Accident Investigation Board Norway

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REPORT SL 2013/06

REPORT CONCERNING AVIATION ACCIDENT ON THE CAPE HEER HELIPORT, SVALBARD, NORWAY, 30 MARCH 2008 WITH MIL MI-8MT, RA-06152, OPERATED BY SPARK+ AIRLINE LTD.

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The Accident Investigation Board has compiled this report for the sole purpose of improving flight safety. The object of any investigation is to identify faults or discrepancies which may endanger flight safety, whether or not these are causal factors in the accident, and to make safety recommendations. It is not the Board's task to apportion blame or liability. Use of this report for any other purpose than for flight safety should be avoided.

Photos: AIBN and Trond Isaksen/OSL

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AIR ACCIDENT REPORT

Aircraft:	Mil Mi-8MT
Nationality and registration:	Russian, RA-06152
Owner:	Federal State Unitary Enterprise “Arktikugol Trust”, Russia
User:	Spark+ Airline Ltd, Russia
Crew:	3, of which two fatal injured and one seriously injured
Passengers:	6, of which one fatal injured, two seriously injured and three with minor injuries
Accident site:	Cape Heer heliport near Barentsburg, Svalbard, Norway (N 78°06’ E 014°16’)
Accident time:	Sunday 30 March 2008 at approx. 1558 hrs

All hours stated in this report are local time (UTC + 2 hours) unless otherwise indicated.

ACCIDENT NOTIFICATION

The Accident Investigation Board's on-duty officer received notification from the Joint Rescue Coordination Centre for Northern Norway on Sunday 30 March at 1655 hrs. The report stated that a Russian Mi-8 helicopter had crashed on the Cape Heer heliport on Svalbard. Four injured persons had been taken to hospital in Barentsburg. The Governor of Svalbard was en route to the site by helicopter. Later, it emerged that the accident also involved fatalities.

Three accident investigators from the Accident Investigation Board arrived on Cape Heer in the afternoon of 31 March and started investigations immediately. In accordance with ICAO Annex 13, ”Aircraft Accident and Incident Investigation”, the Accident Investigation Board informed the authorities in Russia (Interstate Aviation Committee – IAC) as the persons on board, the operating company and the helicopter were all Russian. IAC appointed an accredited representative who arrived at Cape Heer on 2 April together with an advisor. They have assisted in the investigation.

SUMMARY

A Russian helicopter had flown a mission for the coalmining company Trust Arktikugol and was about to land on the home base Cape Heer on Svalbard when the accident happened. There was approx. 18 – 22 mm of dry, fresh snow in the landing area when the helicopter approached the site. The helicopter whirled up snow and the crew lost visual references. As the helicopter was about to touch down, the crew initiated a balked landing to the west in the extension of the approach. Without visual references, and affected by wind from the north, the helicopter's course deviated approx. 50º in a southerly direction. 100 m beyond the planned landing site, the helicopter hit a 12-metre tall hangar and fell to the ground. The commander, flight engineer and one passenger were fatally injured. Three other persons were seriously injured.

The investigation has shown that the operator has a potential for improvement as regards crew cooperation and standardising procedures for landing in powdery snow. Furthermore, the use of safety belts can reduce the risk level considerably.

The Accident Investigation Board has not made any safety recommendations in connection with the investigation.

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 RA-06152 was operated by the helicopter company Spark+ for the coalmining company Trust Arktikugol. The helicopter was stationed at the helicopter Cape Heer heliport to fly transport missions between the coalmining company's bases in Barentsburg and Pyramiden, and Svalbard Airport Longyearbyen (ENSB).

1.1.2 The helicopter had been hangared on Cape Heer and was made ready for flight on Sunday morning. This included installing an auxiliary fuel tank in the helicopter cabin as well as pre-flight inspection. The helicopter company technician performed the work and signed it off in the helicopter's documents. There were no entries in the technical log concerning the condition of the helicopter, and it was pulled out of the hangar at approx. 1040 hrs.

1.1.3 The plan was to fly to Pyramiden first, and then to Longyearbyen with a return to Cape Heer. The helicopter company's deputy director general, who was also the operations manager (hereinafter referred to as the deputy director general), was present and was coming along to assess the flights and performance of the flight crew. He was scheduled to disembark in Longyearbyen. The helicopter took off from Cape Heer at 1107 hrs. Two passengers and some equipment were on board for the flight, which lasted about 25 minutes. Weather conditions during the flight to Pyramiden were good.

1.1.4 Following a stop at Pyramiden, the helicopter took off at approx. 1320 hrs and flew onwards to Longyearbyen where it landed at 1337 hrs. The helicopter company's deputy director general left the helicopter as planned in Longyearbyen. The plan was to return to Cape Heer after a brief ground stop, but they had to wait for a passenger who did not turn up. After waiting for a while, they decided to fly back to Cape Heer without him. During the ground stop, they refuelled with 2,056 litres of Jet A-1, so that there was approx. 3,750 litres of fuel on board, including the auxiliary fuel tank in the cabin.

1.1.5 Before departure from Longyearbyen, the commander made telephonic contact with the attendant in the tower on Cape Heer. It had started to snow on Cape Heer and visibility was reduced to 1,500 metres. The commander therefore decided to further delay the departure. The commander was repeatedly in telephonic contact with the attendant to get weather updates. He was also worried that the Longyearbyen airport would close due to the weather, forcing them to stay there overnight.

1.1.6 At approx. 1510 hrs, the commander was notified by the Cape Heer tower attendant that visibility had increased to 2,000 – 2,700 metres between snow showers. Just before 1540 hrs, visibility was 2,000 metres, cloud base 150 metres and the wind was 6 kt from the north. The weather was improving, although visibility was low during intense snow showers. The commander then informed that he was ready, and decided to take off.

1.1.7 RA-06152 took off from Svalbard Airport Longyearbyen at 1543 hrs. The crew consisted of the commander, a first officer and a flight engineer. The commander sat in the left seat and was pilot flying (PF). The first officer sat in the right seat and the flight engineer sat between them on a folding seat in the door opening between the cockpit and the cabin/cargo compartment. The three in the cockpit could communicate with each other using headsets, but did not have any communication with the passengers. There were six passengers in the cabin/cargo compartment, including an aircraft technician employed by the helicopter company. In addition to the mentioned fuel tank, there was also some cargo at the back of the cabin/cargo compartment.

1.1.8 A VFR flight plan was submitted to the air traffic service in Longyearbyen. Call sign CDS152 was used. The AFIS officer in the tower in Longyearbyen has described the take-off as normal. Soon after take-off, a snow shower came in over the airport and visibility in the western direction fell to 2,000 metres. At 1548 hrs, the crew reported that they were passing a reporting point "*Longyear, Alpha 300 ft. Will report on ground.”*

1.1.9 The first officer has explained to the Accident Investigation Board that visibility was 5,000 metres in light snow along the route to Cape Heer. However, the conversations between the crew members recorded by the cockpit voice recorder (CVR) established that visibility was often significantly lower. The last part of the flight followed the coastline and a row of fence posts leading to the heliport. They passed the EN radio beacon (see Chapter 1.8) and then saw the flashing light east of the landing site (see Item 1.10.5).

1.1.10 They got the site in sight and advised the attendant in the tower accordingly. They were then informed that wind came from 360° with speed of 3 m/s. The crew planned a normal direct approach on a course of 270°. On the way in, they saw the wind sock, confirming the wind information. They were prepared that the helicopter might whirl up loose snow and create white-out conditions, and that it might become necessary to remain in hover until the snow had been blown away. The first officer has explained to the Accident Investigation Board that he and the commander had agreed to notify each other if they lost visual references. The plan was to abort the landing and continue straight ahead using instruments if they lost visual contact with the ground. The flight engineer would read off height above ground level, observe the direction of movement and monitor engine rpm.

1.1.11 They reduced the speed to 60 km/h and continued a slow shallow descending approach towards the landing site. The commander commented that everything was in order, followed by the flight engineer's report that altitude was 18.[1] The first officer has explained that he looked back and saw that snow whirled up by the rotor was approaching from the rear. Visibility became very poor, and the view of the green hangar on the right was lost in drifting snow, but he could still see the ground below. At this time, the first officer could not see the blue lights on the edge of the landing site, as they were on the left side of the helicopter.

