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Swiss Accident Investigation Board SAIB

Aviation Division

Final Report No. 2138 by the Swiss Accident Investigation Board SAIB

concerning the accident involving the
Eurocopter SA315B Lama helicopter,
registration HB-XII

on 8 July 2009

Dufourspitze, Zermatt/VS

Ursachen

Der Unfall ist darauf zurückzuführen, dass während einer Bergungsaktion mit einem Helikopter das Partieseil einer Bergsteiger-Gruppe angehoben wurde und in der Folge der Bergführer abstürzte.

General information on this report

This report contains the Swiss Accident Investigation Board's (SAIB) 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 18th 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 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 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 UTC is: $LT = CEST = UTC + 2 \text{ hours}$.

Final Report

| | | |
|----------------------|----------------------------------|--------|
| Aircraft type | Eurocopter France, SA315B (Lama) | HB-XII |
| Operator | Air Zermatt AG | |
| Owner | Air Zermatt AG | |

| | | | | |
|----------------------------|---|--------------|--------------------------------|----------|
| Pilot | Swiss citizen, born 1963 | | | |
| Licence | JAA-FCL commercial pilot licence helicopter – CPL(H), first issued by the Federal Office of Civil Aviation (FOCA) on 24 January 2007, valid till 12 December 2013. Flight instructor - mountain flying - FI(H) MOU issued by the FOCA, valid till 26 January 2011. | | | |
| Relevant ratings | SA316/319/315 | | | |
| Medical certificate | Class 1 & 2 VDL (shall wear corrective lenses and carry a spare set of spectacles). Class 1 medical fitness certificate valid till 27 August 2009. | | | |
| Flying hours | total | 10 245 hours | during the last 90 days | 54 hours |
| | on the accident type | 5442 hours | during the last 90 days | 36 hours |

| | | | |
|----------------------|----------------------------------|------------------|-------------|
| Location | 30 metres below the Dufourspitze | | |
| Coordinates | 633 140 / 087 380 | Elevation | 4630 m AMSL |
| Date and time | 8 July 2009, 13:35 | | |

| | |
|--------------------------|---|
| Type of operation | VFR, commercial (rescue flight) |
| Flight phase | Lifting of the person to be rescued |
| Accident type | Fatal fall of the accompanying mountain guide |

Injuries to persons

| Injuries | Crew | Passengers | Total number of occupants | Others |
|---------------------------|-------------|------------|---------------------------|----------------|
| Fatal | 0 | 0 | 0 | 1 |
| Serious | 0 | 0 | 0 | 0 |
| Minor | 0 | 0 | 0 | 0 |
| None | 3 | 1 | 4 | Not applicable |
| Total | 3 | 1 | 4 | 1 |
| Damage to aircraft | Not damaged | | | |
| Other damage | None | | | |

1 Factual information

1.1 History of the flight

1.1.1 General

The statements of crew members and eye witnesses, and recordings of radiotelephony on the K channel were used for the following description of the flight preparations and history of the flight.

1.1.2 Flight preparations

At 3:00 clock on the morning of 8 July 2009, a roped party consisting of five people was making its way from the Monte Rosa hut to the Dufourspitze. The members of the party were equipped with climbing harnesses. Since one person began to feel unwell early on during the climb, two of the climbers turned back. The remaining party of three people consisted of two climbers who were guests from abroad and a French mountain guide. This group reached the summit around 11:30. They spent about half an hour on the summit and then began the descent.

Shortly after the start of the descent, some 30 metres below the summit, one of the two climbers complained of feeling unwell and was unable to continue the descent. The mountain guide decided that the sick climber would have to be rescued by helicopter and that he would go on foot with the other climber back to the Monte Rosa hut.

The guide requested a helicopter rescue by calling the emergency 144 number.

For the evacuation, the mountain guide found an exposed rock pillar a few metres high, with a relatively flat surface extending approximately 1 metre by 2 metres. On top of this pillar, there was also a large flat stone slab measuring approximately 150 x 50 cm. The pillar and the slab can be seen on a photograph which was taken during the ascent to the summit (figure 1).



