



Final Report of the Federal Commission on Aviation Accidents

concerning the collision

between the helicopter Alouette III SA316B, HB-XJR

and the helicopter Jet Ranger II AB206B, HB-XNU

on 26 September 2000

at Beuson / Valais

This final report was drawn up by the Federal Commission on Aviation Accidents following an investigation procedure pursuant to articles 22 to 24 of the Decree on aviation accidents and serious incidents of 23 November 1994 (OEAA / RS 748.126.3) concerning the report of the Aircraft Accident Investigation Bureau.

Ursachen

Der Unfall ist auf eine Kollision in der Luft zurückzuführen, die sich aufgrund folgender Faktoren ereignet hat:

- die Piloten haben der Separation zwischen den Helikoptern zuwenig Beachtung geschenkt und der Luftraum wurde nicht genügend überwacht;
- die Piloten haben untereinander mangelhafte bzw. unklare Fluganweisungen ausgetauscht (Flugstrecke, Separationen, Meldepunkte, Gefahren);
- seitens des Veranstalters fehlte ein Reglement und eine klare Organisation für die Durchführung dieser Art von Operationen.

Zum Unfall haben beigetragen:

- Der Pilot der Alouette III HB-XJR wurde möglicherweise beim Anflug durch die Sonne geblendet.
- Die Alouette III HB-XJR befand sich für den Piloten des Jet Ranger II HB-XNU in einem toten Winkel, welcher sich aus der relativen Lage der Helikopter ergab.
- Die Programmverzögerung und die daraus resultierende Eile.

Sicherheitsempfehlung

Als Voraussetzung für den Einsatz von mehreren Helikoptern am selben Arbeitsort muss zwingend ein Assistent am Boden sein, der die Überwachung der Luftfahrzeuge gewährleistet, um das Risiko von Zusammenstößen zu vermeiden.

THIS REPORT HAS BEEN PREPARED FOR THE SOLE PURPOSE OF ACCIDENT PREVENTION. THE LEGAL ASSESSMENT OF ACCIDENT CAUSES AND CIRCUMSTANCES IS NO CONCERN OF THE ACCIDENT INVESTIGATION (ART. 24 OF THE AIR NAVIGATION LAW).

SYNOPSIS

Summary

Four groups of Indian nationals were involved in a tour organised by a tour operator from their country. The tour included a visit to Switzerland. The four groups together represented a total of approximately 150 people who were staying in Valais; their programme included a helicopter flight of the "air baptism" type.

For this purpose, several helicopters of the Air Glacier company were booked to leave from the football pitch in the village of Beuson. During a circuit, in the final approach phase, the Alouette III HB-XJR and the Jet Ranger II HB-XNU collided and crashed on the football pitch.

The seven occupants of the Alouette III HB-XJR and one passenger of the Jet Ranger II HB-XNU died from their injuries at the site; the four other, more or less seriously injured, occupants were taken to the hospital at Sion.

Investigation

The accident occurred at approximately 16:30¹ hours. It was notified at about 17:00 hours to the AAIB – Aircraft Accident Investigation Bureau. The enquiry was started on the same day at approximately 17:45 hours at the location of the accident and was conducted in collaboration with the Valais cantonal police.

1. FACTUAL INFORMATION

1.1 History of the flights

1.1.1 Preparation of the operation

In spring 2000, a local hotelier commissioned Air Glaciers SA to carry out helicopter flights of a few minutes duration of the "air baptism" type with his clients on several occasions throughout the year. For 26 September 2000, 145 passengers of Indian origin were scheduled. The commencement of the flights was fixed for 14:15 hours, leaving from the Beuson football pitch. On the day in question, the Sion base had envisaged assigning three helicopters.

1.1.2 Chief pilot

(Name of chief pilot) was the chief pilot of Air Glaciers SA, Sion base.

¹ All times given in this report are local times (UTC + 2)

In this capacity, he had contact with each of the three pilots assigned to Beuson on the day in question:

- in the early afternoon, he spoke with (name of pilot A) about the mission, mentioning the problem of the large number of passengers; considering that these were simple pleasure flights, he gave him no special instructions;
- (Name of pilot B) was informed that passenger flights lasting six minutes were to be made from Beuson with several helicopters; according to the pilot, no additional instructions were given to him;
- as for (name of pilot C), he was informed on his return from a mission of a new assignment using the Jet Ranger II HB-XNU helicopter for "air baptism" type flights from Beuson; since the pilot had not previously made any flights from this site, the chief pilot showed him the location on a map and invited him to make contact with the pilot already assigned in order to define the flight strategy.

Considering that this was a simple mission, given the experience of his pilots, the chief pilot did not deem it necessary to discuss further details.

1.1.3 Flight assistants

The three flight assistants, (names of the three flight assistants), trained within the company and with flight experience varying from 4 months to 1 year, were sent to Beuson to handle the ground aspects of the passenger flights from the football pitch. The programme envisaged that operations would start at 14:15 hours.

At about 13:50 hours, the first assistant arrived at the landing area in the truck intended for refuelling. He was joined ten minutes later by his two colleagues. One flight assistant, who had already participated three times in flights of this type for the same client - and also starting from the same location - defined the various tasks and landing areas of the helicopters. In view of the large number of people expected, everyone's attention was focussed on the composition of the groups and safety on the ground.

At the time envisaged for starting the operations, one of the assistants was informed by telephone of a delay in the arrival of the tourists of at least half an hour. As 15:00 hours passed, the company's base then informed the assistants of their desire to cancel the flights because of the delay of approximately one hour to the agreed programme.

A little later, about 15:25 hours, the first tourist coach arrived. The flight tickets were immediately supplied to the person responsible for the groups for distribution to the passengers and the information on the arrival of the first tourists was transmitted to the base. The base then announced the departure of the first, type Lama, helicopter. A group of 4 people then prepared for embarkment without delay.

1.1.4 Pilot of the Lama HB-XHD

(Name of pilot B) was waiting at the base. On notification of the arrival of the passengers at Beuson, he took off at the controls of the Lama HB-XHD helicopter. On channel H1, he communicated his approach to the flight assistants on the ground. The round trips began straight away. After taking off in a northerly direction, the pilot turned left to fly up the Beuson valley on its western side. In the Siviez region, he turned around to fly down the eastern side of the valley. Above Beuson, he made a left turn to approach the landing area from the north. Because of the delay, the first trips of 6 minutes were subsequently shortened to four minutes (cf. Appendix 1).

The Lama HB-XHD helicopter carried out five flights in this way before its pilot warned the assistants of the imminent arrival of the Jet Ranger II HB-XNU.

1.1.5 Pilot of the Jet Ranger II HB-XNU

After three missions effected on behalf of the same client, (name of pilot C) landed at the controls of a Lama helicopter at Sion at about 15:30 hours.

Just before 16:00, after receiving information from the chief pilot, he took off with the Jet Ranger II HB-XNU to land a few minutes later on the disembarkation area at Beuson indicated by a flight assistant. In this phase, he was contacted by the colleague already on this mission, at the controls of the Lama HB-XHD, who proposed flying as follows: "We climb to the right and descend to the right". (Name of pilot C) answered him in the affirmative. No other detail was defined.

A group of four people prepared by the flight assistant involved boarded the Jet Ranger II HB-XNU, which took off immediately, applying the agreed procedure. After taking off it then turned to the left to rejoin and climb up the valley of Beuson. The descent was carried out on the east flank of the valley and the helicopter approached the landing site from the north, north-west (see Appendix 1 / circuit A).

Finding during this first trip that the circuit was too long for the helicopter's performance, the pilot subsequently adopted a turn towards Veysonnaz (cf. Appendix 1/circuit B). He did not announce this change to the pilot of the Lama HB-XHD, who for his part did not notice it. The pilots took off and landed alternately, announcing these manoeuvres and seeking visual contact throughout these phases. Five to six cycles took place in this way.

