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Swiss Transportation Safety Investigation Board STSB

Aviation Division

Final Report No. 2258 by the Swiss Transportation Safety Investigation Board STSB

concerning the accident
involving the AS350 B2 helicopter,
registration HB-XSO,

on 29 June 2013

approximately 900 m south of Iragna,
municipality of Lodrino/TI

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General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the accident which is the subject of the investigation.

In accordance with Art 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, 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 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/incident prevention, due consideration shall be given to this circumstance.

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

All information, unless otherwise indicated, relates to the time of the accident.

All times in this report, unless otherwise indicated, are stated in local time (LT). At the time of the accident, Central European Summer Time (CEST) applied as local time in Switzerland. The relation between LT, CEST and coordinated universal time (UTC) is:

LT = CEST = UTC + 2 hours.

Final report

Aircraft type	Eurocopter AS350 B2	HB-XSO
Operator	Heli-TV SA, Aeroporto, 6527 Lodrino, Switzerland	
Owner	Heli-TV SA, Aeroporto, 6527 Lodrino, Switzerland	

Pilot	Swiss citizen, born 1951
Licence	Commercial pilot licence helicopter (CPL (H)) according to the European Aviation Safety Agency (EASA), issued by the Federal Office of Civil Aviation (FOCA)
Essential ratings	AS350, valid till 28 February 2014 Mountain landings (mountain - MOU (H))
Medical fitness certificate	Class 1, shall wear corrective lenses and carry a spare set of spectacles (VDL), issued on 21 February 2013, valid till 21 August 2013[1]

Flying hours	**Total**	901 hours	**During the last 90 days**	3:05 hours
	On the type involved in the accident	418 hours	**During the last 90 days**	1:44 hours

Location of collision with rock	Alp Traps
Coordinates	712 431 / 134 457 **Elevation** approx. 1700 m AMSL
Location of the wreckage	Approx. 900 m south of Iragna, Lodrino municipality/TI
Coordinates	718 003 / 131 113 **Elevation** approx. 1700 m AMSL
Date and time	29 June 2013, approx. 08:00

Type of operation	VFR, commercial
Flight phase	Descent
Type of accident	Loss of control

Injuries to persons

Injuries	Crew members	Passengers	Total number of occupants	Other
Fatal	1	3	4	0
Serious	0	0	0	0
Minor	0	0	0	0
None	1	1	2	Not Applicable
Total	2	4	6	0

Damage to aircraft	Destroyed
Other damage	Minor damage to a storage shed and building materials, and slight soil contamination due to kerosene

[1] The field for commercial flights with passengers as single pilot contains four dashes (see section 1.8.2.3).

1 Factual information

1.1 Pre-flight history and history of the flight

1.1.1 General

The statements of the flight assistant, the passenger, eye-witnesses and managers of the air transport operator were used for the following description of the flight preparations and history of the flight.

No flight path recordings are available.

1.1.2 Flight preparations

The "*Patriziato di Personico"*, hereinafter designated the Personico civil community, had in 2010 and 2011 renovated the huts on Alp Trüsp, which is located approximately two and a half kilometres south-west of Personico. Because of the weather, the planned inauguration ceremony could not be held in either 2011 or 2012.

The inauguration ceremony with the population of the municipality was then planned for 29 June 2013. Since this Alp is difficult to access, guests were offered a helicopter flight to the site of the inauguration ceremony.

Due to the restricted landing options directly in front of the Alp Trüsp huts, a site in the vicinity was prepared to disembark passengers. This landing site, named "Er dal Zelar", had already been evaluated in the year 2011 by another pilot from the same air transport operator and had been deemed suitable after some improvements (cf. section 1.5.2). Landing at Alp Trüsp was approved by the Federal Office of Civil Aviation (FOCA) (cf. section 1.8.2.1).

On 28 June 2013, the day before the inauguration ceremony, two other pilots flew materials and persons to Alp Trüsp in preparation of the inauguration ceremony. In the case of these flights the persons were set down in front of the huts in hovering flight, i.e. by partially resting one or both skids on the grass to the left of the huts or on a boulder to the right. The flight assistant involved in the accident was present during the last mission.

At 07:50 on 29 June 2013, according to the air transport operator's schedule, three flights were planned to fly the organisers and foodstuffs from the embarkation point on the Diga di Personico[2] parking area to the Alp. The flights with the guests were planned from the same embarkation point from 09:00 onwards. At this location, the air transport operator's personnel were responsible for organisation and safety from 08:30 onwards. According to the operator, for all the flights on this day, landing was planned on the specially prepared "Er dal Zelar" landing site.

1.1.3 Flight preparations

According to the available statements of the air transport operator's personnel, the pilot was not familiar with the conditions on Alp Trüsp and the prepared "Er dal Zelar" landing site.

For the day of the inauguration ceremony he was tasked by the operations manager with the passenger flights to Alp Trüsp; according to the operations manager he received appropriate documentation for this assignment. This included information that a prepared landing site was available (cf. section 1.5.2). According to the chief pilot's statement, during a conversation he informed the pilot about the cables in the vicinity and about local wind conditions.

[2] The location is on the edge of the Lago di Rierna, south of Personico.

The operation schedule for helicopter HB-XSO for 29 June 2013 was found in the wreckage. Neither an aeronautical chart nor more detailed information on the various landing sites were found.

1.1.4 History of the flight

At 07:42 on 29 June 2013, the pilot, accompanied by the flight assistant, took off in an AS350 B2 helicopter, registration HB-XSO, from Lodrino aerodrome (LSML) and flew in the direction of Diga di Personico, to the meeting place with the organisers and the invited guests.