1.1.12 The commander repeated that everything was ok, but commented five seconds later that they were near the edge were cleared snow had been piled up. Three seconds later, the flight engineer said that they had to abort the landing, and the first officer immediately repeated this. The first officer has explained to the Accident Investigation Board that they were about to touch down. They moved forward and the first officer lost sense of where they were. He then saw the hangar appearing in front of the helicopter. They hit the

[1] Most likely 18 metres, as Russian altimeters state altitude in metres.

building and the helicopter fell to the ground. On the ground, he noted that the sun was shining in his eyes. He had severe pain in a shoulder, but managed to unbuckle the seatbelts and evacuate the helicopter on his own.

1.1.13 The attendant in the tower on Cape Heer has explained to the Accident Investigation Board that he turned on the lights on the landing site[2] well in advance of the helicopter's arrival. He established visual contact with the helicopter at a range of 2,200 – 2,300 metres and informed the crew that he could see them. He followed it with his eyes and saw that a snow cloud was forming under the helicopter for the last 100 metres before reaching the landing site. Eventually, the snow cloud caught up with the helicopter and it disappeared from sight. The snow drifted towards the tower, and he was convinced that the helicopter had landed.

1.1.14 He looked down to note the time of landing when he unexpectedly saw the helicopter approaching the hangar 6 – 7 metres above the ground while moving sideways to the left. He then understood what was about to happen. A bang was heard and the engines fell silent. Han immediately called the meteorologist who alerted the local rescue team. He then ran out and saw that the crew was seriously injured. When he realised the seriousness of the accident, he alerted the Russian consulate in Barentsburg and the Governor of Svalbard.

1.1.15 The aircraft technician has explained that he was in the helicopter as a passenger. He sat at the front of the cabin/cargo compartment, facing against the direction of flight and was paid attention during the flight. He did not wear a seatbelt. The weather was fine when they left Longyearbyen and visibility was at times good enough for him to see the sea and houses during the flight. It was snowing when they approached Barentsburg, and a lot of snow drifted around the helicopter when they went into hover before landing. He could, however, see a snow bank to the left of the helicopter. After a while, the helicopter started moving and he lost eye contact with the ground. He assumed that the crew had aborted the landing. At the lowest, he estimated that the helicopter was 1.5 – 2 metres above the ground. The technician could not make out how the helicopter was moving before he felt an impact and was thrown out of his seat.

1.1.16 The technician then realised that they were lying on the ground, and exited through an opening at the rear of the helicopter. To the right of the cabin was a pile of luggage. When he came out, he walked forward to the cockpit and helped get the fatally injured commander and engineer out on the ground. There was a strong smell of fuel in the area. A pump in the helicopter was running until someone turned off a switch in the cockpit.

1.1.17 One passenger provided a written description of the course of events. He has explained that he saw the lights at the landing site and perceived that the helicopter had touched down. He then stood up from his seat and was about to get his luggage when the helicopter started shaking and moving so he fell to his knees. The helicopter came into contact with something and turned around before a powerful impact was felt. He then came to lying on the ground near the fuel tank at the rear of the helicopter.

1.1.18 A witness stood at a door in front of the hangar that was hit and saw the helicopter come in for landing. The helicopter then disappeared in a cloud of snow before heading straight

[2] Red lights on the buildings and a row of blue taxi lights on the touch down area.

for the hangar. It hit the hangar almost directly above his head, and he hurried inside to safety.

1.1.19 It had been agreed with air traffic service in Longyearbyen that the crew would report when they were on the ground on Cape Heer. Air traffic service would then close the flight plan. At 1601 hrs, air traffic service tried to contact CDS152, but did not get a response. After calling them three times, still with no reply, the officer on duty in the tower in Longyearbyen sent a fax to the meteorologist on Cape Heer and asked for confirmation that the helicopter had landed. No response to the fax was received, and the officer on duty raised a full alarm at 1616 hrs. Air traffic service in Longyearbyen did not receive any signals from the helicopter's emergency locator transmitter (ELT), and no reports have been filed by the Joint Rescue Coordination Centre of any emergency signals.

1.2 Injuries to persons

Table 1: Injuries to persons

Injuries	Crew	Passengers	other
Fatal	2	1	
Serious	1	2	
Light/none		3	

1.3 Damage to aircraft

The aircraft was substantially damaged. For further details, see Chapter 12.1

1.4 Other damage

Damage to hangar and cargo on board the helicopter.

1.5 Personnel information

1.5.1 Commander[3]

1.5.1.1 Male, 37 years' old, had previously flown both on Svalbard and in Africa as first officer on helicopters. He had been a commander for about three years when he returned to Svalbard to work for Spark+ as commander, about four months before the accident. The first period, of about 45 days, he flew as commander with an experienced commander/instructor. He then flew for about one month as regular commander. The instructor had left Cape Heer around 15 March.

1.5.1.2 Before the commander started his latest working period at Barentsburg, he flew for a period the helicopter type Mi-8T, which is a less powerful version of the helicopter.

1.5.1.3 The commander's personal weather limitations were 2,000 metres visibility and a cloud base of 150 metres.

1.5.1.4 The commander held valid licences to serve as commander on the helicopter type in question. He had an instrument rating and a valid medical certificate.

[3] The commander information is based on information provided by the deputy director general of the helicopter company.

1.5.1.5 Over the last 24 hours, the commander had been on duty for 6 hours and rested for 18 hours.

Table 2: Flying hours commander

Flying hours	All types	On type
Last 24 hours	1:17	1:17
Last 3 days	3:17	3:17
Last 30 days	30:05	30:05
Last 90 days	48	48
Total	3,298	2,945

1.5.2 <u>First officer</u>

1.5.2.1 Male, 35 years' old. He trained as a pilot from 1990 to 1993. He had earlier flown airplanes, but started flying Mi-8 helicopters in 2000. He was employed by Spark+ in 2002 and had worked on Svalbard for two years. The first officer was the company's most experienced employee at the site. He had valid licences to serve as first officer on the helicopter type in question.

1.5.2.2 The first officer has stated that he slept at least 8 hours and was well rested on the morning of the accident. He drank some tea and had a light breakfast before driving from Barentsburg to Cape Heer at approx. 0900 hrs. The first officer also had a light meal during the stay on the ground in Pyramiden.

Table 3: Flying hours first officer

Flying hours	All types	On type
Last 24 hours	1:17	1:17
Last 3 days	3:17	3:17
Last 30 days	6:45	6:45
Last 90 days	24:40	18:40
Total	1,773	971

1.5.3 <u>Engineer</u>

Male, 54 years' old was an employee in Spark+.

Table 4: Flying hours engineer

Flying hours	All types	Relevant type
Last 24 hours	1:17	1:17
Last 3 days	3:17	3:17
Last 30 days	30:05	30:05
Last 90 days	44:40	38:40
Total	Approx.11,000	10,904

1.6 Aircraft

1.6.1 <u>General</u>

The helicopter type Mi-8 is a medium-sized transport helicopter with two turbine engines. It is produced in a number of versions. From 1961, more than 17 000 have been produced, making the helicopter type the most-produced in the world. The helicopter type has a five-blade main rotor rotating clock-wise, seen from above. The model in question, Mi-8MT, is distinguished from other models by a three-bladed tail rotor on the left side of the tail boom and more powerful engines. As such, it is almost identical to the successor Mi-17.

1.6.2 Data

Type:	Mil Mi-8MT
Serial number:	93521
Production year:	1983
Engines:	2 Klimov TV3-117MT, each of 1,950 hp
Fuselage length:	18.17 metres
Diameter main rotor:	21.29 metres
RPM main rotor:	192 rpm
Maximum take-off mass:	13,000 kg
Relevant take-off mass:	10,298 kg
Location of the centre of gravity:	+140 mm
Total flying hours.	3,419 hours
Fuel:	Jet A-1

The helicopter was equipped to fly under instrument meteorological conditions (IMC).

1.6.3 Detailed information

1.6.3.1 The first officer has stated that there were no technical problems with the aircraft. This is substantiated by examination of the wreckage following the accident where no sign of technical failure was found. For that reason, the Accident Investigation Board has decided not to investigate any further the condition of the helicopter before the accident and the maintenance that had been done.