Figure 1: Pillar and stone slab

The guide was on the pillar and belayed himself to the end of a rope, which he wrapped several times around the slab. The sick climber was also on the pillar. He was belayed to the same rope by a loop in the rope connected to his harness, with the loop situated between the slab and the other end of the rope. The climber who was in a good state of health was next to and slightly below the rock pillar, with a view of its surface. He was tied to the other end of the rope as well as being belayed to the rock by a webbing sling. The rope was on the ground under the feet of the persons on the pillar.

1.1.3 History of the flight

The mission order arrived shortly after 13:00 at the Air Zermatt control centre. Helicopter HB-XII lifted off for the mission at approximately 13:18. The crew consisted of the pilot, a rescue specialist and a paramedic. These were in radio contact with each other on the K channel.

The rescue specialist was set down from the hovering helicopter in the vicinity of the rock pillar. He made his way to the climbers and took off his backpack. After assessing the situation, the rescue specialist decided that for the evacuation the patient, himself and the two backpacks would be suspended from the helicopter using three straps of the MERS (Multilateral Evacuation and Rescue System). In consultation with the rescue specialist, the guide removed the sick climber's backpack. Then, at the request of the rescue specialist, he tied this backpack to the rescue specialist's backpack and put both down on the stone slab. Meanwhile, the rescue specialist detached the patient from the rope.

In the meantime, the helicopter had landed in the vicinity, where the paramedic prepared the MERS. At its lower end there were six attachment points, four of which were opened. The paramedic then got back into the helicopter. With the engine running, the pilot waited until a few minutes later the rescue specialist reported over the radio that he was ready.

The pilot approached from an east-north-easterly direction and positioned the helicopter using vertical reference in a hover above the group on the ground. The pilot and the paramedic looked down through the windows of the helicopter.

The rescue specialist took three of the straps and attached the patient, himself and the two backpacks which were tied together each to one hook.

The guide had assumed a crouching position on the rock pillar. The rescue specialist informed the pilot over the radio that he could slowly take up the slack ("*Chasch langsam azie*" - "*You can lift slowly*"). Nine seconds later, when the persons were about 1-2 metres above the ground, the rescue specialist informed the pilot over the radio "*Guet, chasch ewäg*" ("*Good, you can go*"). On the radiotelephony recordings no other transmissions can be heard in this phase.

When the two suspended persons were lifted from the ground, the climber who remained on the ground noticed that the rope, which linked him to the guide, was also being lifted. The climber was unable to state how or where the rope was connected to the load being lifted by the helicopter. However, he observed that the guide had also noticed the lifted rope at the same time, stood up, and tried to release it. At this moment the guide fell backwards off the pillar. According to their statements, neither the crew in the helicopter nor the suspended persons noticed the lifting of the rope.

However, the paramedic observed from the helicopter that the rope between the falling guide and the stone slab tightened and was dragging the stone slab. The movement of the slab was also observed by the pilot and the rescue specialist. All three people observed how the slab fell several metres into the snow below

the pillar, right next to the guide. During these events, the rope was severed and the guide fell several hundred metres down the steep mountainside. He suffered fatal injuries.

1.2 Personnel information

1.2.1 Pilot

According to his statement, the pilot was also a flight instructor, a flight operations manager and deputy director of the operator. He had been employed by the operator for 26 years.

1.2.2 Rescue specialist

According to his statement, the rescue specialist had been a mountain guide since 1972 and was head of the Zermatt rescue station since 1980. He had completed formation as a KWRO (Canton Valais Rescue Organisation) rescue specialist and was on the management board of this organisation. He was president of the KWRO Technical Commission and president of the ICAR (International Commission for Alpine Rescue).

1.2.3 Mountain guide

In the police report, the mountain guide and his experience were described as follows:

The casualty had been "a registered mountain guide since 1988. He worked as a freelance mountain guide. He had often climbed the Dufourspitze in his capacity as a mountain guide. He was considered a very experienced guide."

1.3 Additional information

1.3.1 Examination of the rope

The severing of the rope is not directly related to flight operations. Nevertheless, the way the guide was belayed was investigated in more detail in order to obtain information about the sequence of events of the lifting operation and the fall.