The pilot landed on the parking area near the Diga di Personico. Four of the organisers boarded the helicopter with the rotor turning, one in front on the left and three at the rear on the right. Light luggage was stowed away on board. The flight assistant then took the left rear seat after having checked that the passenger sitting in front had put on his seat belt. Likewise he instructed the three rear passengers belt up and showed them how to release the seat belt. One of the passengers stated later on that no briefing had been given before the flight concerning the use of the seat belts and that the passengers were not belted up.

At 07:47 the pilot took off on the first flight in the direction of Alp Trüsp.

Initially during the climb, the pilot flew the helicopter towards some huts, which were approximately 200 metres to the right and below Alp Trüsp. In doing so, it was observed that the pilot had twice turned to the flight assistant during the climb in order for the flight assistant to point out the Alp Trüsp huts to him. The pilot asked the flight assistant where the second landing site on Alp Trüsp was. He then continued to climb and flew directly to the Alp Trüsp huts. When the helicopter was approximately 50 metres from the landing site, the flight assistant explained to the pilot on the radio where he should land (set-down). He also asked the passengers to unfasten the seat belts and to close them again to keep them from flapping about when the door was open. Shortly thereafter, the pilot of the HB-XSO hovered to touch down at 07:53, by partially setting the left skid down on a boulder (cf. Figure 3).

At that time, several persons were busy with the preparations for the inauguration ceremony. They ran in order to hold on to the tables and benches in close proximity to the boulder onto which the helicopter hovered to touch down. At close range it was observed that the two doors on the left side were open and the flight assistant disembarked from the helicopter. The helicopter had moved to the front and to the right and the rotor blades were getting close to the rock. One of the eye-witness being in close range and opposite to the helicopter cried out and indicated to the pilot that he should move backwards. However, he did not have eye contact with the pilot. Another eye-witness observed the event from a distance of about 25 metres and was of the opinion that the helicopter never rested its skid on the boulder, but remained in hovering flight at a low height.

As the flight assistant assisted the passenger sitting on his right to get out, he perceived an impact and concluded that the helicopter's main rotor had collided with something. The main rotor blades hit a rock during the set-down in hovering flight. The flight assistant then saw the helicopter lifting off in an abrupt upward movement. He immediately pulled the passenger out of the cabin and they both took cover next to the boulder.

After the contact of the main rotor blades with the rock, the pilot managed to hold the helicopter in stable hovering flight. According to eye-witnesses the rotor blades were making a loud noise. The sound of the engine seemed unchanged. The left sliding door was open.

The pilot then initiated a left turn and flew down towards the valley. When the flight assistant advised flying back to Lodrino for an emergency landing, the pilot confirmed over the radio: *"verso Lodrino"* [to Lodrino].

Eye-witnesses in the valley observed the helicopter in stable descending flight and were under the impression that the pilot wanted to land on a field. At a height of approximately 150 m above ground the helicopter was no longer descending and was in level flight towards the south. The eye-witnesses heard a bang and saw the helicopter rapidly lose height in an uncontrolled state. Shortly afterwards the helicopter crashed in a quarry south of the village of Iragna.

The helicopter was destroyed. Fire did not break out. All occupants were fatally injured.

1.2 Personnel information

1.2.1 Pilot

1.2.1.1 General

The pilot began his flying activity on helicopters in 1989. In 2005 he was hired as a part-time pilot and performed the function of accountable manager for the air transport operator involved. The pilot was employed exclusively for passenger flights.

He was not wearing a helmet on the accident flight. He was equipped with a headset and was in radio contact with the flight assistant.

1.2.1.2 Experience and training status

On 25 February 2013 the pilot passed the proficiency check for the renewal of the AS350 type rating. On 31 May 2013 he passed the proficiency check for the renewal of the SA315B type rating. These check flights were conducted by the same FOCA examiner. On both helicopter types, hovering flight with one skid set-down was assessed as acceptable.

From early January 2013 up to the day of the accident, the pilot flew a total of 6 hours and 22 minutes. His experience in mountain flying was not recorded. The last flight before the day of the accident was made on 12 June 2013.

In the twelve months preceding the accident the pilot made few flights on which passengers embarked or disembarked in hovering flight with partial set-down.

1.2.1.3 Medical findings

The autopsy indicated that the death of the pilot occurred immediately as a result of the injuries sustained. From a forensic-toxicological viewpoint, at the time of death there were no indications of consumption of alcohol or narcotics.

The known findings from the independent aeronautical medical examiner's patient history, together with the forensic medical report, gave no indication of any pre-existing health problems which might have contributed to the accident.

1.2.2 Flight assistant

The flight assistant had been employed by the air transport operator since 2009. He was trained according to the flight assistant syllabus and his deployments were recorded in the training records.

According to his own statements, he knew the pilot fairly well and had flown with him a couple of dozen times in the two and a half years before the accident.

The flight assistant was wearing a helmet which was equipped with a radio headset. He was in radio contact with the pilot.