1.6.3.2 The helicopter had been fitted with an auxiliary fuel tank, bolted to the cabin floor along the left side of the cargo compartment. The fuel tank, which takes 900 litres, was connected to the helicopter's fuel system by a rubber hose.

1.7 Meteorological information

1.7.1 General

In this investigation, the Accident Investigation Board has cooperated with the Interstate Aviation Committee (IAC) to obtain weather information. The information from the Norwegian Meteorological Institute, the meteorologist at the heliport and a meteorological station in Barentsburg has been collocated by the Interstate Aviation Committee. A translation of this account can be found below:

On 30 March 2008, a high pressure area of 1025 hPa was centred over the north-eastern parts of Greenland, while the more north-eastern parts of Svalbard were in a weak low-pressure area. With the north-eastern winds, very cold air spread over the Svalbard islands. In the morning hours, the weather in Longyearbyen and the Barentsburg area fitted well with the synoptic situation: An insignificant cloud cover, more than 10 km visibility, weak wind at ground level from the west, and an air temperature of at least minus 16-18 degrees Celsius were observed.

The weather forecast for Longyearbyen for the period 0600-1200 hrs: Wind 120° — 3 m/s, visibility 10 km, cloud cover 1-2 eights (almost no clouds to few clouds) at 300 metres [1000 feet] and 3-4 eights (scattered clouds) at 900 metres [3000 feet].

In the following hours, weather conditions changed in the Barentsburg and Longyearbyen area. As emerges from the data from vertical radiosonde measurements of the atmosphere carried out in Ny-Ålesund at 1100 hrs and in Longyearbyen at 1300 hrs, the air masses at the time were unstable up to flight level (FL) 130 [13000 feet], which caused the formation of cumulonimbus (Cb). The Cb clouds reached up to FL130 (upper cloud top limit), and resulted in precipitation in the form of heavy snow showers.

Numerical methods for forecast (modelling) of wind parameters gave south-westerly wind at ground level, with speeds between 5 and 20 knots (3-10 m/sec.). At an altitude of 2000 feet (700 metres), the calculation method for wind parameters gave a change in the wind direction from westerly to northerly with speeds of 10-20 knots (5-10 m/sec.).

According to radio sonde data from Ny-Ålesund at 1300 hrs, winds had been observed at an altitude of 2000 feet (700 metres)— 300° and 35 knots (18 m/sec.), and higher up, in FL50 and FL100, winds were 270° and 25 knots (13 m/sec.). Radio sonde data from Longyearbyen at 1500 hrs indicate south/south-westerly winds, 10-15 knots (5-8 m/sec.) at FL50.

The observed data say something about how unstable the wind was, both as regards strength and direction, which may be related to the fact that a squall line [line connecting points with lower pressure than the areas on both sides of the line] passed the western parts of Svalbard and there was Cb activity with heavy snow showers.

Significant weather charts for altitudes from ground level to FL400 (SIGWX SFC-FL400) for 30 March 2008 at 1400 hrs of the west coast of Svalbard, indicated an area of masked Cb clouds (i.e. hidden among layers of other cloud formations) with a cloud base of 150-600 metres and a cloud top of 2100-3300 metres in connection with the passing of the squall axis.

According to the ground observations from Longyearbyen at 1600 hrs, the squall line passed from the north-west to the south-east, resulting in the wind on the ground turning from south-easterly to south-westerly direction at 1500 hrs and to north-westerly at 1600 hrs, while visibility in show showers falling to 1500 metres.

Considering that Barentsburg is south-west of Longyearbyen, the wind on the ground shifted somewhat earlier, between 1505 and 1545, from easterly to north-westerly direction at the Barentsburg helicopter landing site, while visibility in show showers was reduced to 1500 metres, probably in connection with the squall line passing Barentsburg.

Wind speeds increased during constant north-westerly wind direction, and the automatic measuring station of the MILOS 500 type set up in Barentsburg by Murmansk County's hydrometeorological zone observatory, measured wind parameters of 330-340° and 4-5 m/sec. with gusts of 8-9 m/sec. in the period 1545 to 1615 hrs.

Surface chart from 30 March 2008 at 1400 hrs, prepared on the basis of observed data from ground observation stations in the Barentsburg area, showed winds of 300° and 20 knots (10 m/sec.), with 2000 metres' visibility in moderate snowfall.

Data from ground observations and photographs received from weather satellite observations confirm that heavy snow showers were coming in along the west coast of Svalbard in the period up to 1600 hrs, with lighter showers towards the evening.

The synoptic situation which had established itself before the helicopter landed at the landing site in Barentsburg, a situation confirmed by data from ground observations made in Longyearbyen and Barentsburg, by data from vertical radiosonde measurements of the atmosphere in Ny-Ålesund and Longyearbyen, and by weather satellite data, thus indicated brief periods of stronger wind (gusts) at ground level, up to 15-20 kt, with north-westerly wind direction and reduced visibility due to snow showers in connection with Cb activity.

1.7.2 METAR and TAF

Times stated in UTC

1.7.2.1 METAR for Barentsburg (ENBA) given to the crew before departure on 30 March:

301350Z 36006KT 2000 SHSN VV005 M13/M14 Q1011=

1.7.2.2 METAR for Barentsburg (ENBA) at the time of the crash on 30 March:

301400Z VRB02KT 2700 SHSN VV005 M13/M14 Q1011=

1.7.2.3 METAR for Longyearbyen (ENSB):

301250Z 25006KT 4000W –SN FEW015 BKN025 M13/M14 Q1010 RMK WIND RWY28 11010KT=

301350Z 20010KT 600W VCSH FEW015 SCT025 M13/M18 Q1011=

301450Z 01009KT 310V070 1500 SHSN VV012 M12/M15 Q1011 TEMPO 1000 SHSN VV008=

1.7.2.4 TAF for Longyearbyen (ENSB):

ENSB 301100Z 301218 12005KT 999 FEW010 SCT030 TEMPO 1218 300 –SN BKN014=

1.7.3 Witness observations

1.7.3.1 The attendant in the tower on Cape Heer has explained to the Accident Investigation Board that the weather on the morning of the day of accident was cold and clear with no precipitation. After RA-06152 had landed in Longyearbyen, the tower attendant was in contact with the commander and stated that it had started to snow. During showers, visibility was reduced to 1,500 metres. Closer to the time of the accident, there were signs that the general weather was improving, but the snow showers were more intense. The cloud base was 150 m and the wind was northerly. He observed the wind indicator during the landing and saw that it varied between 350 – 360° 0 – 3 m/sec. The registration frequency for the wind indicator was according to the attendant then set to 5 seconds during landings, as opposed to the normal frequency which is 2 minutes. When the landing took place, the window of the tower cabin blew shut, which may indicate that the wind was occasionally more powerful.

1.7.3.2 The accident happened in daylight conditions.

1.8 Aids to navigation

According to the Norwegian Civil Aviation Authority's inspection report, the heliport was equipped with a radio beacon (Non Directional Beacon – NDB) with the call sign “EN”. The radio beacon was not relevant to the accident, and no investigation has been made into the function of the equipment.

1.9 Communication

1.9.1 The helicopter had two VHF radios that were normally set to communicate with Cape Heer (126.000 MHz) and Longyearbyen (118.100 MHz), respectively. The same radios could also be used for communication on the emergency frequency 121.500MHz.

1.9.2 The tower at Cape Heer had two VHF radios that were normally set to the Cape Heer (126.000 MHz) and Longyearbyen (118.100 MHz) standard frequencies. The same radios could also be used for communication on the emergency frequency 121.500MHz. The radio that was normally used on the 126.000 MHz frequency was equipped with a VHF direction finder (VDF), but, according to the attendant, this was not working at the time of the accident.

1.9.3 During the first part of the flight, two-way communication was established between RA-06152 and air traffic control in Longyearbyen. During the last part of the flight, normal two-way communication was established between RA-06152 and the tower attendant at Cape Heer.

1.10 Airports and aids to navigation

1.10.1 The Cape Heer heliport is situated 3.5 km north of Barentsburg. The heliport was built in the 1970s with two hangars, an administration building, a control tower and radar. The heliport was modern at the time and had relatively high activity. In recent years, however, the heliport has been characterised by lack of maintenance and activities have been limited to the operation of one helicopter. The Norwegian Civil Aviation Administration gave a permit for use of the helicopter heliport with certain restrictions on 1 August 1980. At the time of the accident, the heliport was owned and operated by the Russian mining company Trust Arktikugol.