The rope was examined forensically by the Scientific Forensic Services Zurich City Police (WD - Wissenschaftlicher Dienst). The total length was 34 metres. The point at which it was severed was of particular interest; it was 13.7 metres from the knot to which the guide was attached (figures 2 and 3). At this location (the section marked in red), the sheath of the rope had been permanently deformed (flattened) and exhibited a frayed tear in the sheath (encircled in green). The core of the rope was severed at the other end of the deformed section, where the rope sheath was also cut through over about $\frac{3}{4}$ of its circumference (the purple arrow).

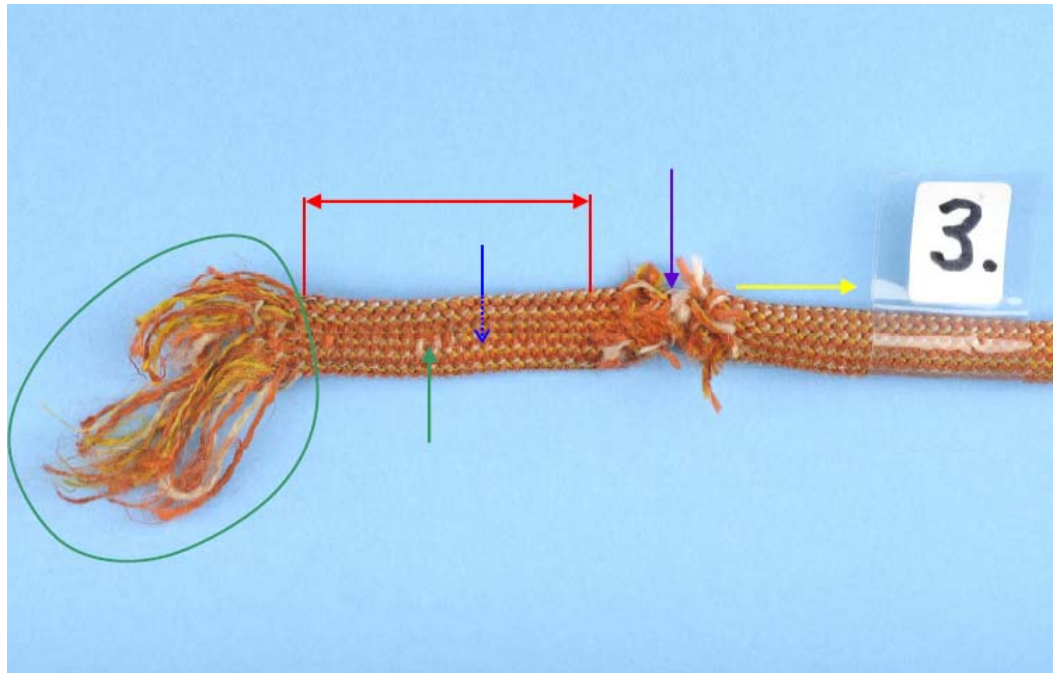


Figure 2: Top view of the flattened section of the severance location (mountain guide side)