1.3 Aircraft information

1.3.1 General

Registration	HB-XSO
Aircraft type	Eurocopter AS350 B2 “Ecureuil”
Characteristics	Single-engine multi-purpose helicopter with high skid landing gear and six seats. Main rotor with three blades, tail rotor with two blades.
Manufacturer	Eurocopter
Year of manufacture	1986
Owner	Heli-TV SA, Aeroporto, 6527 Lodrino, Switzerland
Operator	Heli-TV SA, Aeroporto, 6527 Lodrino, Switzerland
Engine	Turbomeca Arriel 1D1, twin-shaft turbine
Maximum permissible mass	2250 kg
Mass and centre of gravity	Mass and centre of gravity were within the limits specified by the manufacturer throughout the flight. The total mass of the helicopter when it landed on Alp Trüsp was approximately 2010 kg. The mass at the time of the accident was approximately 1800 kg.
Hours of operation	Approximately 14 108 hours TSN[3]
Maintenance	The last scheduled maintenance work was released on 28 June 2013 at 14 105:23 hours TSN.
Technical limitations	None
Fuel on board	Fuel on board on take-off from Lodrino: 215 l
Types of operation	In commercial use: VFR by day

[3] TSN: time since new

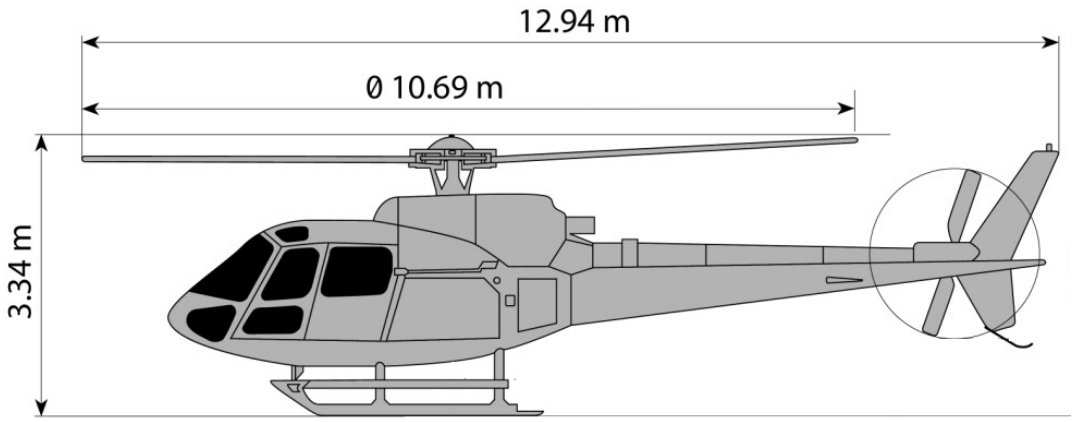

Figure 1: Dimensions of the HB-XSO helicopter

1.3.2 Information on the hydraulic system

Because of the considerable control forces, the AS350 B2 uses hydraulic assistance for the flight controls. The system operates with a constant pressure, which is supplied by a hydraulic pump, which is mounted on the input casing of the main gear box and is driven by a belt.

Sudden pressure loss in the hydraulic system may lead to loss of control at high speeds. For this reason the system is equipped with a warning device and with pressure accumulators. If the pressure drops below 30 bar, the HYD warning light is illuminated on the warning light panel (cf. Figure 2) and an aural alert is triggered. The remaining pressure in the accumulators is sufficient to allow speed to be reduced to 40 to 60 knots. A landing can then be made without hydraulic assistance.

Figure 2: HB-XSO warning light panel.

Among other things, the hydraulic system is controlled via a guarded cut-off switch for rapid deactivation of the hydraulic system. In the OFF position this rocker switch on the collective immediately and simultaneously switches off and dumps all three main rotor control hydraulic cylinders, including the accumulators.

1.4 Meteorological information

1.4.1 General weather situation

A trough extended from southern Norway to the Adriatic. On its western flank a warm front reached the Alps on Saturday morning and caused extensive cloud layers.

1.4.2 Weather at the time and location of the accident

On the Alpine ridge and in the central Ticino Alps the wind was blowing from the north-west to north and was the cause of a northerly Föhn wind at the ridges. In the valley floor of the Leventina and the Riviera winds remained light. Fairly compact altostratus with isolated virga extended over the Alps towards the south. The weather was dry.

Weather/cloud	Thick cloud, 8/8 altostratus at approximately 9600 ft above mean sea level (AMSL)
Visibility	30 km
Wind at 2171 m AMSL	350 degrees, 7 kt
Wind at 255 m AMSL	Variable, 1 kt
Temperature/dew point at 2171 m AMSL	9 °C / 3 °C
Temperature/dew point at 255 m AMSL	13 °C / 9 °C
Atmospheric pressure QNH	1020 hPa
Hazards	None

1.4.3 Astronomical information

Position of the sun	Azimuth: 80°	Elevation 23°
Lighting conditions	Daylight	

1.4.4 Weather according to eye-witness reports

According to the flight assistant, it was not windy nor were there any particular weather conditions.

1.5 Information on Alp Trüsp

1.5.1 Landing site in front of the Alpine huts

The landing site used by HB-XSO in front of the renovated Alp Trüsp huts is located on sloping terrain which is interspersed with various pieces of rock and does not allow the helicopter to set down completely. Hovering is possible, with one skid set-down on a flat, slightly inclined stone surface (S) (cf. Figure 3).

After the left skid touched down, the tips of the main rotor blades of HB-XSO were rotating in close proximity to the rock (F), which was in front of the helicopter.