Subsequently, the Lama HB-XND helicopter left Beuson for another mission. The Jet Ranger HB-XNU helicopter carried out one or two round trips before the Alouette III HB-XJR helicopter announced that it was arriving from Sion. After the latter had landed, he set down in turn in the south-eastern corner of the landing area.

1.1.6 Pilot of the Alouette III HB-XJR

(Name of pilot A) was engaged in various transport missions at the controls of the Lama during the morning.

At the beginning of the afternoon, the chief pilot informed him of the afternoon's mission in Beuson. (Name of pilot A) knew the area though had not previously flown such flights from this location.

Because the arrival of the first group of Indian tourists had not been announced, (Name of pilot A) flew with the Alouette III HB-XJR from Sion airport for a rescue mission at about 15:05 hours.

After the rescue flight, (Name of pilot A) arrived at Beuson where he announced his arrival and landed the Alouette III HB-XJR in the south-western corner of the football pitch, a spot previously utilised by the Lama HB-HXD.

1.1.7 Accident

(Name of pilot C), at the controls of the Jet Ranger II HB-XNU, observed the embarkation of the six passengers in the Alouette III HB-XJR and its take-off. After the passengers had boarded his aircraft he took off for his trip.

According to (Name of pilot C), the following conversation took place between the two pilots:

(Name of pilot C): "For the flights, we do the same as with the Lama, we climb to the right and descend again to the right of the valley".

(Name of pilot A): "We climb to the right and descend to the left".

(Name of pilot C): "We climb to the right and we descend to the right in the direction of flight".

(Name of pilot A): "Ah! OK".

The pilot of the Jet Ranger II HB-XNU carried out the flight as previously and made his approach from the north (Appendix 1 / circuit B). In the course of this final flight phase he heard: "JR on approach" and then the following announcement was made: "NU on final approach".

As for the pilot of the Alouette III HB-XJR, according to the video recorded by a passenger in this aircraft, after choosing a circuit to the north in the direction of Veysonnaz, he approached the landing area by making a left turn followed by a right turn, which placed his trajectory to the left of that of the Jet Ranger II HB-XNU and behind it.

On short final, when he was dealing with the power control, the pilot of the Jet Ranger II HB-XNU suddenly heard turbine noise, immediately followed by the collision.

A statement made by one of the inhabitants of the village of Beuson is as follows:

"I was in front of my garage on my property, which is below the football pitch, a hundred metres further down. At a certain moment, I saw a helicopter coming from Veysonnaz and descending. At the same moment, I also heard and saw another aircraft which was coming from Sornard, which is in the north-westerly direction."

"The two aircraft were descending and, as far as I could see, their slope had not been modified. I was astonished by their trajectories which were converging and which were not modified at any time. I watched the course of the flight with a certain apprehension, imagining what could happen. A few seconds later, the two machines approached one another and then collided".

Following the collision, deprived of its tail rotor, the Jet Ranger II HB-XNU helicopter started to turn about its axis while descending onto the football pitch. On contact with the ground, the doors opened, the left-hand rear passenger was ejected from the cabin and, finally, the aircraft came to rest on its right-hand side. The pilot had his legs and his right arm wedged under the wreckage while three passengers were still in the cabin.

The main rotor blades of the Alouette III HB-XJR were greatly damaged during the impact which cancelled the lift. The aircraft crashed upside down to the north of the area. The seven occupants were fatally injured.

A flight assistant immediately informed the Sion base about the accident and the first rescue measures were organised at the site.

About ten minutes later, the first ambulances and the rescue helicopters arrived.

The firemen and the police arrived on the scene about twenty minutes after the accident.

Co-ordinates of the location of the accident: 114,200 / 591,150

Altitude: 1080 m above sea level.

Swiss national map 1:25,000, Sheet No. 1306, Sion.

1.2 Killed and wounded

	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatally injured (Alouette III HB-XJR)	1	6	---
Fatally injured (Jet Ranger II HB-XNU)	---	1	---
Seriously injured (Jet Ranger II XNU)	1	2	---
Slightly injured (Jet Ranger II XNU)	---	1	---

1.3 Damage to the aircraft

The two helicopters were destroyed.

1.4 Other damage

Damage and pollution to the public enclosure of the football pitch.

1.5 Information on the occupants

1.5.1 Pilot of the Alouette III HB-XJR

Deceased, Swiss national, born 1950.

Holder of professional pilot licence No. 17549 for helicopters, issued by the Federal Office for Civil Aviation on 4 May 1987 and valid until 13 January 2001.

Flight experience

A total of 4715 hours 54 minutes, of which more than 1221 hours on the type of helicopter involved; during the three previous months, 162 hours 34 minutes, of which 8 hours 29 minutes on the type involved.

Start of aeronautical training: 11 January 1983

Practical examination for the private pilot licence: 1 February 1984

Practical examination for the professional pilot licence: 16 December 1986

Types of helicopters authorised: B-206/206L, SE 3130, SA 315, SA 316, AS 350 types, AS 355.

Extensions:

- ITU radio telephony
- Night flight
- Landings in mountains

Last medical examination: 1 July 2000; suitable without restrictions

(Name of pilot A) received his instruction in order to obtain his pilot and professional pilot licences within the Air Glaciers company.

Since 1 November 1990, (Name of pilot A) had been a helicopter pilot for the Air Glaciers company and carried out all the activities allocated to this type of activity. No incident or accident has been revealed in the course of these ten years of activity.

With respect to character, (Name of pilot A) was described by his chief pilot as a discreet person who scarcely became involved outside his work but who gave a lot to his profession. His enthusiasm for rescue operation was total and corresponded to his high concept for all operations of this type.

(Name of pilot A) had never carried out flights from Beuson within the framework of similar operations (passenger flights); nevertheless, he knew this location well because he had used it on several occasions in the past.

1.5.2 Passengers of the Alouette III HB-XJR

Front left-hand passenger:
Deceased, Indian national, born in 1958.
No aeronautical experience and no licence.

Centre front passenger:
Deceased, Indian national, born in 1960.
No aeronautical experience and no licence.

Window passenger, rear left-hand
Deceased, Indian national, born in 1952.
No aeronautical experience, no licence.

Rear left-hand passenger:
Deceased, Indian national, born in 1961.
No aeronautical experience, no licence.

Rear right-hand passenger:
Deceased, Indian national, born in 1959.
No aeronautical experience, no licence.

Window passenger, rear right-hand:
Deceased, Indian national, born in 1959.
No aeronautical experience, no licence.

1.5.3 Pilot of the Jet Ranger II HB-XNU

Swiss national, born in 1966.

Holder of professional pilot licence for helicopters No. 25654 issued by the Federal Civil Aviation Office on 27 May 1992 and valid until 19 May 2001.

Flying experience:
A total of 2273 hours 08 minutes, of which 850 hours 42 minutes on the type of helicopter involved; in the three previous months, 130 hours 15 minutes, of which 26 hours 28 minutes on the type involved.

Start of aeronautical training: 16 January 1989
Practical examination for the private pilot licence: 13 March 1989
Practical examination for the professional pilot licence: 22 May 1992

Types of helicopters authorised: R 22, B-206/206L, SA 315, SA 316, AS 350 types.

Extensions:

- ITU radio telephony
- Night flight
- Landings in mountains

Last medical examination: 11 May 2000, suitable without restrictions

After training as a private pilot, carried out by means of a Robinson 22, (Name of pilot C) finished his training as a professional pilot at the controls of a Jet Ranger II.

(Name of pilot C) was engaged by the Air Glacier company as a helicopter pilot and attached to the Lausanne base from 1 March 1994 and was then attached to the Collombey company base from 1 January 1998.

His last experience with "air baptism" flights in co-ordination with other aircraft goes back to the preceding month on the occasion of the inauguration of a new runway of the Lausanne La Blécherette aerodrome.

His contacts with (Name of pilot A) were not very numerous because they were attached to different bases (Collombey and Sion). They met at times early in the morning when engaged in rescue operations.

1.5.4 Passengers of the Jet Ranger II HB-XNU

Front left-hand passenger:
Indian national, born in 1959.
No aeronautical experience and no licence.