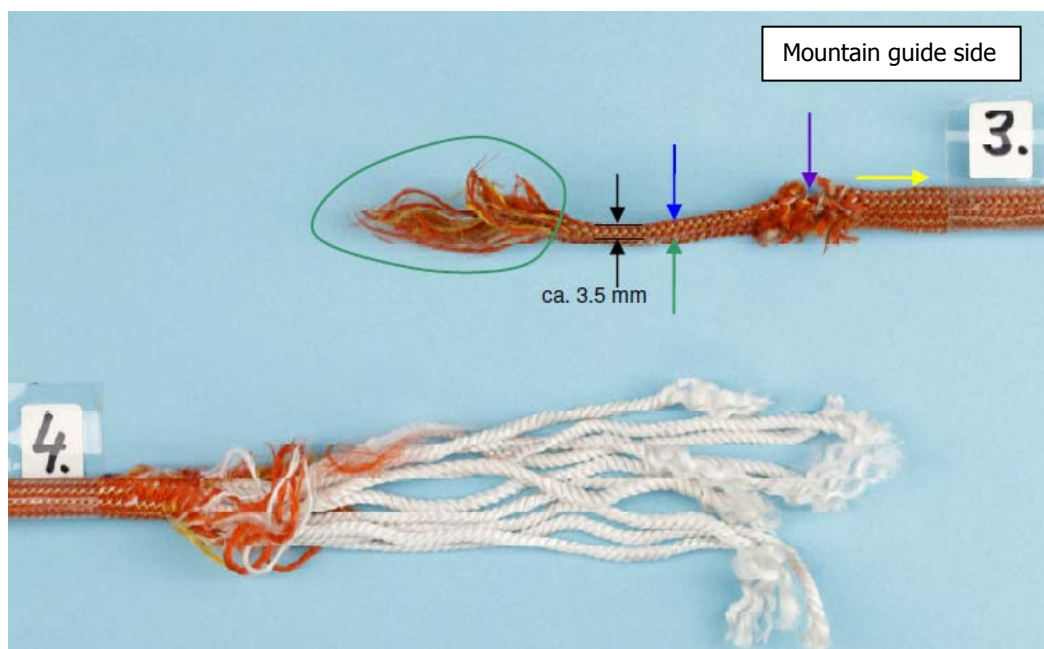


Figure 3: Side view of the deformed severance location (mountain guide side) and opposite end

The rope exhibited further damage, signs of abrasion and inclusions of foreign material (e.g. rock dust and metal particles). However, from the investigation findings of the Scientific Forensic Services it was not possible to explain the kind of influence that caused the severance of the rope.

Since the manufacturer and the technical parameters of the rope were yet unknown at that time, the rope was examined in greater detail at the premises of an experienced mountaineering equipment manufacturer (Mammut), under the supervision of the Aircraft Accident Investigation Bureau.

The rope was identified as a Mammut product manufactured in 2006. The wear and the general condition of the rope were assessed to be commensurate with

normal use as normal and acceptable. The strength of the rope was tested using the standardised dynamic drop test of the UIAA (International Mountaineering and Climbing Federation) and passed this test.

Using an identical new reference rope, several tests were carried out in the drop tower in order to develop a possible scenario for the observed permanent deformation. However no results were produced which would have supported the scenario of a break due to a dynamic overload (over an edge or due to pinching in a groove).

The Aircraft Accident Investigation Bureau (AAIB) performed several other tests in which an identical new reference rope under tension was subjected to impacts to create a pinch. None of these tests resulted in severance or a similar permanent flattening as was observed in the sheath of the rope involved in the accident.

1.3.2 Examination of the rope securing knot on the guide's harness

The knot by which the rope was attached to the guide's harness was not very tight on examination after it was recovered. The knot was a bowline on a bight, which is especially common among sports climbers. This knot has the advantage that it is easier to release after subjecting it to a load (e.g. due to a fall), as opposed, for example, to a figure-of-eight knot. It is sufficient to wiggle or move the knot.

1.3.3 Securing the rope to the stone slab

To belay himself, the guide wound the rope several times around the stone slab lying on the pillar. From an estimation of the dimensions of the stone slab with the aid of figure 1, it can be concluded that the stone slab weighed between 500 kg and 700 kg. According to a mountaineering and rock-climbing expert, this type of belay is normal and comprehensible.

1.3.4 Lifting of the rope as the persons were being lifted

The climber who was in a good state of health was next to and slightly below the rock pillar. He was about two to three metres away from the guide who subsequently had the accident and had him in view. He made the following statements in his native language, English¹:

"When the helicopter lifted, I saw how the rope of H. and me went with it. I have absolutely no doubt that it was the rope between H. and me. I was afraid that the helicopter would have pulled H. and me up with it. [...] As soon as I saw that our rope was lifting, H. made the same observation. [...] The rope was between H. and me. When the rope lifted between us, we looked at each other. I noticed that H. had also observed the rope lifting. H. was kneeling on the rock and reacted directly to the lifting of the rope. He immediately tried to release the rope and stood up as he did so. [...] I don't know if the rope was tangled up with someone (with a person or a backpack). The last time I saw the rope hanging in the air, H. was trying to release it. In this situation, H. fell. [...] The downwash was strong, but it didn't make me concerned."

Note: H. denotes the guide involved in the accident.

According to the statements of the pilot, the paramedic and rescue specialist, at no time did they notice any unusual change of attitude or load, or a jolt.

¹ The original verbal statement was immediately translated and only recorded in German. This is a translation of the recorded German statement.

The backpacks of the rescue specialist and the sick climber, which were tied together during the rescue and which were suspended with the two persons, exhibited no damage.