1.10.2 On 16 October 2007, the Civil Aviation Authority inspected the heliport. According to the inspection report, the helipad itself consisted of a 90 x 21 metre concrete platform in an east-west orientation. This pad, to the far east of the heliport, was the final approach and take-off area (FATO) and the touchdown and lift-off area (TLOF). There was an eight-metre wide taxiway between the concrete platform and the hangars, running to an apron of approx. 96 x 62 metres in front of the largest hangar (see Figure 1). The largest hangar is 96 metres long, 32 metres wide and 8 metres tall.

1.10.3 During the inspection in 2007, the Civil Aviation Authority identified several nonconformities in relation to regulatory requirements described in Norwegian Civil Aviation regulations (BSL) D, E and G. The nonconformities included that the manoeuvring area was poorly cleared of snow and hard to see. There were comments relating to insufficient marking of the landing area (FATO/TLOF) and obstacles in the approach from the west.

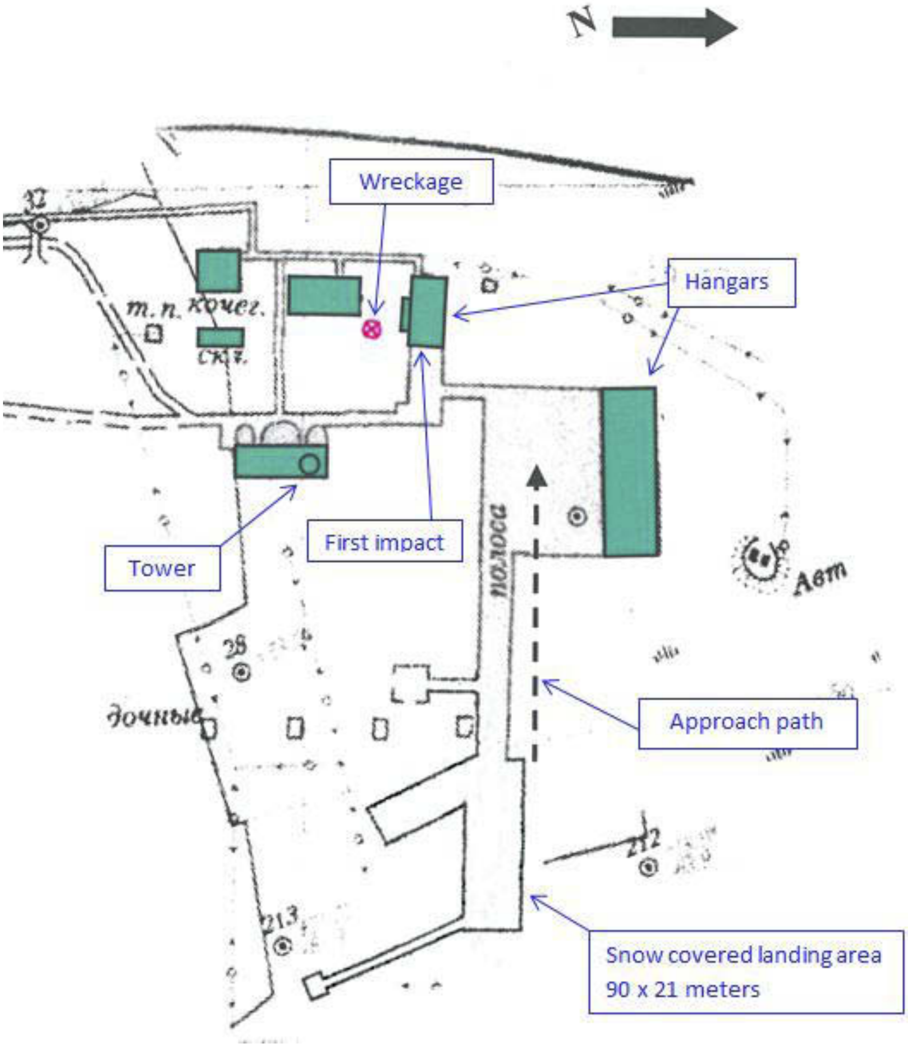

Figure 1: Drawing of the heliport.

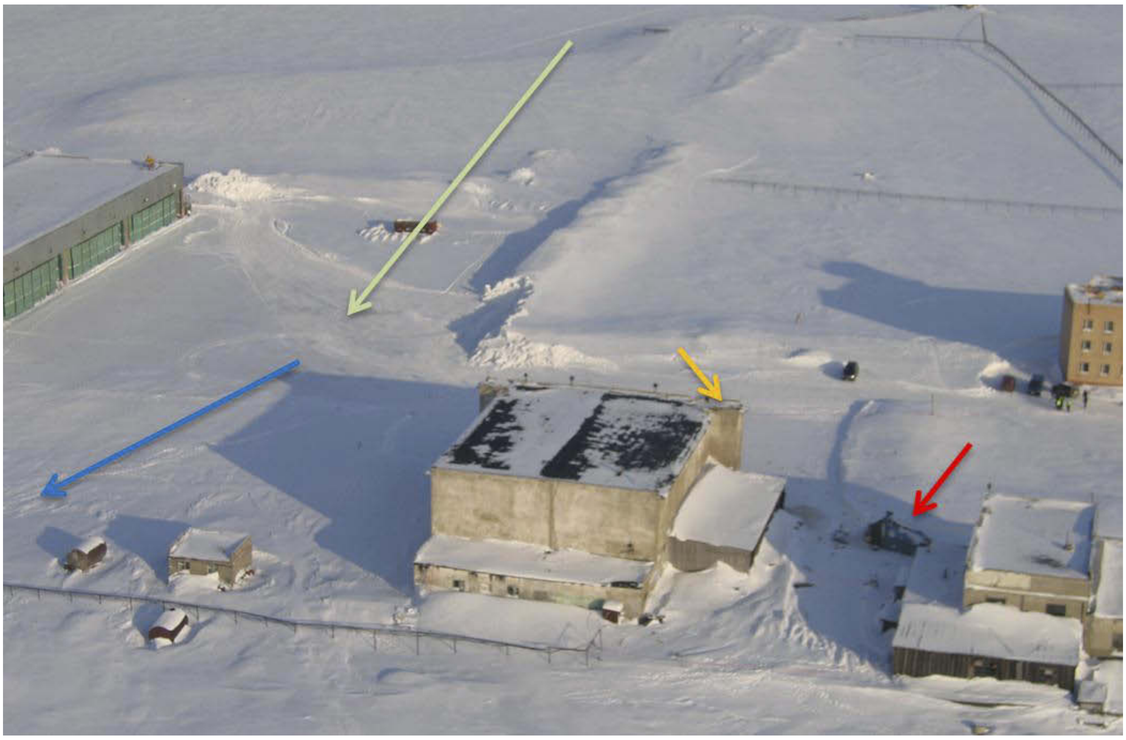

Figure 2: The heliport seen towards east-northeast. The light green arrow shows the approach direction towards the planned landing site. The blue arrow shows the planned route in the event of a balked landing. The yellow arrow marks the impact on the smallest hangar. The red arrow points to the helicopter wreckage. The picture was taken three days after the accident, after parts of the snow ridge near the landing site had been removed.

1.10.4 The taxiway and helipad had not been cleared of snow when the accident happened. Departures and landings therefore took place at the platform in front of the largest hangar. Most of the area between the hangars had been cleared of snow and were surrounded by snow ridges that were high in places. After the accident, a part of the snow ridge nearest to the landing site was removed (see Figure 2).

1.10.5 The outer edge of the platform and a taxiway between the hangars had been marked with 13 blue lights. Four of the blue lights formed a line parallel to and 62 metres from the large hangar. The distance between these four lights was 32, 32, and 22 metres. A white flashing light had been installed 1,000 m due east of the heliport. A wind sock 350 metres east of the tower, and one on the roof of the large hangar, were both illuminated. There were also red lights on the roof of all the buildings. However, several of these lights did not work.

1.10.6 The heliport is situated approximately 25 metres above sea level and 100 – 150 meters from the edge of the sea at the mouth of the Grønfjorden.