Rear left-hand passenger:
Deceased, Indian national, born in 1950.
No aeronautical experience and no licence.

Rear centre passenger:
Indian national, born in 1976.
No aeronautical experience, no licence.

Rear right-hand passenger:
Indian national, born in 1978.
No aeronautical experience, no licence.

1.6 Helicopters

1.6.1 Alouette III HB-XJR

Type:	SA 316B
Manufacturer:	Eurocopter France/Aerospatiale
Characteristics:	Single-engined helicopter with 7 seats, fixed landing gear with wheels
Year of manufacture:	1971
Series No.:	1781
Engine:	Turboengine with rotors locked together
Manufacturer:	Turbomeca, Tarnos, France
Type:	Artouste III B1

Power:	405 kW/500 hp (metric)
Series No.:	2200
Registration certificate:	Issued by the Federal Office for Civil Aviation (FOCA) on 6 January 1997.
Navigability certificate:	Issued by FOCA on 16 January 1997 and valid up to new order.
Field of use:	VFR by day and night for private use, VFR by day for commercial use.
Proprietor and operator:	Air Glaciers SA, Case Postale 34, 1950 Sion.
Service hours at the time of the accident:	8682 hours of which 294 hours since general overhaul. Engine: 7122 hours, of which 2241 hours since general overhaul. The last FOCA examination took place on 17 December 1999 at Sion. The last 100 hour inspection took place on 15 September 2000 at a total of 8670 hours in service and the last 200 hour inspection took place on 9 June 2000 at a total of 8572 hours in service.
Mass and centre of gravity:	The maximum mass at take-off is 2200 kg. The mass at the time of the accident was approximately 1980 kg. The mass and the centre of gravity at the time of the accident were within the prescribed limits.
Performance:	According to the manufacture's tables, the Alouette III HB-XJR helicopter could maintain stationary flight without ground effect at the time and location of the collision. (res. approximately 200 kg)
Endurance:	Approximately 1 hour
Distress transmitter:	The helicopter was equipped with an ELT which was functional.

1.6.2 Jet Ranger II HB-XNU

Type:	AB 206B
Manufacturer:	Giovanni Agusta SPA, Italy
Characteristics:	Helicopter with 5 seats and fixed undercarriage with skids.
Year of manufacture:	1971
Series No.:	8289

Engine:	Turboengine with free rotors
Manufacturer:	Allison, U.S.A.
Type:	250-C20B
Power:	309 kW/420 hp (metric)
Series No.:	CAE 821987
Registration certificate:	Issued by the Federal Office for Civil Aviation (FOCA) on 6 April 1994.
Navigability certificate:	Issued by FOCA on 19 April 1995 and valid up to new order.
Field of use:	VFR by day and night for private use, VFR by day for commercial use.
Proprietor and operator:	Air Glaciers SA, Case Postale 34, 1950 Sion.
Service hours at the time of the accident:	6084 hours; Engine: 8064 hours The last FOCA examination took place on 6 June 2000 at Sion. The last 100 hour inspection took place on 11 August 2000 at a total of 5984 hours in service and the last 50 hour inspection took place on 25 August 2000 at a total of 6032 hours in service.
Mass and centre of gravity:	The maximum mass at take-off is 3200 lbs. The mass at the time of the accident was approximately 2870 lbs. The mass and the centre of gravity at the time of the accident were within the prescribed limits.
Performance:	According the manufacture's tables, the Jet Ranger II HB-XNU helicopter could maintain stationary flight without ground effect at the time and location of the collision. (res. approximately 200 lbs)
Endurance:	Approximately 1 hour
Distress transmitter:	The helicopter was equipped with an ELT which was functional.

1.7 Meteorological conditions

1.7.1 From the report by the Swiss Meteorological Institute, Geneva Centre

General situation

High pressure (1024 hPa) centered on the Baltic, depression trough, Iceland to France. Jet stream from the south at altitude over the Alps.

Estimation of the meteorological conditions at the location and at the time of the accident:

Precipitation: 0 mm; Temperature: 22 °C; Relative humidity: 48%

Wind: maximum gusts less than 20 km/h;

Nebulosity: 1-3/8 towards 5000 feet above ground

Visibility: 10-15 km;

Pressure: 1019 hPa QNH

Probable dangers on this day: None

The exact position of the sun at the time of the accident has been determined, as below, by the Astronomical Institute of the University of Berne and by the Meteorological Physics Observatory of Davos:

"In accordance with the agreed information, the sun was located, looking in a southerly direction, 55.2° to the west (azimuth 55.2°) and was located 27.1° above the horizon (elevation 27.1°).

1.8 Aids to navigation

Not applicable

1.9 Communications

The radiotelephone communications were not recorded and took place normally using working channel H1. Because of this, the flight assistants and the company pilots working in the region heard, more or less completely, the dialogue and the announcements by the pilots of the Jet Ranger II HB-XNU and Alouette III HB-XJR helicopters.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

Neither prescribed nor installed.

1.12 Wreckage and impact information

After the collision, during which the main rotor blades of the Alouette III HB-XJR broke off the tail boom of the Jet Ranger II HB-XNU, the two helicopters terminated their trajectory on the football pitch.

1.12.1 Observations at the accident locations:

Alouette III HB-XJR helicopter

The cabin, which was upside down, was greatly flattened on its right-hand side. Its upper part was destroyed and the instrument panel was deformed in compression. All the instruments were damaged and their readings are zero or missing. The throttle lever was in the "flight" position, that of the shut-off valve was in the front sealed position and the servo-command valve was open. The "Batt", "Gen", "Ext. Lights", "Gyro", "Horizon" and "Mission" switches were at "ON".

The control of the rotor brake was partially withdrawn, the sleeve of the cyclic pitch was folded in a V while the sleeve of the altitude control system was withdrawn into a vertical position. The friction wheel of the flight controls was in the "loose" position. The pedals of the rudder bar were close to the neutral position. The pilot's seat was in position and its back was very deformed. The safety belts of the pilot were open and had not suffered damage. All the dual controls had been dismantled.

The cabin floor, the landing gear equipped with skids and the installation of the rear-view mirrors and of the footsteps were intact. On the other hand, the turbo-engine assembly / principal transmission box / rotor mast was lying on the ground, disconnected from the mechanical platform.

The three main rotor blades were still attached to the rotor head; two of them had been greatly damaged. The tail boom had been deformed in compression; the rear rotor was complete, two of the three rear blades were bent at more than 90°.

Jet Ranger II HB-XNU helicopter

The front part of the cabin, which was lying on its right-hand side, was greatly damaged. The front doors and the Plexiglas windows had been destroyed. The instrument panel was practically intact and the instruments had returned to the rest position.

The directional gyroscope indicated a heading of 115°, the altimeter was immobilised between 1019 and 1020 hPa with a recorded value of 3420 ft, the "control boost pump" switch was at "ON", the "DG/Hor", "Anti-collision", "Pos. Lights" switches were also at "ON" whereas those of "Batt", "Gen" and "Ldg lights" were at "OFF".

Several front and rear belt attachments have been torn off at the cabin level. To the right, the cyclic pitch control was centered, that of the altitude control system was completely withdrawn, the right-hand pedal of the rudder bar was pushed down and the floor was greatly deformed. The flight control friction was released. The dual control of the cyclic pitch and that of the altitude control system had been dismantled. The left-hand rudder bar was in place.

The turbine and the rotor mast were in the normal place, the two main rotor blades were unequally damaged, one of them being smashed at mid-length. The right-hand skid of the landing gear was separated from the two transverse

support bars whereas the left-hand skid was no longer held except at the position of the rear fixing.

The tail boom had been torn off at its base; the rear engine fairing had two rectangular openings of a similar shape, one below and the other at a distance to the rear. The upper opening has emptied the oil reservoir and the lower one has broken the fixings of the tail boom, which had been destroyed over its complete length and was found outside the perimeter of the Beuson pitch. Similarly, the stabiliser, the rear transmission box and its rotor were to the north of the site.