When the climber who remained on the ground observed the guide fall - he was attached to him by the rope - he prepared to break his fall by bracing himself on the rock. However, neither when the rope lifted nor when the stone slab moved, nor when the guide fell, did he feel any tug on in the rope.

1.4 Meteorological information

The information on the meteorological situation was provided by MeteoSwiss.

1.4.1 General meteorological situation

A Scandinavian depression with moderate westerly winds at altitude was driving cooler, unstably stratified maritime air towards Switzerland. The wind at altitude was turning from west to north-west, and the accompanying moist air gradually abated. On the southern side of the Alps, as a result of the north wind, a rapid improvement in the weather was taking place.

1.4.2 Weather at the time and location of the accident

Clouds: Above clouds (2-3/8 in the vicinity, cloud tops at approx. FL120)

Weather: -

Visibility: Over 50 km

Wind: West wind, 25 kt

Temperature/dewpoint: -10°C / -25°C

Atmospheric pressure: QNH LSZH 1015 hPa, QNH LSGG 1017 hPa, QNH LSZA 1010 hPa

Position of the sun: Azimuth 181°, elevation 66°.

Hazards: Light to moderate orographical turbulence possible.

1.5 Aircraft information

The available power of the helicopter at this altitude (Hover Out of Ground Effect – HOGE) was checked by the pilot by means of a powercheck and deemed to be sufficient to be able to lift the two persons and their backpacks.

1.5.1 Rescue equipment

The helicopter was equipped with a so-called MERS (Multilateral Evacuation and Rescue System). From the helicopter's cargo hook, a 30 m line was doubled to form a 15 metre length from which a weighted football buoy was suspended; anchor straps were in turn connected to this (figure 4). The resulting length from the helicopter to the attachment points was 20 metres. Of the six anchor straps, four attachment points were open, in order to attach the patient, the rescue specialist and their backpacks.

