over flat terrain.
- According to his statements, the pilot had very little experience of mountain flying under difficult meteorological conditions.
- The flying school at which the pilot began further training for conversion of his foreign licence in Switzerland found that the pilot was insufficiently trained in navigation and mountain flying.
- The flying school in Switzerland at which the pilot completed the conversion of his foreign licence was not informed about the pilot's training deficits.

3.2 Causes

The accident is attributable to the fact that the aircraft collided with the terrain because the flight was continued even though adequate visual references were no longer available.

The following factors contributed to the origin of the accident:

- the pilot's limited experience of mountain flying under demanding weather conditions.
- incomplete flight preparation.
- insufficient exchange of information within a flying training organisation.

4 Safety recommendations and measures taken since the accident

4.1 Measures taken since the accident

In a letter dated 26 May 2008, the Swiss Pilots School Association stated that it has taken the following measures after the accident:

„Als Reaktion auf den Unfall hat die Swiss PSA intern die Vorgaben bei einem Schulwechsel geändert. Einerseits werden „Problemfälle“ nach wie vor den Schulleitungen zur Kenntnis gebracht. Zusätzlich muss jeder Fluglehrer der Swiss PSA bei der Übernahme eines Flugschülers aus einer anderen Flugschule (egal woher), zwingend mit dem letzten Fluglehrer Kontakt aufnehmen und sich über die Leistungen und die Gründe für den Flugschulwechsel ins Bild setzen.“

Translation: "As a reaction to the accident the Swiss PSA has internally amended the guidelines in the event of a change of school. On the one hand, "problem cases" will continue to be brought to the attention of the school management. In addition, on taking over a trainee pilot from a different flying school (regardless from where) every Swiss PSA flying instructor must make contact with the last flying instructor and get an overview of performance and of the reasons for the change of school."

Payerne, 13 January 2009

Aircraft Accident Investigation Bureau

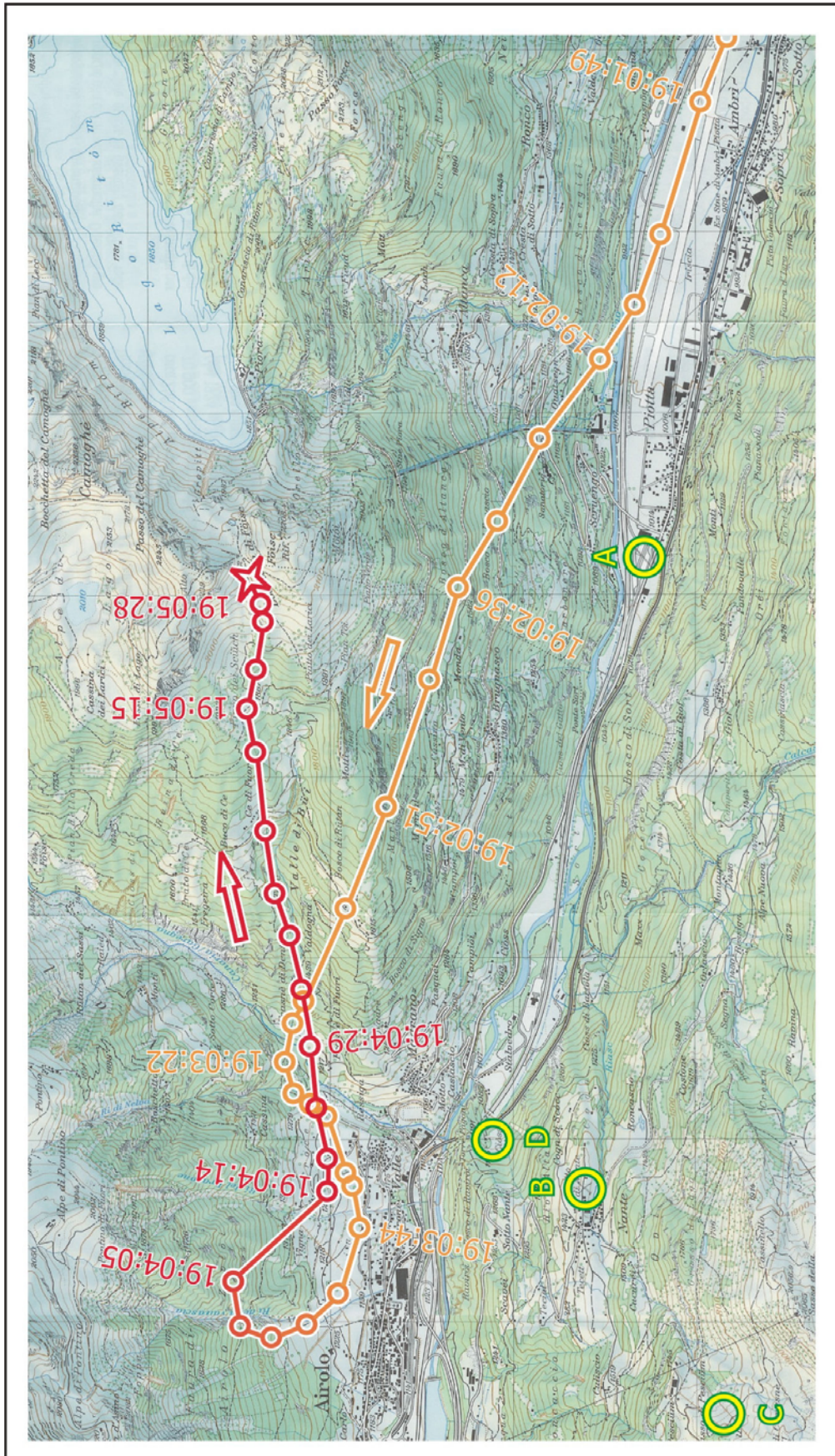
This report contains the AAIB's conclusions on the circumstances and causes of the accident which is the subject of the investigation.