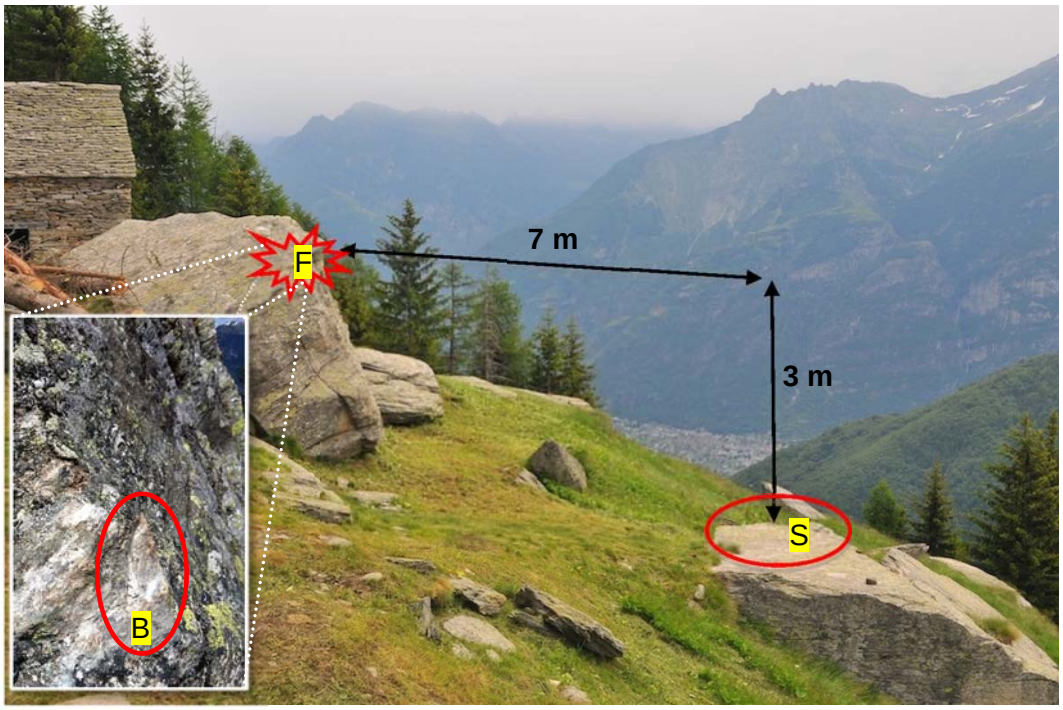

Figure 3: Landing site, with horizontal and vertical distances between the stone surface (S) and the rock (F) with traces of contact (B) shown enlarged in the box.

While the skid was supported in hovering flight, the tips of the main rotor blades came into contact with the rock (F). At a height of approximately 3 metres above the stone surface (S), traces of contact were found on this rock. Rub marks were found on the stone surface (S).

1.5.2 Landing site “Er dal Zelar”

In 2011 a new landing site, designated “Er dal Zelar” was completed, some 300 metres from Alp Trüsp and free from obstacles. On the valley side, some trees were shortened, in order to ensure an approach which was as free from obstacles as possible. This landing site was evaluated by one of the operator's pilots and assessed as suitable. This is the only place in the immediate vicinity of Alp Trüsp where landing a type AS350 helicopter is possible and where the engine can be shut down.

On the FOCA approved application form for the passenger flights to be made on the occasion of the inauguration ceremony, the coordinates of Alp Trüsp were specified, not those of the “Er dal Zelar” landing site. The “Er dal Zelar” landing site was not known to the FOCA (cf. section 1.8.2.1).

Both the Personico civil community and the air transport operator intended to make all flights for the inauguration ceremony on Alp Trüsp to the "Er dal Zelar" landing site.

Figure 4: Landing site “Er dal Zelar”; the helicopter shown in the picture is not HB-XSO which was involved in the accident.

1.6 Wreckage and impact information

1.6.1 Site of the accident

The site of the accident was in a quarry in the Blono hamlet, which is located on the valley floor between the villages of Iragna and Lodrino. There was minor damage to a storage hut and building materials. The kerosene which leaked out caused minor soil contamination.

An open empty backpack was found in a field approximately 500 metres away from the site of the accident. On the site of the accident no spectacles of the pilot were found.

1.6.2 Impact

The findings at the site of the accident allow the conclusion that the helicopter impacted the ground at a low rate of descent, with a forward direction of motion.

1.6.3 Wreckage

The helicopter was destroyed on impact with the ground. Fire did not break out. The Kannad 406 AF-H automatic emergency locator transmitter (ELT) was triggered.

A section of the front left skid was found approximately 100 metres away from the wreckage.

The seat belts on the rear row of seats were all found to be closed and tightened. The lap and shoulder belts on the two front seats were open.

The guarded hydraulic cut-off switch was in the ON position. The drive belt for the hydraulic pump was not found.

The input casing of the main gear box exhibited fractures.

Figure 5: Wreckage of the HB-XSO at the site of the accident.

1.7 Technical investigations

A detailed examination of the wreckage revealed no indications of a pre-existing defect. The damage found was assessed as consistent with an impact on an uneven surface by the helicopter in forward flight and at a low rate of descent.

The tips of the main rotor blades exhibited damage which was consistent with contact with a foreign object.

Metallurgical investigations, in particular of the skid-type landing gear, provided no evidence of pre-existing fatigue fractures. The fractures at the input casing of the main gear box were ductile static failures under shearing load. Some blades of the flex couplings between the two sections of the tail rotor drive shaft exhibited fractures with indications of high speed fatigue.

The tail rotor blades exhibited traces which indicate a low speed of rotation, with power not being delivered, at the time of impact.

Investigation results indicated that the engine was fully operational at the time of the accident.

From detailed investigations it was concluded that the filament bulbs of the HYD and GEN warning lights on the warning light panel were activated at the time of the impact (cf. Figure 2).