1.10.7 The heliport was equipped with wind measuring equipment on the roof of the tower cabin, which was indicated on an instrument in the tower cabin.

1.10.8 The heliport is located in uncontrolled airspace, Class G. The tower only serviced Spark+ and was only manned in connection with Spark+ flights. Due to language problems, there was no regular telephonic contact with the air traffic service in Longyearbyen and the staff in the Cape Heer tower. Communication concerning flights normally took place via fax between air traffic service in Longyearbyen and the meteorologist on Cape Heer. The meteorologist was stationed in an office in the same building as the control tower.

1.10.9 The landing site was inspected visually on all days with planned flights. Any fresh snow was also cleared in that connection. The maximum permitted snow depth, if a flight was scheduled, was 50 mm.

1.11 Flight recorders

1.11.1 Cockpit voice recorder

1.11.1.1 The helicopter was equipped with a model MC-61 cockpit voice recorder (CVR). The unit's serial number was 295600. The recorder recorded one channel on a thin magnetic steel wire. The wire is stored on reels and passes from a full to an empty reception reel during recordings. A new reel must be installed when the tape is used. The recorder was located at the back of the cabin, in an area that was severely damaged in the accident. The lid covering the reels had been knocked off, and both recorder reels had been thrown out during the accident. Four back-up reels were also found in the snow near the wreckage. A total of six reels were therefor secured in connection with the investigation.

1.11.1.2 The six reels were sent to the Interstate Aviation Committee (IAC) in Moscow for playback. The wire on the active reel had been torn and tangled. Engineers at the laboratory were, however, able to connect the pieces properly and obtain information from the recordings. This information was useful in the investigation.

Figure 3: Two reels with tangled wire.

1.11.2 Flight data recorder

1.11.2.1 The helicopter was equipped with a model SARP-12 flight data recorder (FDR). It was equipped with a filmbased type KS-05 storage unit with serial number 1293508-2. The flight recorder was located at the back of the cabin, in an area severely damaged in the accident, but the storage unit was undamaged.

1.11.2.2 The storage unit was sent to the IAC in Moscow for playback. As the storage unit is based on photographic film, the film must be changed when exposed. It turned out that the film in question had not been changed as prescribed, but rewound and double-exposed. Using experience and meticulous work, the engineers at the laboratory were, however, able to obtain the stored information.

1.11.2.3 The flight data recorder recorded the rotor rpm, the main rotor blade angle, aircraft pitch and roll, as well as speed. The graphs from the last minute of the flight have been reproduced in Appendix B. The times under the graphs have been given as if the crash time was 1400 hours. They have not been correlated with the relevant time of the accident. The time from the helicopter aborted the landing and until it hit the hangar wall has been estimated to 14 seconds. A brief description of the content is provided below:

- The rotor rpm varied between 95% and 97% right up to the balked landing was initiated, when the rpm at one time came down to 93.7%.

- The main rotor blade angle varied between 7.0° and 9.7°. A marked increase from 7.0° to 9.4° over a period of less than a second occurred at the time the Accident Investigation Board believes the commander decided to abort the landing. After the helicopter hit the hangar wall, the angle increased markedly to 13.9°.

- The pitch of the helicopter reduced from approx. +5° (nose up) to approx. 0° during the approach and transition to hover. In connection with the acceleration following the aborted landing, the pitch at one time was 2.9° nose down. After hitting the hangar wall, the helicopter's pitch went off the scale.

- The helicopter's roll varied little during the approach, with a left bank of 5.5° as the most noteworthy exception. After hovering for a period, the helicopter banked markedly to the right three times in connection with the initiated balked. The most marked of these was 14°. After hitting the hangar wall, the helicopter banked severely to the left, at values off the scale.

- The helicopter approached with an indicated airspeed of approx. 30 km/h gradually reduced to a stationary hover. The only exception was a brief abrupt increase in airspeed from 30 to 62 km/h during the approach, about 40 seconds before the helicopter hit the hangar wall. During the balked landing, the helicopter briefly had an airspeed of 20 km/h before accelerating to 50 km/h before hitting the hangar wall. During the draft report consultation, the IAC remarked that airspeed readings below 60 km/t are unreliable.

Figure 4: The flight data recorder storage unit (cassette containing photographic film).

1.11.3 Global Positioning System (GPS)

The helicopter was equipped with a Garmin 128 GPS. The unit was examined with the aid of Norwegian police experts. It became clear that the automatic tracking function had been turned off, and that the GPS contained only the coordinates for the last waypoint, i.e. the accident site.

1.12 The accident site and helicopter wreckage

1.12.1 The crash site

1.12.1.1 The tower attendant estimated that there was approx. 18 – 22 mm of dry, powdery snow on the landing site at the time of the accident.

1.12.1.2 The helicopter first hit the upper south corner of the front of the smallest hangar. Clearly visible scrape marks could be seen in the green plank wall. Blue colour from the helicopter had also been scraped onto the concrete in multiple locations. Figure 5 also shows missing roof tiles and other damage to the roof, but some of this was most likely not caused by the accident. Pieces of Plexiglas were found on the hangar roof.

1.12.1.3 The 12-metre tall hangar is approx. 100 metres from the intended landing site. The point of impact on the hangar corresponded to a sideways movement to the left of 75 metres or a change in course of approx. 50° to the left in relation to the straight approach path of 270° followed by the helicopter. The gap between the two hangars was 88 metres (see Figure 1).

Figure 5: The point of impact on the south (left) corner of the hangar. The green arrow indicates the direction from which the helicopter approached, and the red arrows show blue colour deposited on the concrete. After the impact, the helicopter continued to the left as indicated by the blue arrow.

1.12.1.4 Figure 6 shows impact marks from the main rotor in the hangar wall. A total of six separate impact marks from the rotor can be identified. The first clear impact mark slopes approx. 15° down relative to the horizon, while the last clear mark points approx. 55° down. The helicopter did not come into contact with the underlying building which extended 9 metres from the hangar wall, but hit the ground approx. 11 metres from the extension. The helicopter wreckage came to rest on packed snow and ice, 4 metres from a garage.

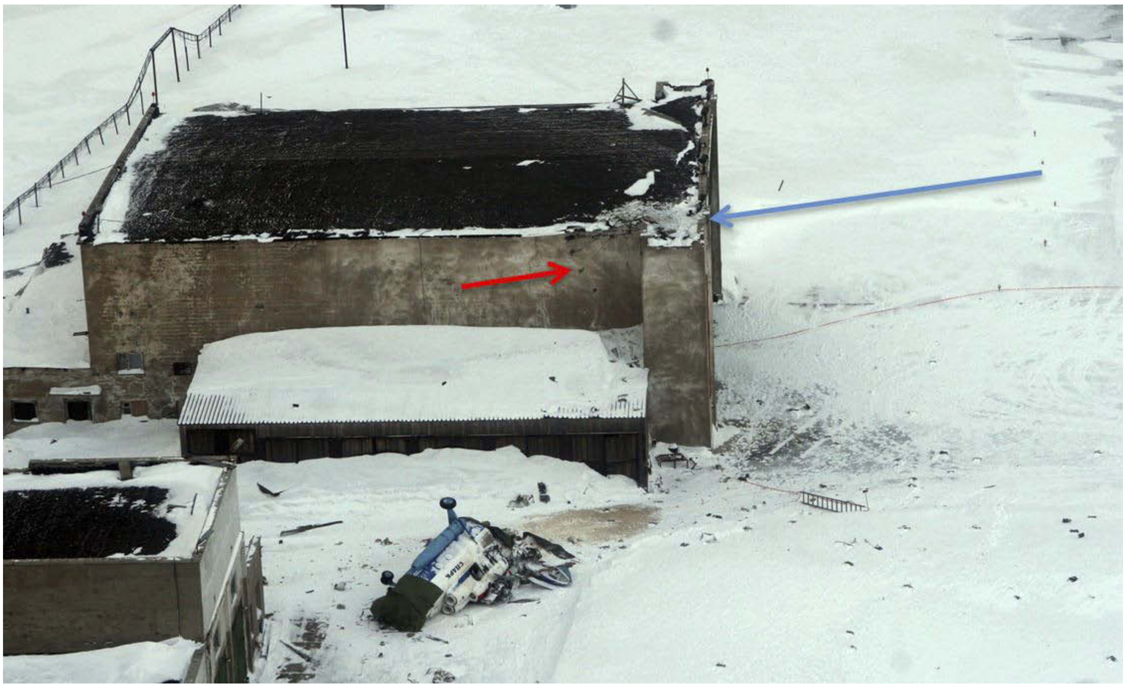

Figure 6: The hangar seen from the south. The blue arrow indicates the direction from which the helicopter approached. The red arrow shows impact marks from the main rotor in the hangar wall. The wreckage is on the ground in the foreground of the picture. Large amounts of fuel mixed with snow can be seen between the hangar and the wreckage.