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 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.

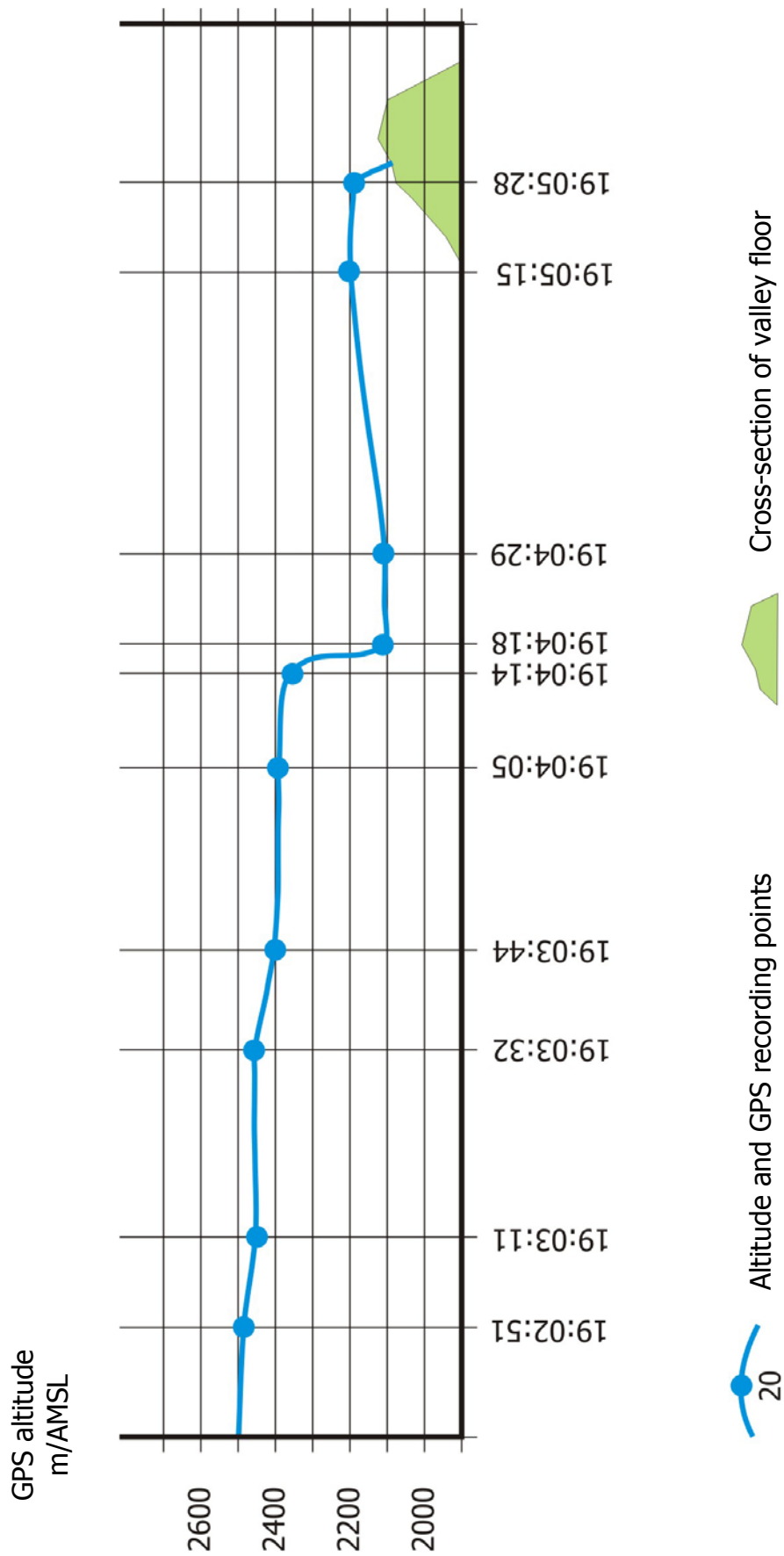
If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