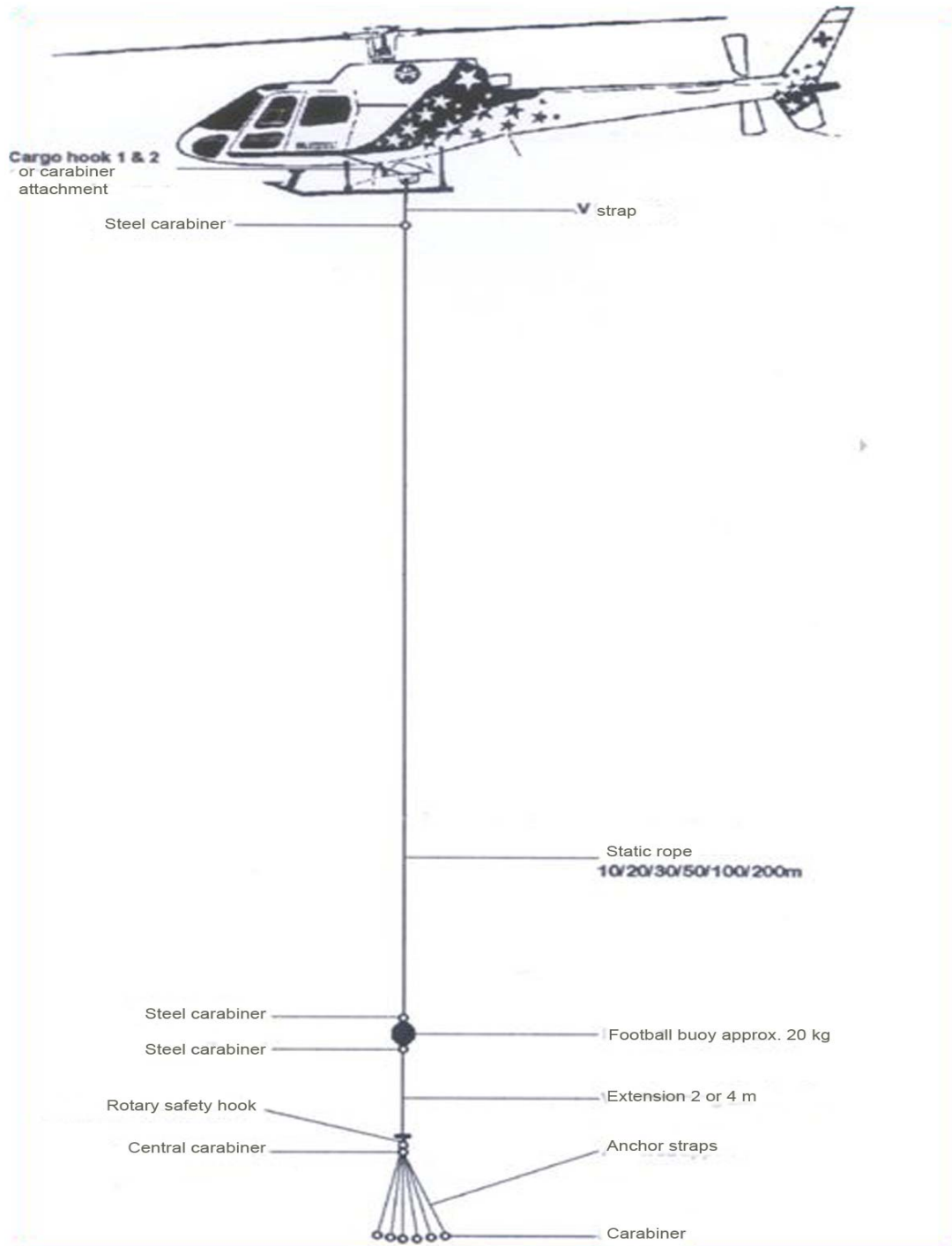


Figure 4: Multilateral Evacuation and Rescue System (MERS)

1.6 Organisational and management information

Flight operations using the MERS are described by the operator in a Code of Practice entitled "Human External Cargo (HEC), MERS and abseiling equipment". The following excerpts are taken from the version of this document which was made available to the AAIB:

"Missions with the MERS must be carried out with due care and with an increased safety factor. [...]"

The rescue specialist [...] is additionally responsible for the following points: [...] Preparing passengers for the evacuation or the flight [and] the safe rescue of passengers. [...]"

After attachment, the rescuer reports: 'LINE ATTACHED', 'LIFT SLOWLY', 'LINE UNDER TENSION', 'LOAD LIFTING' and 'LINE FREE'.

2 Analysis

2.1 Technical aspects

2.1.1 Helicopter

There is no evidence of any technical or mechanical problems with the helicopter which played a role in the accident.

The helicopter was maintained in accordance with the regulations.

The available power HOGE was sufficient for lifting the two people and their backpacks.

2.2 Human and operational aspects

2.2.1 Crew qualifications

The pilot had the necessary licences and extensive experience of rescue flights in mountain regions.

Both the pilot and the rescue specialist had considerable experience of rescue flights in mountain regions and of the use of the Multilateral Evacuation and Rescue System.

2.2.2 General conditions

The weather conditions for the mission were good. Neither visibility nor the wind had a negative effect on the ability of the pilot to set down the rescue specialist while hovering and subsequently rescue the persons and material.

2.2.3 Lifting of the rope and course of the accident

The lifting of the rope was described by an eye witness who was standing in close vicinity and who had the rope in his field of vision. The lifting alarmed him because he was simultaneously attached to this rope and the rock and feared being torn from the mountain by the helicopter. According to this statement, the lifted rope was also the reason why the guide stood up from his kneeling position. None of the crew members had observed the lifting of the rope. It must be assumed, with a probability bordering on certainty, that the rope was connected to the persons or material (backpacks) being lifted and was lifted together with these.

The lifting of the rope caused the guide to stand up. While trying to release the rope, he apparently lost his balance.

The downwash of the rotor was very pronounced on the ground. However, according to the statement of the healthy climber, the strength was not perturbing. It is unknown how experienced the mountain guide was with such conditions.

The guide's harness was attached to the rope by a bowline on a bight. For a belay, this rope was wrapped several times around the stone slab which lay on the pillar. This type of attachment is generally considered normal and appropriate.

The non-tightened state of the bowline on a bight knot after recovery does not allow any conclusions to be drawn as to whether the rope was under load during the accident. A yank on the knot could have been caused either by the fall or by

the link with the helicopter. In any case, however, the knot could have become loose again as a result of movement during the fall.