1.12.2 The helicopter wreckage

1.12.2.1 *General*

The helicopter wreckage ended up lying on the left side, mostly in one location. A number of parts, especially from the main rotor blades, had been thrown about in a radius of approx. 50 metres. Outside of this area, three larger sections of the main rotor blades were found, one lying 100 metres from the main wreckage. The damage to the helicopter was mostly limited to the front and left side of the cockpit, the main rotor, the area between cabin/cargo compartment and tailboom, as well as the tailboom.

Figure 7: Picture of the helicopter taken shortly after the accident. Note the four marked impact marks from the main rotor in the hangar wall.

1.12.2.2 *Cockpit and cabin/cargo compartment*

The front of the helicopter had been smashed in and parts of the radome torn off. Some parts of the cockpit were severely damaged on the left side. Several window panels on the left side of the cockpit were broken and both instrument panels had come loose and been displaced (see Figure 7 and Figure 9). There were minor traces of green paint on the front of the helicopter, corresponding to the colour on the hangar.

The cabin/cargo compartment was mostly undamaged. The two clamshell doors at the rear of the cabin/cargo compartment had been torn off and were lying loose on each side directly behind the helicopter. The fuel tank fitted along the cabin wall in the cargo compartment had come loose from its attachments and was lying directly behind the cargo compartment, between the clamshell doors. Damage to the tank attachments shows that it was torn out backwards. Folding seats had been installed along the walls in the cabin/cargo compartment. The seats and seatbelts were hanging down from what became the ceiling after the helicopter had tipped over. Only one double seat had been installed on the left side, also with seatbelts.

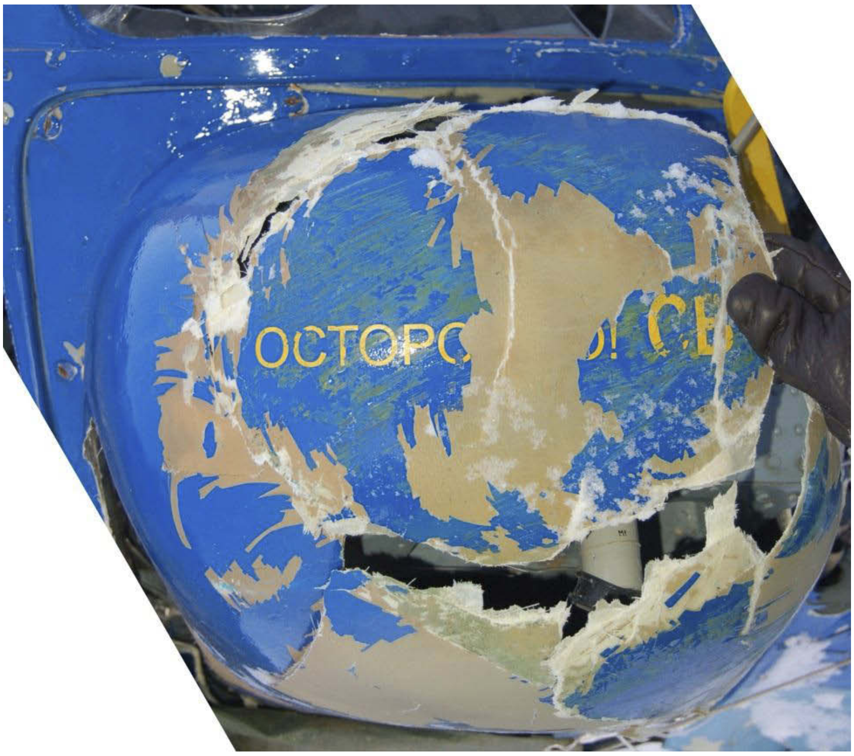

Figure 8: Parts of the radome had been torn off. The picture shows the dome after it was put back in place. Green paint from the hangar wall was deposited on the cover.

1.12.2.3 *The main rotor*

All main rotor blades had come loose from the spindles. The longest remaining rotor blade section found was approx. 2 metres.

1.12.2.4 *The engines*

With the exception of minor foreign object damage to the compressor, the engines did not appear to be damaged.

1.12.2.5 *The tailboom*

The transition from fuselage to tail boom was severely deformed. In this area, the tailboom had been bent completely to the left, pointing in the direction of flight, lying partly under the helicopter.

The tailboom was relatively intact between the forward deformed section and back towards the vertical fin. The vertical fin, including the tail rotor gear box and tail rotor, had been torn loose from the rest of the tailboom. The support that prevents the tailboom and tail rotor from hitting the ground was, however, practically undamaged (see Figure 9). Both horizontal stabilisers at the back of the tailboom had detached.

There was little damage to the tail rotor. One tail rotor blade was almost undamaged, one blade was bent in an even curve and one blade had a minor deformity. The tail rotor drive shaft had separated in the transition between fuselage and tailboom, and in the transition between tailboom and vertical fin.

Figure 9: The damage on the left side of the helicopter. The tail rotor and the undamaged support at the rear of the tailboom are marked with red arrows.

Figure 10: The damage in the transition between fuselage and tailboom. The tailboom and tail rotor on the left in the picture.

1.13 Medical and pathological information

The three persons killed were autopsied at the pathological anatomical department at the University Hospital in Tromsø. The reports concluded that the cause of death for all three were extensive crushing injuries. For the commander and passenger, this also included extensive head injuries. Analysis of blood samples from the engineer showed traces of pharmaceuticals. The concentrations were low and compatible with ordinary use of medicines. The importance of this finding is characterised as uncertain and most likely without significance.

1.14 Fire

No fire occurred during the accident. The auxiliary tank in the cargo compartment was torn out, causing a major fuel leakage. The fuel spilled out in the snow, but posing minimal fire hazard in the cold weather.

1.15 Survival aspects

1.15.1 It is somewhat uncertain who was wearing seatbelts in the helicopter. The commander most likely wore seatbelts that were opened during the rescue work. The first officer wore seatbelts and managed to unfasten these before getting out. The engineer was not wearing a seat belt and was partially thrown out of the cockpit during the crash. The flight technician who sat in the cabin/cargo compartment on a folding seat, with his back to the cockpit wall, has explained that he did not use the installed seatbelts. Several other passengers were tossed around the cabin/cargo compartment during the crash, and it is therefore unlikely that they wore seatbelts. The Accident Investigation Board found no damaged seatbelts in the cabin/cargo compartment.

1.15.2 No one in the helicopter wore a helmet.

1.15.3 The helicopter was equipped with an ARM 406P emergency locator transmitter (ELT), which transmits on frequencies 406.025 MHz and 121.500 MHz. The emergency locator transmitter activates automatically when exposed to vertical loads of 5±0.3 G. It can also be activated manually, but this was not the case during the accident. There is no information to indicate that the emergency locator transmitter was activated (see Item 1.1.19).

1.15.4 People came to the scene immediately following the accident. The injured were put on stretchers and cared for until more personnel and an ambulance arrived from Barentsburg. The injured were then taken to the hospital in Barentsburg. The Svalbard Governor's office was notified of the accident at 1610 hrs, and a Super Puma helicopter from the Governor's office arrived with two doctors and police on Cape Heer at 1715 hrs. It then became clear that one of the injured who was in hospital in Barentsburg had died. Two of the other injured in the hospital were flown by helicopter to Longyearbyen, and then by plane to the University Hospital in Tromsø that evening.

1.15.5 According to a report prepared by the Civil Aviation Authority in connection with the inspection in the autumn of 2007, no special plans had been prepared for handling accidents at the heliport. There were, however, general plans for handling accidents in the Barentsburg area, e.g. in connection with mining operations. Except for hand-held fire extinguishers and stretchers, there was little equipment available at the heliport for handling accidents. The heliport had no fire truck, and a fire truck from Barentsburg would use five minutes to reach the port.