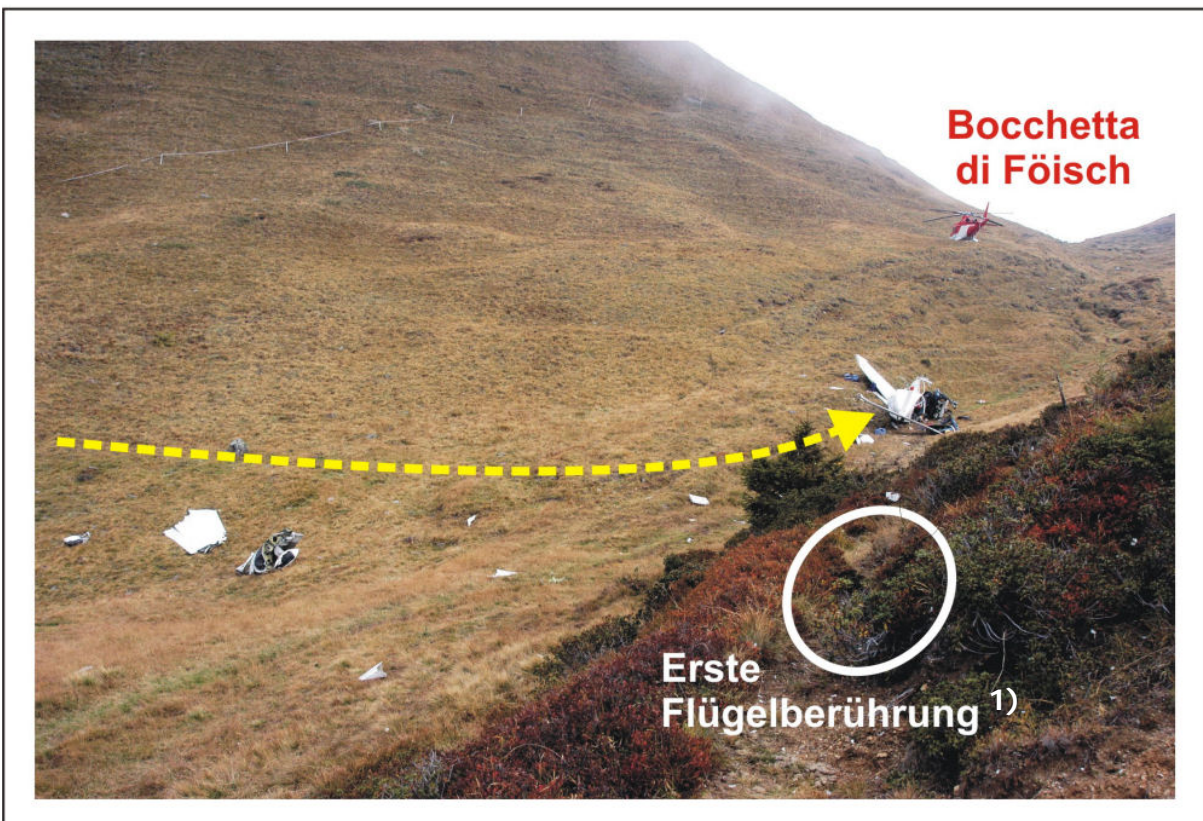
Annexes

Annex 1



Annex 2





Presumed direction of approach and final position of the wreckage

1) Initial wing contact