1.13 Medical information

The body of the pilot of the Alouette III HB-XJR was autopsied at the University Institute of Legal Medicine in Lausanne. The conclusions of the report are as follows:

- Presence of multiple major traumatic lesions, in particular thoracic damage with laceration of the heart and the aorta, depression of the cranium, lacerations at the base of the two frontal lobes and of the left temporal lobe, lesions which led to his death.
- No evidence found of organic substrate which could have impaired the capacity of the pilot of the helicopter. A malignant tumour was discovered but did not play any part in the fatal event.
- No evidence found of traces of alcohol, medicine or drugs.

After investigation, it was found that the pilot was not aware of the existence of this tumour.

1.14 Fire

No fire was reported but the wreckage had been sprayed with foam in such a way as to prevent any initiation of fire.

1.15 Survival aspects of the occupants

1.15.1 Occupants of the Alouette III HB-XJR

In view of the gravity of the injuries revealed on the body of the pilot, it is plausible to state that the passengers had practically no chance of survival, even though they were all attached by a ventral belt which resisted the impact.

The fact that the helicopter fell more or less vertically from a height of more than 10 m in an inverted position greatly crushed the structure of the cabin and caused severe head injuries to each of the occupants of this helicopter.

1.15.2 Occupants of the Jet Ranger II HB-XNU

After the collision, the helicopter started to turn to the right about its own axis. The impact of the rotating aircraft with the ground apparently caused the ejection of the left-hand rear passenger, who died at the location.

An expert technical report makes it possible to state that the three rear passengers were attached at the time of the accident. Due to the violence of the impact, some belt fixings yielded. The front left-hand passenger, also attached, was severely injured as well as the rear right-hand passenger. It was only the passenger who was seated in the central rear seat who suffered only slight injuries.

The pilot, who had buckled his ventral belt, was thrown out of his seat and was found crushed beneath the wreckage of the Jet Ranger II HB-XNU which turned over onto him after the impact on the ground.

1.16 Tests and research

The services of the Scientific Department of the City of Zurich Police were employed to reply to the following five questions (quote):

- 1) Precise altitude information for the two helicopters at the time of the collision?

"Immediately before the collision, the two helicopters were at an altitude of approximately 16 m to 18 m above the football pitch and, at the time of the collision, had an altitude of approximately 13.5 m to 16 m above the football pitch (measured from the underside of the cabin)." (Appendix 3)

- 2) Precise angles of the flight paths of the two helicopters during the collision? (Possibly speed at the time of the collision?)

"The angle between the two flight paths immediately before and during the collision was approximately 43°." (Appendix 4)

"With respect to the speed of the two helicopters at the time of the collision, it is impossible to provide any accurate information from the traces available."

- 3) Precise position of the collision?

"The precise position of the collision is shown in Fig. 34." (Appendix 2)

- 4) Influence of the sun on the pilot of the Alouette III HB-XJR? (blinding or dazzle)

"Viewed in the southerly direction, the sun was 55.2° in the west (azimuth 55.2°) and was 27.1° above the horizon (elevation 27.1°)."

"The diameter of the sun's disc was some tenths of a degree and the range of the central viewing field of the human eye is approximately $\pm 1.5^\circ$ so that the pilot of the Alouette III would be greatly dazzled by the sun in

the angular range of approximately 53° to 57° azimuth and approximately 25° to 29° elevation." (Appendix 6)

"We include this direction, starting from the Alouette III, in the three-dimensional model of the flight position directly before the collision."

"The direction to the sun extended slightly above the Agusta Jet Ranger in the region of the transition from the rear end of the cabin into the rear boom."

"The landing approach of the Agusta Jet Ranger HB-XNU took place, from the view of the pilot of the Alouette III HB-XJR, directly from the direction of the sun."

- 5) Condition of the safety belts (closed or open) for all the passengers seated at the rear?

"The complete trace pattern on the belts of the rear seats of the Alouette III HB-XJR seems to indicate that the belts were worn at the time of the accident. An unambiguous statement is not, however, possible."

"The investigation of the three belt pairs from the rear seats of the Agusta Jet Ranger HB-XNU showed that, on the basis of the traces available, these were worn at the time of the accident."

1.17 Additional information

A video recording carried out by the front left passenger of the Alouette III HB-XJR has been recovered. This sequence partially shows the trajectory carried out in the course of this flight, more particularly the approach phase and the flight parameters. This document also makes it possible to determine the position of the three passengers and to observe the behaviour of the pilot.

In addition, the development of a film found at the scene of the accident revealed photographs taken from the interior of the Alouette III HB-XJR. These show the exact position of each occupant. It is also possible to note that none of the passengers was equipped with radio telephone equipment. A conversation of one or several passengers among themselves and/or with the pilot was therefore impossible without greatly raising the voice.

2. ANALYSIS

2.1 Technical aspects

2.1.1 Jet Ranger II HB-XNU

The expert visual report on the wreckage of the Jet Ranger did not reveal any technical anomaly capable of causing the accident. In addition, the pilot of this helicopter never mentioned any technical problem.

The enquiry carried out by the Scientific Department of the City of Zurich Police made it possible to reconstruct the position and the kinetics of the collision of the main rotor blades of the Alouette III HB-XJR with the back of the fuselage of the Jet Ranger II HB-XNU. The loss of the tail boom of the Jet Ranger II HB-XNU was due exclusively to this collision and the final behaviour of the Jet Ranger, turning to the right, is characteristic of this type of helicopter when deprived of its rear rotor.

2.1.2 Alouette III HB-XJR

The video document produced from the front left-hand seat up to the moment of collision shows neither technical anomaly nor any problem encountered by the pilot. Similarly, no abnormal change to the engine regime was audible up to the time of the accident.

The more or less vertical fall may be explained by the loss of lift caused instantaneously by the serious damage to the principal rotor blades due to their impact with the rear structure of the Jet Ranger II HB-XNU.

The inversion of the Alouette III HB-XJR as it fell is principally due to the fact that the heavy mechanical assemblies (main transmission box, turbine, rotor mast) were above the fuel tank, i.e. at the level of the upper part of the cabin.

2.2 Operational aspects

2.2.1 Organisation at the level of Air Glaciers SA

“Air baptism” type flights were considered by the management of Air Glaciers SA as normal, regular, even simple missions. Consequently, these did not merit a chapter in the company FOM and Air Glaciers SA did not consider it necessary to designate a local operations manager; the pilots themselves had to assume responsibility for coordination and safety.

In this regard, it is noted that in this case the mission involved managing and flying a group of 150 Asian passengers using three helicopters with different performance levels for short-term round trips (of approximately six minutes) from a small landing and take-off area, with access which was not unobstructed (a hedge of trees and floodlights). Furthermore, because of its topographical situation, this landing area is a cul-de-sac, meaning that approach and departure necessarily take place using the same corridor.

The sum of all these factors gave this mission a complex character; clear organisation was indispensable in order to manage it, even given the experience of the pilots assigned to it.

In principle, the management of this type of mission should have been laid down in the FOM.

In addition, it is noted that the cumulative delay in the start of operations interfered with the order of assignment of the helicopters to such a point that at one time the managers of the Sion base even envisaged cancelling the flights. Finally, after more than an hour's delay, the mission did nonetheless start, initially with a single helicopter. This situation inevitably provoked some haste.

2.2.2 Chief pilot

In view of the nature of the flights to be made, which was considered simple, the chief pilot limited himself to providing each pilot with certain information on this mission, notably concerning the location, the number of passengers and the duration of the trips. He did not designate a person in charge and did not hold a briefing on how the operation was to be conducted, either with the assistants or with the pilots. As far as he was concerned, the pilots alone were responsible for handling the flights.

As already noted above, this was in fact not a simple mission. In this case, it was up to the chief pilot to designate a person in charge and to ensure that a briefing was held with the assigned personnel to lay down the details for carrying out the operation.

2.2.3 Flight assistants

For the mission in question, Air Glaciers SA assigned three assistants, only one of which had previously taken part, three times, in a similar operation for the same client and at the same place, but using a maximum of two helicopters.