1.16 Tests and research

None.

1.17 Organisational and management information

1.17.1 Supervision

1.17.1.1 According to the 1920 Svalbard treaty, Norway has sovereignty over the Svalbard archipelago. Signatory states are entitled to exploit natural resources on the islands. The highest local authority in the archipelago is the Governor of Svalbard. The Russian company Trust Arktikugol started mining operations in Barentsburg in 1932. Barentsburg has since been a Russian mining town, and had a population of approx. 400 in 2008.

1.17.1.2 In principle, the Civil Aviation Authority supervises aviation on Svalbard as in the rest of Norway. This means that licences must be applied for in accordance with Section 7-5 of the Aviation Act to build, operate or own a landing site. In accordance with Section 2-2 of the Aviation Act a permit is requires to operate commercial flights within Norwegian territory.

1.17.1.3 Helicopter operations in connection with Russian mining operations on Svalbard were long considered a purely Russian concern. In time, enforcement of the Aviation Act has been given stronger emphasis. As such, the Cape Heer heliport was given formal approval by the Civil Aviation Authority in 1980, but a strict enforcement of applicable requirements was not considered practical. According to the Civil Aviation Authority, closing the landing site could result in the helicopter traffic moving to more primitive natural landing sites without licence requirements. The Civil Aviation Authority therefore atempted to establish a dialogue with the mining company to remedy the nonconformities and implement corrective measures.

1.17.1.4 In November 2007, Spark+ applied to the Civil Aviation Authority to operate RA-06152 on behalf of Trust Arktikugol. The use would be limited to the mining company's commercial and scientific activities. On the basis of the application, the Civil Aviation Authority granted a permit for Spark+ to operate flights in connection with the mining company's operations.

1.17.2 The helicopter company

1.17.2.1 The Trust Arktikugol mining company owns and operates the Cape Heer heliport. Trust Arktikugol has assigned the responsibility for the mining company's helicopter operations to the helicopter company Spark+. The helicopter company Spark+, with a main base in St. Petersburg, had about 100 employees and operated 7 helicopters at the time of the accident. Three of these helicopters belonged to Trust Arktikugol, but only RA-06152 was airworthy at the time of the accident. Normally, there was one flight crew, two licensed aircraft technicians and a licenced engineer on Cape Heer. In addition, the tower attendant was also a Spark+ employee. The commander who died in the accident was also the heliport manager.

1.17.2.2 Crews working for Spark+ normally stayed in Svalbard for three months at a time, maximum four months. During the summer months, the crew flew 25 – 30 hours per month. The corresponding figures for the winter months were approx. 10 hours.

1.17.2.3 The helicopter company's deputy director general had extensive experience with the helicopter type Mi-8 and winter operations. He emphasised that the flights on Svalbard should follow visual flight rules and has described to the AIBN how operations were supposed to be carried out. If the pilot lost visual references during landing in white-out, he should convert to instruments, climb and fly straight ahead. The other pilot should look out, but also monitor helicopter attitude and vertical speed. The engineer should monitor rotor rpm and the radar altimeter.

1.17.2.4 The deputy director general believed that it was inadmissible to stop in low hover in an area with powdery snow. In this case the helicopter started a descent too soon after the hover. He would rather remain in high hover and gradually descend as the snow blew away, as is common practice on unprepared. This assumes good visual references to contrasting objects. At known prepared sites, such as Cape Heer, he would have made an shallower approach maintaining speed and touched down before the drifting snow could catch up with the helicopter.

1.17.2.5 During draft report consultation, the AIBN received the following comment from IAC describing company operational procedures:

> *The helicopter company's Flight Crew Operations Manual contains standard operational procedures that strictly comply with the Helicopter Flight Manual (Flight Operations Instruction). These procedures do not allow hovering lower than 20 meters when approaching to land with whirled snow. To make such hovering possible at this altitude the procedures imply that in case conditions for snow whirl formation exist at the landing site the crew shall estimate the helicopter flight weight in such a way as to make it compatible with such conditions by the time of the approach. According to the procedures, the priority way of escaping the snow whirl is by performing a vertical climb until visual references are back in sight. The actual weight and available engine thrust of the Mi-8MT RA06152 made this maneuver possible. Besides, in case of snow whirl conditions the crews are recommended to select the approach direction in such a way as to avoid crosswind component from the right. If the landing site is long enough the crews are recommended in case of snow powder to approach for landing with a short run on order to avoid the snow whirl catching up with the helicopter before it lands. Besides, the helicopter company's crews are trained to land vertically without hovering, with the longitudinal speed totally damped as the helicopter touches the ground.*

1.17.2.6 During draft report consultation, the AIBN received the following comment from IAC regarding company descriptions of crew actions:

> *The Flight Operations Manual for Mi-8 helicopter, Para 4.9 "Peculiarities of flights at dusty, sandy and snow-covered landing sites" provides detailed description of the crew actions during a rejected takeoff/landing due to loss of visual references.*
>
> *The Instruction on Crew Resource Management for Mi-8 helicopter, Chapter "General", Para 2 describes the actions of flying and monitoring pilots. The non-flying pilot is obliged to monitor the helicopter systems; during the takeoff, approach and landing they shall keep hands and feet on the relevant control levers without pressing them, and in case of any deviation from the target flight parameters they shall help to recover by giving input to the flight controls.*

1.17.2.7 The deputy director general knew that turbulence could arise in strong winds due to the location of the hangars near the landing site. This should have been taken into account. Further, he believed that this would be easily recognized in the helicopter.

1.17.2.8 The deputy director general stated that the accident was the first fatal accident in the history of the company.

1.17.2.9 In 2010 Spark+ Airline changed its name to “GazAvia”. The company stopped its operations at Svalbard in 2012.

Figure 11: The Governor's Super Puma landing at the accident site. The helicopter is in high hover and blowing away the snow.

1.18 Additional information

The Russian company Aeroflot experienced an accident with many similarities near Pyramiden on Svalbard on 27 March 1991. A helicopter of the same type as RA-06152 was flying miners between the mining community Pyramiden and Longyearbyen when it crashed during the approach to Pyramiden. The crew lost visual references under marginal weather conditions during a steep banking left turn. The helicopter hit the sea ice with the left side of the cockpit (cf. report SL 1991/06). The following is quoted from the report:

> *“The commander, in the left seat, died in the collision. The engineer, who was not using seatbelts, was thrown out of the cockpit. He died two hours after arriving in hospital in Pyramiden. The first officer, in the right seat, was injured, but survived the crash.”*

1.19 Useful or effective investigation techniques

No methods qualifying for special mention have been used in this investigation.

2. ANALYSIS

2.1 Introduction

2.1.1 Based on investigation results and interviews with persons involved, the Accident Investigation Board has concluded that malfunctions in the helicopter were not a factor in the accident. The investigation has shown that the accident, with great likelihood, was caused by operational factors. The analysis will accordingly focus on the weather conditions, visibility conditions during the landing and operational factors which probably caused the helicopter to hit the hangar. Survival aspects are an additional important aspect.

2.1.2 An overall assessment of the weather conditions during the relevant flight shows that it was, except for during the heaviest snow showers, possible to fly according to visual flight rules. The Accident Investigation Board accepts the first officer's statement and concludes that the flight proceeded routinely and without noteworthy problems up to reaching the heliport on Cape Heer.

2.2 Execution of the approach and the balked landing

2.2.1 The flight crew had experience from Svalbard and therefore also experience with the challenges potentially posed by powdery snow. They anticipated approx. 6 kt of wind from the right during the landing, but expected probably not gusts up to 18 kt. They were also aware that the helicopter would whirl up snow in connection with the landing, and that this could obscure the visual references that were required to land the helicopter safely. The crew had prepared for the problem of whirling snow, and agreed to alert the other crew members if they lost visual references. The first officer was prepared that the drifting snow would catch up with the helicopter and at first looked back to monitor the situation.

2.2.2 The Accident Investigation Board believes that the crew used an unsuitable procedure during the approach. If conditions permit, the approach and landing can be carried out as recommended by the deputy director general (see Item 1.17.2.4), i.e. quickly enough to avoid the drifting snow from catching up with the helicopter before the wheels are safely on the ground. Alternatively, the loose snow should be blown away while the helicopter remains in high hover with good visual references. During the landing in question, it seems that the crew applied a mix of these two methods, ending up just above ground without visual references.