1.8 Organisational and management information

1.8.1 Air transport operator

1.8.1.1 General information

The air transport operator was founded by the current owner on 4 July 1995. At the time of the accident it employed approximately twenty people, of whom five were full-time pilots and, depending on the season, two to three part-time pilots. The operator was based at Lodrino aerodrome and had four other helicopters in addition to HB-XSO.

On 18 September 2012 an accident involving helicopter HB-ZJO, operated by the same air transport operator, occurred (cf. STSB final report No. 2207). The pilot who was fatally injured in that accident held the position of deputy chief pilot at that time.

1.8.1.2 Information on the flight operation manual

The responsibilities and duties of the operations manager are described in the flight operation manual (FOM) revision 8 effective 15 March 2013, on pages 8 ff. in section 1.7.3, including, among other things, the following points:

- *"Procurare le documentazioni necessarie per la programmazione e l'esecuzione dei voli, ad esempio cartine, documenti per la navigazione aerea, permessi d'atterraggio, NOTAM[4], AIP[5], ecc."*
  [Procurement of the necessary documents for planning and execution of flights, for example charts, flight route documents, landing permissions, NOTAM, AIP, etc.]
- *"Definire la formazione dell'equipaggio per ogni volo, rispettivamente designare un comandante."*
  [Define the composition of the crew for each flight, and designation of the commander]
- *"Distribuire le missioni di volo, facendo particolare attenzione a: conoscenze e capacità del comandante* […]*"*
  [Assignment of flight missions with special attention to: knowledge and capabilities of the commander (…).]
- *"Organizzazione e controllo del grado d'allenamento nonchè di istruzione di ogni membro d'equipaggio."*
  [Management and monitoring of the training status and training of each crew member.]
- *"Esecuzione del controllo annuale sul grado d'istruzione sia teorica sia pratica di ogni pilota."*
  [Performance of the annual check of the theoretical and practical training status of each pilot.]

The duties of the chief pilot specified in section 1.8 of the FOM are included in the preceding point.

In addition, among other things the following is described on page 10 in section 2.3 "*Composizione dell' equipaggio"* [composition of the crew]:

"*Il responsabile delle operazioni di volo decide sulla composizione dell'equipaggio. Questa decisione si deve basare sull'esperienza, la qualifica* […] *dei piloti."* [The operations manager determines the composition of the crew. This decision must be based on the experience and qualifications (…) of the pilots.]

Among other things, on page 26 in section 9.3 the following points are made regarding off-field landings:

"Il ROV [responsabile operazioni volo] *dell'impresa è responsabile della scelta dei luoghi d'atterraggio. Eglì sceglierà il posto tenendo presente le capacità del pilota,* […]". [The operator's operations manager is responsible for the selection of landing sites. He selects the site in consideration of the pilot's capabilities, (…).]

In the revision of the FOM which was valid at the time of the accident, nothing particular is specified concerning briefing and instruction in types of operation.

[4] NOTAM: notice to airmen

[5] AIP: aeronautical information publication

1.8.1.3 Authorization list for types of operation

An authorization list for types of operation, undated and unsigned, contains for each pilot the operator's requirements for each type of operation.

In terms of the types of operation relevant to the present case, i.e. off-field landings and mountain landings, the pilot involved in the accident was classified in category 2. This is defined as follows:

"Operazione consentita, un eventuale briefing e pianificazione sono necessari in accordo con IL capo piloti Vista la bassa esperienza into questo tipo operazioni" [Operation permitted, possibly a briefing and planning are necessary by agreement with the chief pilot in view of the limited experience of this type of operation.]

According to statements from the director of the air transport operator, there were no rules according to which the assignment of missions had to be undertaken.

1.8.1.4 Information on the chief pilot

After his recruitment by the air transport operator in February 2012, he was appointed chief pilot in January 2013 on the basis that he had the most experience. He knew the pilot involved in the accident, but did not know when the latter was recruited and what his duties were. He had never flown with him and did not know his level of training.

The chief pilot stated that no check flights are conducted within the company. He would not be informed about detailed results of the proficiency checks carried out annually by FOCA examiners for renewal of the type rating; he would only know whether a proficiency check had been passed or not. He was aware of the limited flying experience of the pilot involved in the accident, without knowing the reasons for this.

The chief pilot knew roughly where Alp Trüsp was located, but had never made any flights there. He had knowledge of the landing conditions there from descriptions by the operator's pilots who had already made several landings at Alp Trüsp. According to his own statements, it was not his decision to assign this mission to the pilot involved in the accident, and he did not know when the latter had been advised of the mission.

1.8.1.5 Information on the operations manager

The person employed by the air transport operator since September 1998 and appointed two years later as operations manager had no flying experience. The operations manager stated that the tasks assigned to him in the FOM were not clearly described but included the following areas, among other things: customer relations, operational planning, crew selection on the basis of the type of mission; in cases of doubt or in the event of difficulties in making decisions, he could turn to the chief pilot or his deputy.

The operations manager was acquainted with the Alp Trüsp landing sites only on the map and had never been there himself. He was aware that the pilot had made only a few flights during the first months of 2013. He also stated that the pilot had never made flights to Alp Trüsp before. For the day of the inauguration ceremonies, the operations manager tasked the pilot with the passenger flights to Alp Trüsp.

1.8.2 Federal Office of Civil Aviation

1.8.2.1 Approval of passenger flights to Alp Trüsp

In accordance with the Ordinance on Take-Offs and Landings by Aircraft Outside Aerodromes which was in force at the time of the accident (Off-Field Landing

Ordinance), the FOCA can approve off-field landings above 1100 m AMSL if the occasion for these is a significant anniversary in mountain flying. For transportation of passengers for tourist or sporting purposes this is done in agreement with the competent cantonal and local municipality authorities. In this case, the FOCA does not have to verify whether the locations envisaged for off-field landings are suitable; accordingly the approvals include neither exact coordinates nor precise elevation data. The responsibility for the selection of the landing site lies with the pilot or the operations manager respectively.