The assistants were informed of the type of operation, and the place and time of commencement of the flights. At Beuson, they organised management on the ground and assigned the tasks amongst themselves. One of the assistants was designated to keep the tourists at a distance from the helicopters and to make up the groups of passengers. The other two were responsible for embarkation.

A video document confirms that the people who were waiting were well away from the embarkation zones and that the groups were being supervised by the flight assistants.

At the time of the accident, none of the three assistants, who were busy managing the large number of passengers, was able to follow the development of the critical situation soon enough to intervene by radio.

It must be stated that none of the assistants was designated as responsible for organisation on the ground and that no briefing of the assistants on handling the flights had taken place; they acquired some information via the communications between the pilots and with the base respectively.

For satisfactory management of this operation, the number of assistants should have been correlated to the special circumstances of the site, the number of passengers and the number of helicopters involved.

Finally, the assignment of several aircraft to the same landing area necessitated the presence of an assistant on the ground able to carry out monitoring of the aircraft, in particular to warn of risks of collision.

2.2.4 Pilot of the Lama HB-XHD and pilot of the Jet Ranger II HB-XNU

The pilot of the Lama HB-XHD was the first, and initially the only pilot assigned to Beuson. This circumstance and the performance of his aircraft allowed him to freely choose the circuit, which he shortened somewhat after the first round trips.

Subsequently, the second pilot at the controls of the Jet Ranger II HB-XNU intervened. The only instruction issued at the time between the two pilots was the proposal to "climb to the right and descend to the right", made by the pilot of the Lama HB-XHD.

This single and vague instruction was incomplete, since it did not include any precise indication relating to the circuit nor any elements on separations, notification points or the dangers.

After making one trip around the agreed circuit in a southerly direction into the Beuson valley, the pilot of the Jet Ranger II HB-XNU made a turn to the north towards Veysonnaz, this being more suitable for the performance of his aircraft. He did not notify this change to the pilot of the Lama HB-XHD, who did not realise that this was happening.

In order to guarantee safe separation between the helicopters and ensure coordinated management of the operation, the pilot of the Jet Ranger II HB-XNU should have announced the change in his circuit, indicating his new trajectory and the notification points.

2.2.5 Pilot of the Jet Ranger II HB-XNU and pilot of the Alouette III HB-XJR - Accident

After the Lama HB-XHD had left Beuson, the Jet Ranger II HB-XNU made only one or two round trips. The pilot then heard the announcement of the Alouette III HB-XJR helicopter which in the meantime had landed at Beuson. The pilot of the Jet Ranger II HB-XNU then landed in turn.

Once his passengers were onboard, the Alouette III HB-XJR took off. It was only then that the following conversation took place between the pilots:

Jet Ranger II HB-XNU	“For the flights, we do the same as with the Lama, we climb to the right and descend again to the right of the valley.”
Alouette III HB-XJR	“We climb to the right and descend to the left”.
Jet Ranger II HB-XNU	“We climb to the right and we descend to the right in the direction of flight.”
Alouette III HB-XJR	“Ah! OK”

This conversation, the purpose of which was to settle the course of the flights, was belated, since it took place only after the Alouette III HB-XJR had taken off, and clearly inadequate, since it contained no precise indications relating to the circuit nor any element concerning separations, notification points or the dangers.

Moreover, there is reason to doubt the clear intention (south circuit or north circuit?) of the pilot of the Jet Ranger II HB-XNU who referred to the turn of the Lama HB-XHD, when one is aware that, just previously, the latter two pilots had completed different circuits.

Moreover, it is noted that the pilot of the Alouette III HB-XJR would find it impossible to know the true intention of the pilot of the Jet Ranger II HB-XNU. This did not prevent him from continuing his flight and completing a circuit.

Each pilot followed his own trajectory, which was unknown to the other, and during the circuits consideration of the separation between the helicopters and monitoring of the airspace were deficient.

During these different and uncoordinated circuits, the Jet Ranger II HB-XNU caught up with the Alouette III HB-XJR and presented itself in an approach from the north. For his part, the pilot of the Alouette III HB-XJR approached almost simultaneously, from the north-east also.

Whilst the two helicopters approached the landing area, the pilot of the Alouette III HB-XJR announced “JR on approach” and the pilot of the Jet Ranger II HB-XNU “NU on final”. These radio communications, which referred to positions which were not clearly defined, still did not cause the pilots to wonder about their actual separation, unless the pilot of the Jet Ranger II HB-XNU interpreted that the Alouette III HB-XJR was some distance behind him.

According to the video document shot by the front left passenger of the Alouette III HB-XJR, it appears that the pilot made the approach by making a

left turn followed by a right turn which placed him on the left of the Jet Ranger II HB-XNU. Since the pilot of the latter was sitting in the front right-hand side seat, he could not see the Alouette III HB-XJR coming from behind on the left (blind spot). Nor did his passengers sitting on the left notice the close proximity of the Alouette III HB-XJR.

The video sequence recorded in the course of the approach demonstrates that the pilot of the Alouette III HB-XJR was calm and that his concentration was directed at the landing area. In addition, it shows that he was wearing sunglasses and that the position of the sun dazzled him on the right-hand side; this may have prevented visual contact with the Jet Ranger II HB-XNU.

In order to guarantee safe separation between the helicopters and to ensure a coordinated arrangement of the circuits, the two pilots should have agreed clear instructions and closer attention should have been paid to monitoring the airspace.

3. CONCLUSION

3.1. Findings

- The two pilots held valid professional helicopter pilot licences.
- There is nothing to suggest that the state of health of the pilots was affected at the time of the accident. The seminome, which was unknown to the pilot of the Alouette HB-XJR helicopter and was discovered during the autopsy, had no effect on his piloting capabilities.
- The mass and centering limits were respected for the two helicopters; furthermore, their respective performance permitted the execution of stationary flight outside ground effect at the time and at the location of the accident.
- The Air Glaciers SA FOM did not contain any indication on the management of "air baptism" type flights.
- The radio communications between the two pilots were not recorded.
- The three flight assistants were equipped with radio transmitters.
- No flight assistant had surveillance duties regarding the departures and arrivals of the helicopters. None of them was able to follow the development of the critical situation soon enough to intervene by radio.
- The cumulative delay in the start of operations interfered with the order of assignment of the helicopters and provoked some haste.
- The video document recorded by the front left-hand side passenger of the Alouette III HB-XJR helicopter shows that the aircraft made a left turn followed by a right turn on approach, a manoeuvre which resulted in positioning it to the left of the trajectory of the Jet Ranger II HB-XNU.

- Examination of the wreckage of the Jet Ranger II HB-XNU and Alouette III HB-XJR helicopters did not reveal any defect which could have been the cause of the collision. The dual controls had been dismantled, with the exception of the rudder bar on the Jet Ranger II HB-XNU.
- All the helicopter occupants involved in the collision were attached by means of a ventral belt. In the Jet Ranger HB-XNU, the belt fixings at the right-hand rear and at the centre failed while the rear left-hand belt had torn and then opened during the uncontrollable rotations of the helicopter.
- At the time of the collision, the Alouette III HB-XJR helicopter was 13.5 m above the ground while the Jet Ranger II HB-XNU helicopter was 16 m above the ground. The aerial collision took place above the northern limit of the football pitch at an angle of 43°.
- At the time of the two simultaneous approaches, the elevation of the sun was 27.1° and the azimuth was 55.2° in the western sector looking in a southerly direction. The pilot of the Alouette III HB-XJR was dazzled in a sector from approximately 53° to 57° in azimuth and from 25° to 29° in elevation.
- General meteorological situation
 High pressure (1024 hPa) centred on the Baltic, depression trough from Iceland to France. Jet stream from the south at altitude over the Alps.
 Estimation of the meteorological conditions at the location of and at the moment of the accident
 Precipitation: 0 mm; Temperature: 22 °C, Relative humidity: 48%
 Wind: maximum gusts less than 20 km/h; Nebulosity: 1-3/8 at 5500 ft above the ground
 Visibility: 10-15 km; Pressure: 1019 hPa.