The permanent deformation (flattening) of the rope at the point at which it was severed could not be reproduced either during the dynamic tests in the drop tower or when subjected to an impact while under static tensile load. The persons in the helicopter did not notice any unusual change in load during the lift, and neither the suspended rescue specialist nor the climber on the ground (who was attached to the rope) noticed any tension on the rope. Consequently, it is unlikely that the helicopter, apart from lifting it, exerted any tension on the rope, which, for example, could have displaced the stone slab. It is most probable that the rope was hit by chance by the stone slab when it first hit below the pillar, and in the process was deformed and severed.

2.2.4 Operator's operational procedures

The use of the Multilateral Evacuation and Rescue System was not in accordance with the procedure described in the operator's Code of Practice.

Instead of the standard phraseology described, communication between the rescue specialist and the pilot was reduced to a minimum. Three of the five statements were not made by the rescue specialist ("*Line attached*", "*Line under tension*", "*Load lifting*").

However, the two essential messages for the pilot were communicated by the rescue specialist. The instruction "Lift slowly" was given with the words "*you can lift slowly*", and the information "*Line free*" was communicated with the words "*Good, you can go*". In fact, however, the rope was lifted with the load. According to their own statements, none of the crew members involved observed the lifting of the link rope. It may be concluded that for them the possibility of a connection between the ground and the people and material (backpacks) being lifted did not exist, and they therefore paid no attention to it. This does not correspond to the instructions in the Code of Practice that missions using the MERS must be carried out with the necessary care and with an increased safety factor.

Clearly described procedures for flight operations are particularly important during routine operations to prevent actions being taken habitually and in anticipation of regular past experiences. Thus the required "*Line free*" report is intended to ensure that a check is actually conscientiously carried out to determine whether the rope or the load is free.

The instructions for personnel must include the procedure not only for normal operations but also for abnormal situations. The Code of Practice does not contain any instructions about how to proceed if for example it is detected during lifting that the load is not free.

However, it must be noted that it would probably not have been possible to prevent the guide's fall even if the lifting of the rope had been detected after the lift-off and appropriate measures taken. At this point, the guide had already stood up. The initiating event for the accident was therefore incomplete preparation of the lift site. The preparation must ensure that while the load (persons and material) is being lifted, it is free and cannot become entangled.

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 available power (HOGE) was adequate and did not influence the course of the accident.

3.1.2 Crew

- The pilot held the necessary licences for the flight.
- The rescue specialist had considerable experience of rescue flights in the mountains and of using the MERS.

3.1.3 History of the flight

- The setting-down of the rescue specialist in the vicinity of the climbers proceeded normally.
- In consultation with the rescue specialist, the mountain guide subsequently involved in the accident took the sick climber's backpack and tied it to that of the rescue specialist.
- The rescue specialist prepared the sick climber and the material for transportation. This preparation was incomplete, because the load became tangled with the rope without this being detected.
- The rope between the guide and the climber on the ground was lifted when the two people were being lifted.
- Neither the rescue specialist nor the helicopter crew noticed that the load being lifted was still connected to the rope.
- Radio communications between the pilot and the rescue specialist was minimal during the rescue operation and did not meet the requirements of the Code of Practice.
- It is unlikely that the helicopter applied tension to or lifted the stone slab or the guide.
- The lifting of the rope caused the guide to stand up. While trying to release the rope, he fell from the rock pillar.
- The non-tightened knot by which the rope was attached to the guide's harness permits no conclusions to be drawn as to whether it was subjected to a load.
- The method of belaying a rope by wrapping the rope around a stone slab is generally considered normal and acceptable.
- As a result of the guide's fall, the stone slab to which he was attached also moved, fell off the rock pillar, and impacted below the pillar right next to the guide.
- It is probable that the rope was hit by chance during this first impact of the stone slab below the pillar and in the process was deformed and severed.

3.2 Causes

The accident was caused by the lifting of the safety rope between a climbing party during a rescue mission with a helicopter, and the subsequent fall of the mountain guide.

Payerne, 24 April 2012

Swiss Accident Investigation Board

This final report was approved by the management of the Swiss Accident Investigation Board SAIB (Art. 3 para. 4g of the Ordinance on the Organisation of the Swiss Accident Investigation Board of 23 March 2011).

Berne, 31 May 2012