1.8.2.2 Training and coaching of the air transport operator's personnel

After the fatal accident in 2012 involving a helicopter from the same air transport operator (cf. 1.8.1.1), the FOCA in its supervisory role examined various aspects of the company. There were numerous findings, which were acknowledged as problem areas by mutual agreement and which were also intended to be resolved jointly. Clear goals for training and coaching were set for both the full-time and part-time pilots.

On 7 January 2013, a FOCA circular *"Training and coaching of flight operations personnel - responsibilities and documentation"* was sent to all commercial helicopter operators. It contained references to the applicable legal basis and instructions for amending the FOM in relation to the following four topics:

1. Organisation and responsibilities
2. Training programme, monitoring and checking of training status
3. Table with operational limitations and authorization lists
4. Keeping and archiving of records concerning training and checks

Helicopter operators were given until 30 April 2013 to submit the FOM revision. A first revision was submitted by the operator on 29 April 2013. This was returned to the operator by the FOCA on 28 May 2013 with various findings. Issues 9 and 10 of the revised FOM were approved by the FOCA on 8 August 2013.

1.8.2.3 Restrictions on commercial transport of goods and persons and special permissions

The pilot's medical certificate was issued by the FOCA medical examiner on 21 February 2013 in accordance with the applicable EASA regulations of the commission regulation (1178/2011; FCL[6].065). Appropriately for his age, the pilot was re-certificated for unrestricted flying activity for a period of six months, subject to the condition *'shall wear corrective lenses and carry a spare set of spectacles'* (VDL). Since the EASA regulations do not provide for single-pilot operation carrying passengers for pilots older than 60, no date was entered in the corresponding field, but instead it contained four dashes.[7]

In March 2012, all persons holding a pilot's licence received a letter headed "*General information concerning the introduction of the new European rules for flight crew licensing"*. In this letter, it was announced that the FOCA would provisionally begin the implementation of the European rules for flight crew licensing from 1 June 2012 onwards. Furthermore, on the occasion of a meeting with the Swiss Helicopter Association (SHA) on 22 June 2012 in the run-up to the

[6] FCL: flight crew licensing

[7] This field is required since the validity period of the medical certificate for pilots aged between 40 and 60 is different for "class 1" and "class 1 - single-pilot operation carrying passengers".

EASA introduction, this age-related restriction on single-pilot operation was addressed (article FCL.065).

Shortly after the accident under investigation, on 4 July 2013, all helicopter companies were informed of the restrictions on commercial transport of persons and goods applicable to pilots aged over 60. In case the operators identified any safety risks, they could apply with the FOCA for a maximum two-year exemption to continue such flying operations within Switzerland by providing a justification as well as applicable mitigations. Additional medical exams were also a component of this exemption. Such an exemption was in any case granted subject to a dissenting opinion by the EASA or the EU Commission and in such a case would have had to be revoked.

At the time of the accident there were not yet any exemptions granted.

2 Analysis

2.1 Technical aspects

There are no indications of any pre-existing technical defects which might have caused or influenced the contact of the main rotor with the rock on Alp Trüsp.

2.2 Human and operational aspects

2.2.1 History of the flight

At Diga di Personico, four of the organisers with light hand luggage boarded the helicopter with its rotor turning, without any other personnel from the air transport operator being present except for the flight assistant.

There are contradictory statements concerning buckling of the seat belts before take-off and their early opening during the final approach. In view of the fact that the seat belts on the rear bench were all found to be closed and tightened, it must be concluded that the passengers at the rear had not been belted up throughout the flight.

The subsequent flight to Alp Trüsp was uneventful. The fact that during the climb the pilot initially directed the helicopter towards some huts which were approximately 200 metres to the right and below Alp Trüsp indicates that he did not have any clear idea of where Alp Trüsp was located. He was guided by the flight assistant, who was familiar with the locality. Both the Personico civil community and the operator intended to make all flights for the inauguration ceremony on Alp Trüsp to the “Er dal Zelar” landing site. The exact reasons why the Alpine huts were approached directly for the landing instead of the landing site approximately 300 metres from Alp Trüsp could not be determined.

In view of the ongoing preparations for the inauguration ceremony, in particular in view of the tables and benches already set up, the decision to allow the passengers to disembark in front of the huts on Alp Trüsp in hovering flight was subject to risk.

The approach and the initial hovering flight, with the left skid resting on the stone surface, took place without any particular incidents. This was thanks to the quick reaction of the eye-witnesses at the location, who held on to the tables and benches. When the flight assistant disembarked the helicopter and prepared to help the passenger next to him to disembark, the helicopter slowly began to move forward on the flat rock surface, which resulted in contact of the main rotor blades with the rock (cf. Figure 3). One obvious explanation could be that the pilot, after the flight assistant had disembarked, did not consider the shift in the centre of gravity and the reduction in total mass and did not quickly enough compensate for the lower contact pressure of the metal skid with the stone surface. This could explain the statement of one of the eye-witnesses, according to which the helicopter never rested on the rock, but remained in hovering flight at a low height. According to the statement of the eye-witness in close range and opposite to the helicopter, the pilot's view was not directed forwards before the contact with the rock. It appears that while hovering the pilot paid insufficient attention to the obstacle in front of him and did not notice the forward motion of the helicopter. The abrupt pulling-up of the helicopter observed after the contact with the rock can be interpreted as a reflex action.