3.2 Cause

The accident was due to a mid-air collision resulting from:

- the inadequate consideration by the pilots of the separation between the helicopters and the inadequate monitoring of the airspace;
- unclear and inadequate flight instructions between the pilots (circuits, separations, notification points, dangers);
- the lack, at company level, of regulations and clear organisation for the management of this type of operation.

Contributory factors:

- possible dazzling of the pilot of the Alouette III HB-XJR by the sun during the approach;
- the position of the Alouette III HB-XJR in a blind spot for the pilot of the Jet Ranger II HB-XNU, resulting from the relative positions of the helicopters;
- the delay in the schedule and the resulting haste.

4. SAFETY RECOMMENDATION

The employment of several helicopters at the same workplace must involve the presence of a ground assistant able to carry out monitoring of the aircraft in order to prevent the risk of collision.

Berne, 23 January 2003

**Federal Aircraft Accident
Investigation Bureau**

André Piller, President

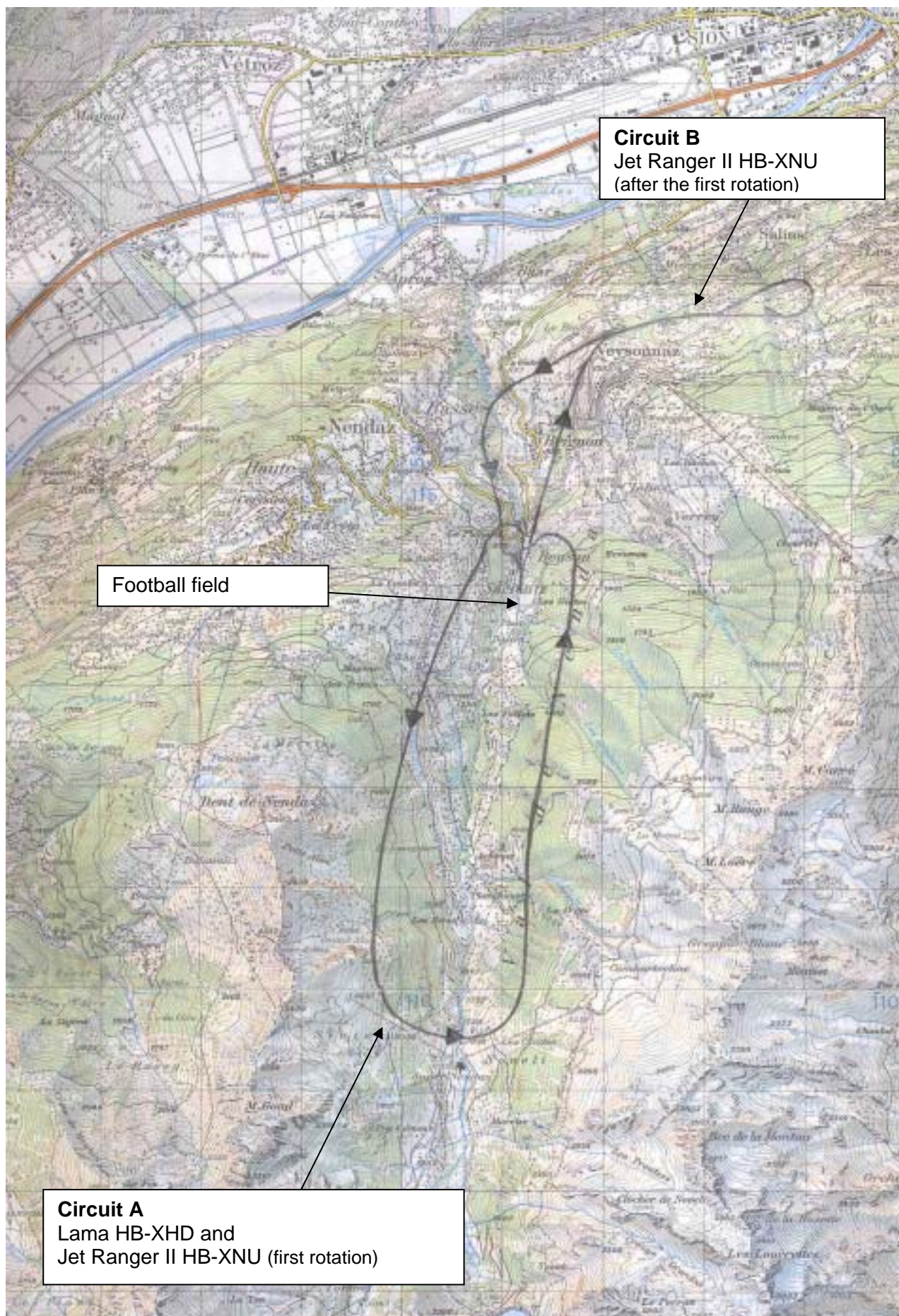
Tiziano Ponti

Ines Villalaz – Frick

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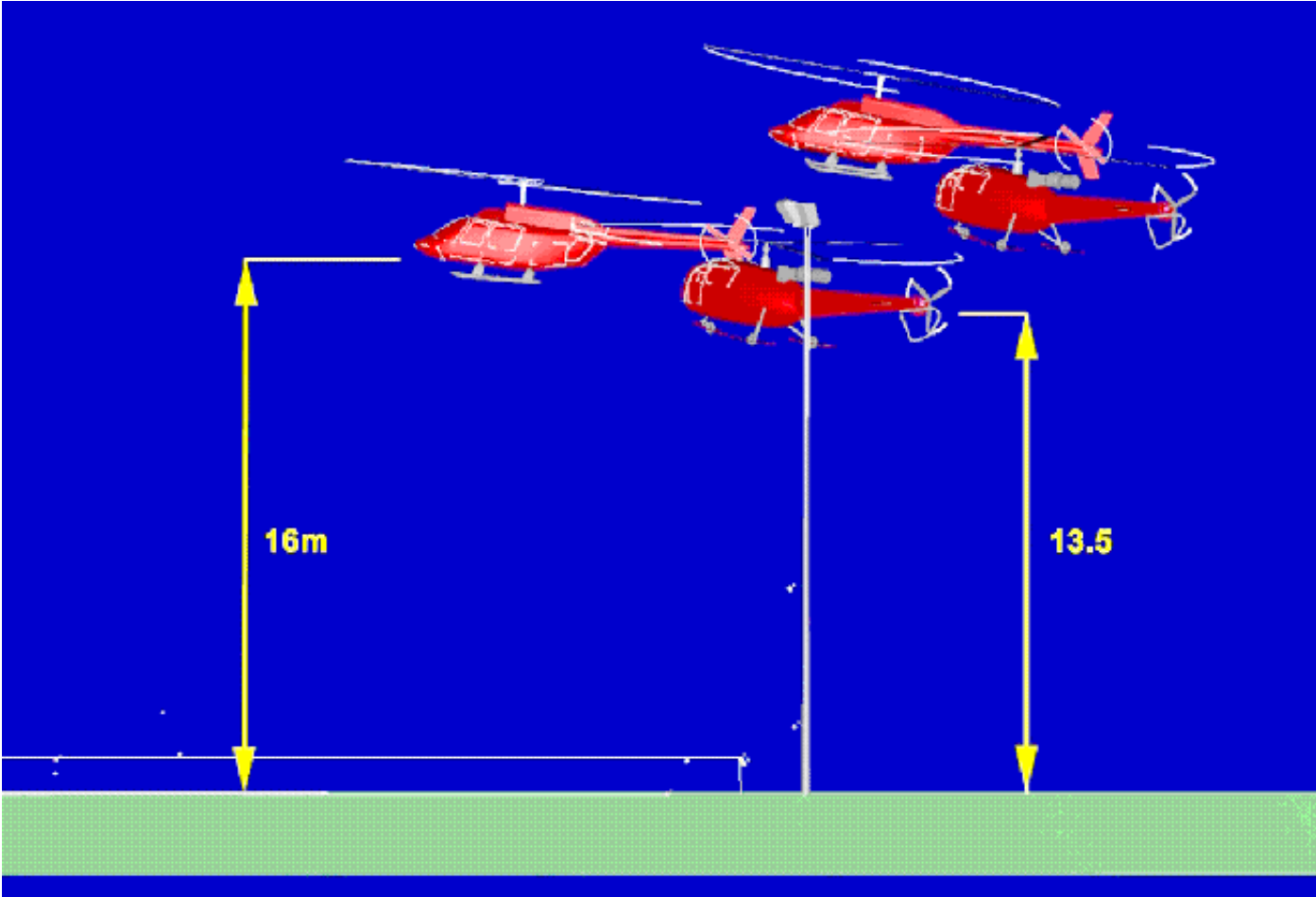
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Circuits traversed by the helicopters Lama HB-XHD and Jet Ranger II HB-XNU

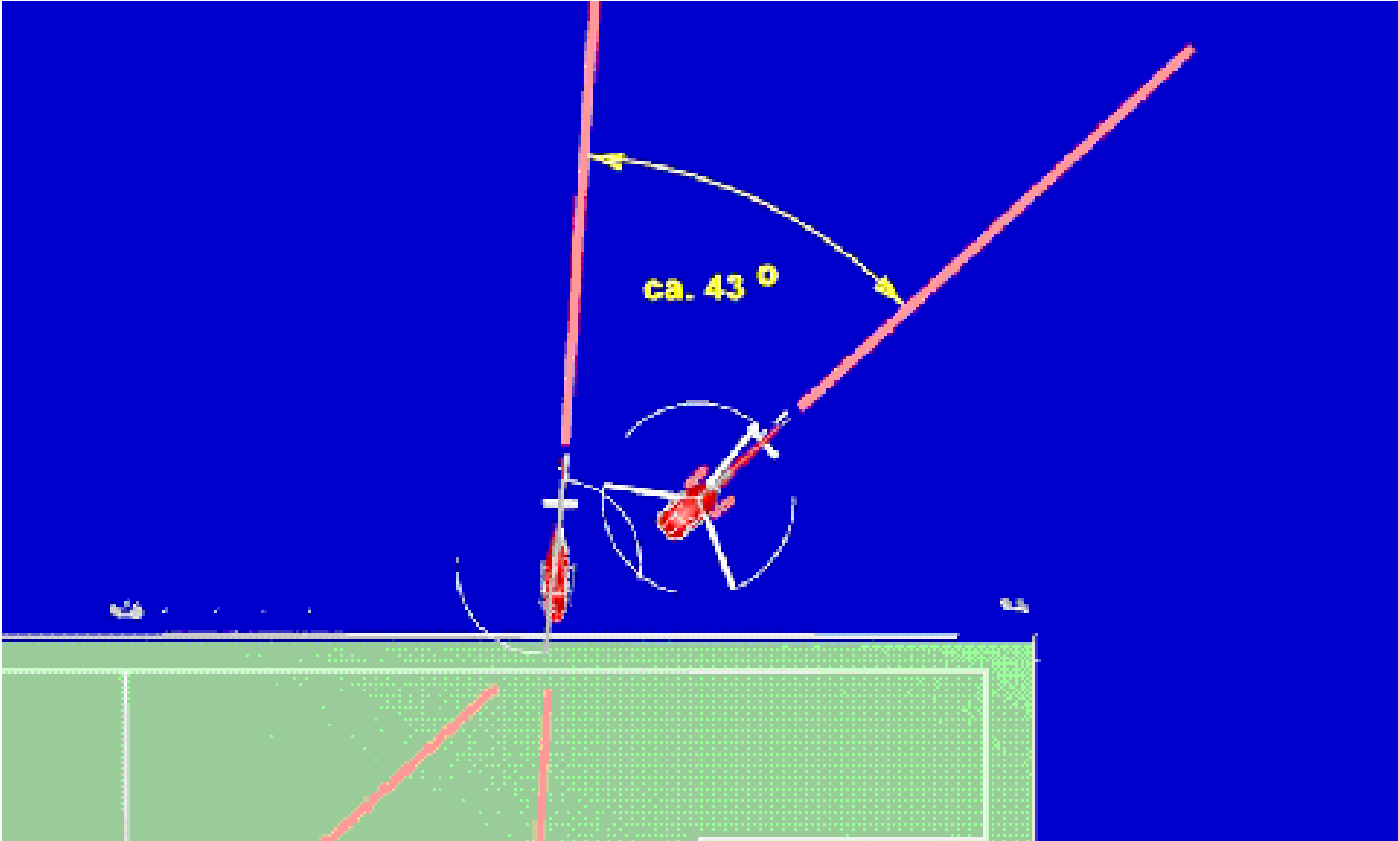




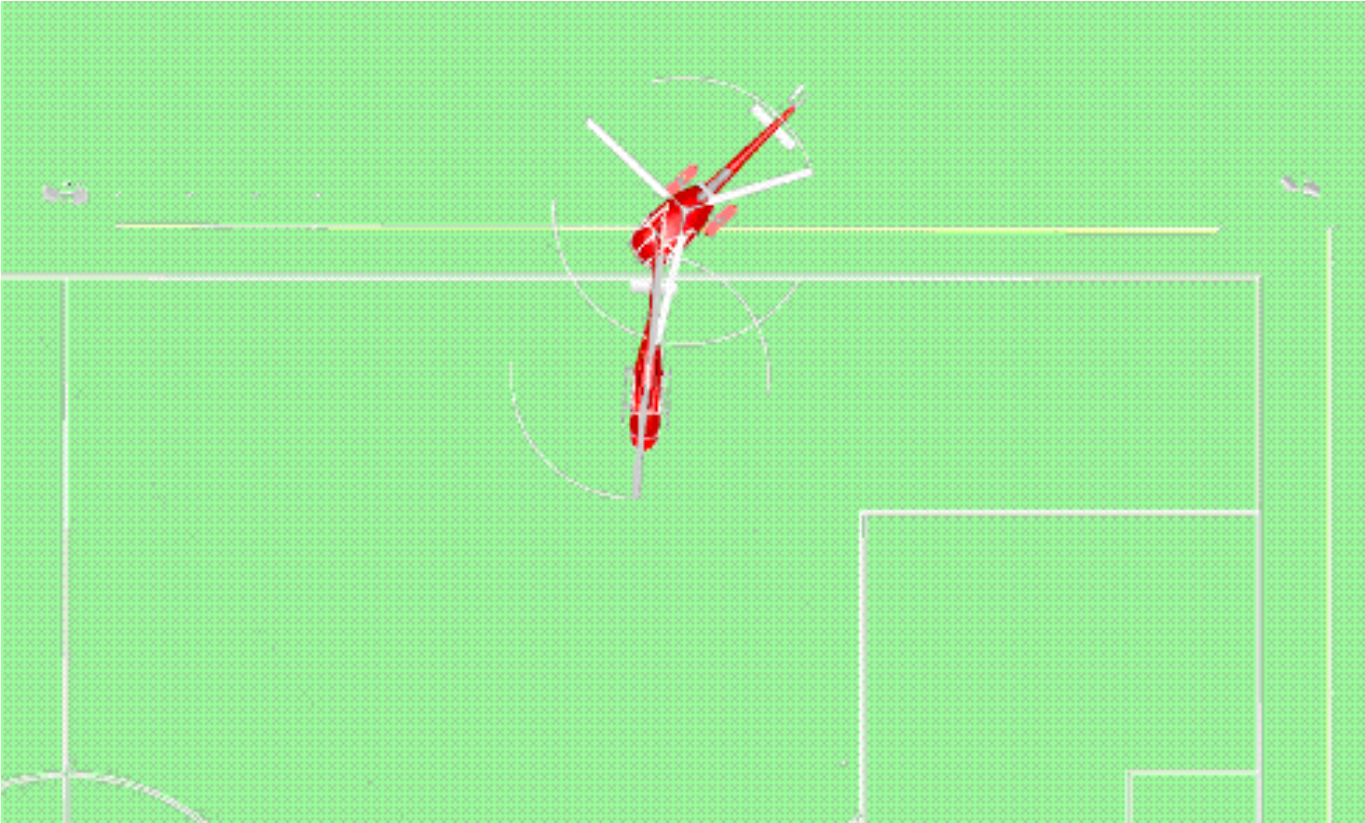
Position of both helicopters immediately before the collision.