The subsequent flight towards the valley, with the aim of returning to the base in Lodrino, indicates that the “Er dal Zelar” landing site was still unknown to the pilot at this time. It must remain open whether a landing on the prepared “Er dal Zelar” landing site would have been possible under these circumstances.

It appears that the pilot underestimated the time-critical effects of damaged main rotor blades after contact with the rock. In flight, damaged main rotor blades have very rapidly a destructive effect on the helicopter due to imbalance and along going vibrations. It is impossible to assess conclusively how much the decision of the pilot was affected by the flight assistant's advice to fly back to Lodrino for an emergency landing.

The statements of all the eye-witnesses who were in the immediate vicinity of the impact site are in agreement that the helicopter descended towards the valley making an unusual, deafening noise, but with a controlled flight attitude. It is impossible to determine with certainty whether this noise originated from the damaged main rotor blades or from damage to other components.

After the pilot had transitioned from a descent to level flight at a height of approximately 150 metres above ground, eye-witnesses heard an explosion-like bang and saw the helicopter perform uncoordinated flight movements and finally crash. Forensic investigations concluded that the filament bulbs of the HYD and GEN warning lights on the warning light panel were activated at the time of the impact (cf. Figure 2). Metallurgical investigations of the input casing of the main gear box, on which the hydraulic pump is mounted, indicated ductile static failures under shearing load. Everything indicates that from this point in time hydraulic assistance was lost. It is therefore to be assumed that after briefly transitioning to level flight, certain structures no longer withstood the stresses caused by the vibration as a result of the damage.

The tail rotor blades exhibited traces which indicated a low speed of rotation, not delivering power, at the time of impact. This means that the tail rotor drive shaft before the impact with the ground was no longer positively connected.

A simultaneous failure of the tail rotor drive and the hydraulic assistance system makes this helicopter type uncontrollable.

The impact with the ground occurred with no chance of survival.

2.2.2 Air transport operator

The duties described in the operator's flight operation manual (FOM) document include, among other things, assignment of flying missions in accordance with the respective capabilities of pilots and their general training status (cf. section 1.8.1.2). An authorization list for types of operation accordingly contains the respective operational conditions for each pilot for each type of operation. According to this list the pilot involved in the accident was classified as category 2, i.e. the planned passenger transport to Alp Trüsp was in principle permitted; possibly a briefing and planning in discussion with the chief pilot would have been necessary in view of the pilot’s relative lack of experience of this type of mission (cf. section 1.8.1.3).

The chief pilot stated that he knew the pilot involved in the accident but had no knowledge of his level of training or flying capabilities; he had never flown with him. He also stated that no check flights are conducted within the air transport operator. He would not be informed about detailed results of the proficiency checks carried out annually by FOCA examiners for renewal of the type rating. He was aware of the limited flying experience of the pilot involved in the accident, without knowing the reasons for this.

Concerning the mission for the pilot involved in the accident, he knew approximately where Alp Trüsp was located; however, he had never flown there. His knowledge of the landing conditions there were only based on descriptions by other pilots of the operator. In a discussion with the pilot involved in the accident,

he mentioned, in addition to general points of an operational nature, that a prepared landing site was available.

According to the operations manager, the duties assigned to him in the FOM were not clearly described; in the event of difficulties when making decisions, he could turn to the chief pilot or his deputy.

The director of the air transport operator stated that there were no rules according to which the assignment of operations had to be undertaken.

A comparison of the principles laid down in the operator's documentation and the above statements by the managers concerned permits the conclusion that many tasks and duties were not performed and understood more as being of a purely formal nature, in order to meet the administrative requirements of the operator's organisation chart. A profound knowledge of the operating documentation is, however, an important prerequisite in order to be able to understand the assigned tasks and responsibilities. As a systemic safety net they can prevent the occurrence of an accident at an early stage.

After the fatal accident in 2012 involving a helicopter from the same air transport operator, the FOCA in its supervisory role examined various aspects of the company. There were numerous findings, which were acknowledged as problem areas by mutual agreement and which were also intended to be resolved jointly. Thus for the time of the accident under investigation, a picture emerged of a company which was in a crucial state of change in terms of its internal organisation and the application of safety regulations in its everyday operations. This included a restructured organisation chart, clear task descriptions for managers and all employees, a transparent classification of the capabilities of all pilots, and transparency of deployments for working flights and passenger flights, whether over flat terrain or in the mountains. Directives for the integration, training and monitoring of pilots were also drawn up.

It is incomprehensible why safety deficits uncovered by the FOCA and acknowledged by the operator were not remedied within a reasonable period of time.

2.2.3 Pilot

The pilot involved in the accident was neither familiar with the conditions on Alp Trüsp nor with the prepared “Er dal Zelar” landing site. In a discussion with the chief pilot he only received information based on statements of other pilots. It was intended that all landings should take place on the prepared “Er dal Zelar” site. Different options regarding the selection of the landing site were not brought up for discussion.

The pilot therefore took off on this mission without having precise knowledge of where the “Er dal Zelar” landing site was located. The fact that before the commencement of his flight a helicopter pilot is only approximately aware of the destination location and relies on his flight assistant for this information is not unusual. This circumstance is reflected in the fact that during the climb the pilot initially directed the helicopter towards some huts below Alp Trüsp and was then shown the precise location by the flight assistant. The pilot also asked the flight assistant where the second landing site on Alp Trüsp was located. To rely on the detailed information of the flight assistant, who was familiar with the locality, was appropriate. However, the final decision on safe execution of a flight lies with the pilot.