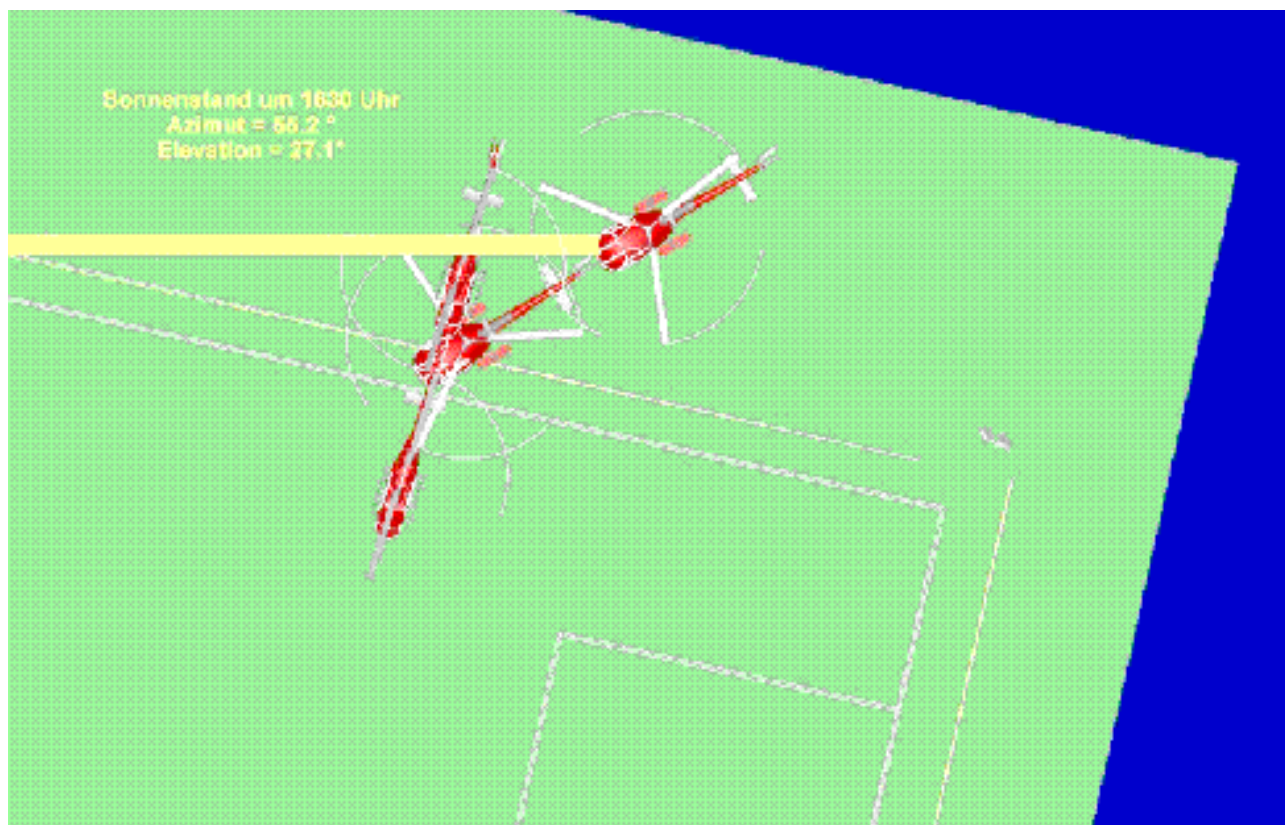
Respective height of both helicopters at the time of the collision.



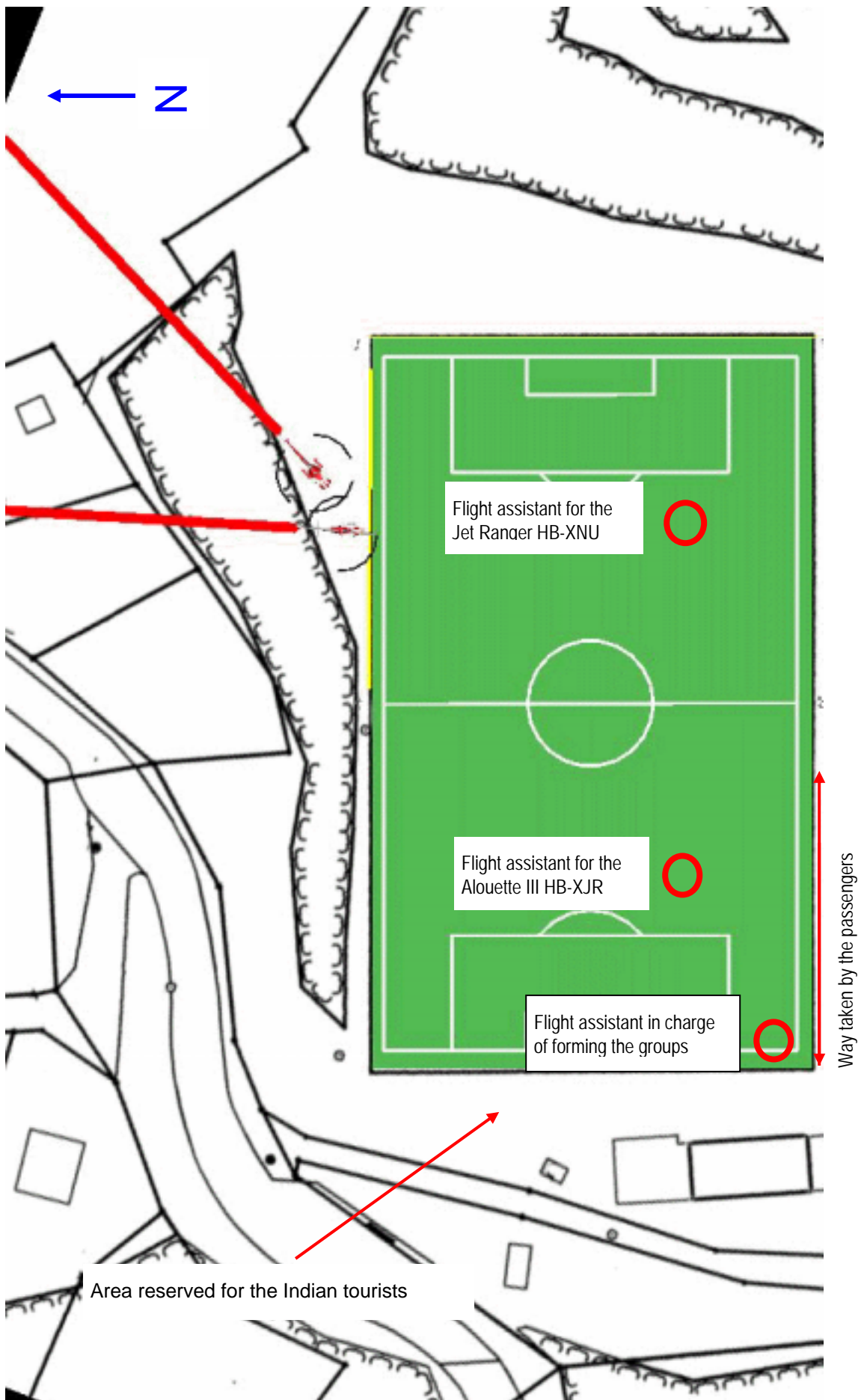
Angle of convergent flight path followed by the helicopters HB-XJR and HB-XNU.



Location of the collision (north boundary of football field).



Position of the sun for the pilot of the Alouette III HB-XJR.



Position of the flight assistants and area reserved for the passengers