According to the eye-witnesses, the preparations for the inauguration ceremony were in full swing when the helicopter approached Alp Trüsp. The very fact that

many unsecured items were in the vicinity of the spatially restricted landing site and were therefore in the immediate area affected by the main rotor downwash, indicates an inadequate hazard assessment by the crew.

Even though hovering flight with support on a skid was assessed as acceptable in the last two proficiency checks to renew the type rating on the AS350 and SA315B, it must be noted that this is not representative for the flying challenges that the pilot was faced with in the present case. In addition to the fact that due to the restricted space the pilot was forced to use the set-down point on the stone surface on Alp Trüsp, there were the additional difficulties of the shift in the centre of gravity and the change in total mass, which must be promptly compensated for by the pilot. This is not a manoeuvre which is the subject of a regular proficiency check.

A landing with partial support on one skid on a flat, slightly inclined stone surface with limited obstacle clearance in hovering flight, and allowing passengers to exit, involves high-risks and imposes difficult challenges. In view of his low training level at the time, the pilot exceeded his flying capabilities with this manoeuvre. This fact contributed to the occurrence of the accident.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- There are no indications of any pre-existing technical defects which might have caused or influenced the accident.
- The helicopter was certified for daytime VFR commercial operation.
- The emergency locator transmitter (ELT) was triggered.
- The guarded cut-off switch for the hydraulic system was in the ON position.
- The drive belt for the hydraulic pump was not found.
- The filament bulbs of the HYD and GEN warning lights on the warning light panel were activated at the time of impact.
- The tail rotor drive shaft was fractured prior to the impact with the ground.

3.1.2 Crew

- The pilot held a valid licence and type rating for this flight.
- The pilot held a valid Class 1 medical certificate with the restriction “shall wear corrective lenses and carry a spare set of spectacles” (VDL); the field for commercial flights with passengers as a single pilot contained four dashes.
- There are no indications of the pilot or flight assistant suffering any health problems during the accident.
- There are no indications that the pilot was wearing spectacles on the accident flight.
- The pilot was not wearing a helmet; he was equipped with a headset and was in radio contact with the flight assistant.
- The flight assistant was wearing a helmet with a built-in headset. He was in radio contact with the pilot.
- The pilot was informed in advance of the passenger flights to the inauguration ceremony on Alp Trüsp and received corresponding documentation from the operations manager; in a discussion with the chief pilot he was informed that a prepared landing site was available.
- The pilot had never made any flights to Alp Trüsp before this.
- The operation schedule for helicopter HB-XSO, dated 29 June 2013, was found in the wreckage. No chart showing the “Er dal Zelar” landing site was found.
- The pilot did not participate in the supply flights to Alp Trüsp on the day before the accident.

3.1.3 History of the flight

- At 07:42 on 29 June 2013, the pilot, accompanied by the flight assistant, took off in the AS350 B2 helicopter, registration HB-XSO, from Lodrino aerodrome (LSML).
- The pilot landed on a parking area near Diga di Personico and with the rotor turning four passengers boarded, one in front on the left and three in the rear on the right.

- At 07:47 the pilot took off for the first flight to Alp Trüsp.
- At 07:53 the helicopter landed on Alp Trüsp by setting-down the left skid in hovering flight on a flat, slightly inclined stone surface in front of the Alpine huts.
- The flight assistant disembarked from the left side of the helicopter.
- The main rotor blades contacted a rock during the hovering flight with the skid set-down.
- The flight assistant managed to pull one passenger out of the helicopter.
- After hovering briefly at a low height, the pilot initiated a left turn and flew down towards the valley floor.
- When the flight assistant advised flying back to Lodrino for an emergency landing, the pilot confirmed over the radio: *"verso Lodrino"* [to Lodrino].
- At a low height above the valley floor, there was a loud bang; the helicopter went into an uncontrolled state and rapidly lost height.
- The helicopter impacted the ground in a quarry approximately 900 m south of the village of Iragna.
- The helicopter was destroyed on impact with the ground. Fire did not break out. All the occupants were fatally injured.
- The seat belts on the rear row of seats were all found to be closed and tightened. The lap and shoulder belts on the two front seats were open.

3.1.4 Operational aspects

- The mass and centre of gravity were throughout the flight within the limits specified by the manufacturer.
- The authorization list for types of operation contained no statement on minimum requirements for the current training status regarding the upcoming flight mission.
- It was intended that all landings should take place on the prepared "Er dal Zelar" site.
- At the time of the accident the operator was in a crucial state of change in terms of its internal organisation and the application of safety regulations in its everyday operations.

3.1.5 General conditions

- The weather was no factor in the accident.

3.2 Causes

The accident is attributable to a failure of the tail rotor drive and the hydraulic assistance system, after the helicopter's main rotor blade tips contacted a rock.

The following factors contributed to the occurrence of the accident:

- The choice of a landing site with a degree of difficulty which exceeded the flying capabilities of the pilot.
- continuation of the flight with damaged main rotor blades, possibly because the effect was underestimated.

The planning and execution of the flight mission which were not performed in accordance with the operator’s principles concerning flight operations were deemed to be a systemic contributing factor.

4 Safety recommendations, safety advisories and measures taken since the accident

4.1 Safety recommendations

None

4.2 Safety advisories

None

4.3 Measures taken since the accident

None

Payerne, 2 December 2015 STSB Investigation Service

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

Berne, 10th December 2015