2.2.3 The Accident Investigation Board assumes that the commander aborted the landing just before the helicopter touched down. It is unclear whether he took the decision due to advice from the other crew members or if he lost visual references himself.

2.2.4 The Accident Investigation Board believes that there were major deficiencies in the crew's cooperation during the landing. The commander aborted the landing without informing the rest of the crew, leaving the first officer to guess what was going on. The first officer had no agreed-upon role during the balked landing, and the commander did not assign any tasks. This left the commander alone to handle a demanding situation.

2.2.5 A balked landing as a result of losing visual references entails risk, especially at low altitude and between obstacles. Without visual references, it becomes necessary to fly on instruments only, a demanding transition that can make the navigation of the aircraft somewhat inaccurate in a transition phase. The point of collision with the hangar was about 75 meters left of the desired track. This was equivalent to an approx. 50º course deviation. The Accident Investigation Board believes this could have been caused by two factors, which are analysed below.

2.2.6 The Accident Investigation Board estimates that the helicopter flew approx. 14 seconds without visual references. If crosswind wasn’t compensated for by the crew, an average wind of 5,3 m/s (10,4 kt) from the right could theoretically have moved the helicopter as much as 75 meter sideways to the left of planned course. The helicopter mass would have slowed down this sideways movement, but meteorological data shows that the wind in periods gusted up to 9 m/s. This helps substantiate such a drift. Damages to the helicopter front and the sideways scratches on the radome indicate that the helicopter hit at an angel of approx. 90° and with a sideways movement. This supports the theory that the helicopter drifted sideways due to the wind.

2.2.7 There is also a possibility that the helicopter during the balked landing deviated from the intended course due to insufficient pedal compensation when the engine power was increased. The helicopter will automatically turn in a direction opposite of the main rotor (i.e. left) when the engine power is increased (raising collective control). With available external visual references, the pilot compensates for this instinctively, but when references are lost, an unintended course change easily occurs. The Accident Investigation Board has no recorded data or other information that may determine why the helicopter deviated from the planned course. Hence, it cannot be established whether the deviation was caused by the wind, insufficient pedal compensation, or a combination of these factors

2.2.8 The flight recorder data shows that the main rotor blade angle during the approach and attempted landing varied between 9.7º and 7.0º. In connection with the engine power increase during the balked landing, the blade angle increased to 9.4º, but then decreased to 8.1º over the next seconds. This can indicate that the commander was cautious when increased engine power, and that it then was allowed to drop. The Accident Investigation Board believes that this indicates hesitation on part of the commander, contributing to the departure angle becoming shallow enough for the helicopter to climb only 10 metres over a distance of more than 100 metres. What seems like hesitation might also indicate that the commander reverted to the more cautious approach previously used on the less powerful Mi-8T helicopter.

2.2.9 The Accident Investigation Board would like to emphasise the importance of having detailed and thoroughly prepared operational procedures which describe the standards for balked landings following loss of visual references. These procedures must also describe different crew tasks in detail. Lack of standardisation is detrimental to education, training and crew cooperation. A common way of reducing the challenges inherent in the demanding transition from visual to instrument flying is allocating the pilot that is not flying the helicopter to monitor the instruments. That pilot can then take over control immediately if the pilot flying loses visual references. It seems like company procedures in this aspect was somewhat imprecise and they were not completely adhered to.

2.3 The landing site

2.3.1 The Accident Investigation Board believes that factors concerning markings, snow clearing and obstacles in the departure route were also of relevance for the accident. Good snow clearing and marking of the landing area are factors that contribute to reducing the risk of landings in snowy weather. When the helicopter came in to land, the landing site was completely white and covered in a layer of powdery snow. Figure 2 shows approximately how the snow conditions were at the time of the accident. The visual references then consisted of the surrounding buildings, the row of four blue lights to the commander's left, and any tracks and shades in the snow directly below the helicopter.

2.3.2 During the landing at the landing site in question, the helicopter had a departure zone free of obstacles between the buildings that was 88 metres wide. By altering the course to the right directly after departure, the distance to the obstacles could be further increased. With good visual references, the hangars did not pose any significant risk. In this accident, these references were not available, and the helicopter could change course or drift without the crew discovering this. The distance to the obstacles in the departure path accordingly became a safety-critical factor. The original helipad farther east on the heliport was not cleared of snow. If this area had been cleared of snow and used, the distance from the landing site and to the nearest obstacle would have been significantly longer than was the case. This would also have made it possible to use the method where you approach faster and touch down before the drifting snow catches up, i.e. a rolling landing. The Accident Investigation Board therefore believes that the accident could have been avoided if the helipad east on the heliport had been cleared of snow and used.

2.4 The collision

2.4.1 Based on the damage on the hangar and the helicopter, the Accident Investigation Board believes that the radome in the nose of the helicopter impacted first on the top left of the green field of the hangar (see Figure 5). As mentioned earlier, it is difficult to say anything certain about the course and sideways movement of the helicopter when it hit the hangar. The damage to the radar was limited and the Accident Investigation Board believes that the forward speed upon impact was low. Sideways movement towards the left during impact probably caused the tail to swing to the left. The helicopter must then have moved south along the hangar wall, tail first, until the hangar corner. During its passage, it did not tear down the floodlight on the roof (see Figure 5), nor did it cause significant damage to the extending concrete sections[4].

2.4.2 The helicopter then tipped over to the left along its longitudinal axis, resulting in the main rotor impacting hard on the south wall of the hangar. The rotor blades on the left side of the helicopter hit the wall going forward[5] and made distinct marks. With reservations concerning the rotor rpm at the time, the main rotor rotated at a rate of approx. 3.2 revolutions per second. A five-bladed rotor will accordingly hit the wall 16 times during a second, an impact every 0.063 seconds. If so, four of the marks on the hangar wall show that the rotor angle changed approx. 40° over 0.19 seconds. This equals a change in angle of approx. 213° per second. In other words, the helicopter rolled very quickly to the left along its longitudinal axis while falling backward down from the hangar wall.

[4] When the hangar doors open and are pushed to the side, the doors are gathered in these rooms on each side of the hangar front.
[5] Seen in relation to the helicopter's normal flight direction.

2.4.3 The remaining kinetic energy after the collision with the hangar, combined with the counter force which arose when the main rotor hit the hanger, caused the helicopter to continue out past the underlying roof. The helicopter then hit the ground with the tail at an angle down towards the ground. A rotation around the longitudinal axis of an estimated 270° resulted in the helicopter hitting the right side of the tail. This protected the tail rotor and the tail support so that they only suffered minor damage. The weight of the helicopter during the sudden stop against the ground then bent the tail boom powerfully to the left. At this time, the fuel tank came loose in the cabin/cargo compartment and the two rear clamshell doors came off. The helicopter's kinetic energy then caused the helicopter to tip over and fall down on the left side. During this process, the tail was bent completely up along the side of the helicopter fuselage.

2.4.4 The first powerful impact probably occurred when the helicopter hit the ground after the fall from the 12-metre hangar. Although the tail absorbed some of the forces, passengers and luggage were thrown backwards in the cabin/cargo compartment. The next powerful impact was when the helicopter fell down on the left side. The helicopter cabin, including the cockpit, is approx. 9 metres long, and the cockpit was particularly damaged when it fell almost 9 metres to the ground as the helicopter tipped over to the side.

2.5 Survival aspects

2.5.1 Fire

The Accident Investigation Board has not investigated what caused the engines to stop in connection with the crash. The left engine must have stopped almost immediately, as there are no clear marks of heat impact in the area where the engine's exhaust system was facing the ground. The fact that the engines stopped immediately was a contributing factor to avoiding a fire in connection with the crash. Other factors included the cold and the snow on the ground. The major fuel leak that occurred in connection with the auxiliary tank being torn off, took place behind the wreckage. The fuel spilled onto the ground near the auxiliary fuel tank, mixed with the snow and limited the fire hazard in the cold air. In addition, this fuel did not come near any obvious ignition sources. The fact that no fire started was decisive to enable the persons on board the helicopter to evacuate without suffering further injuries.

2.5.2 Use of seatbelts

2.5.2.1 Several of the persons on board were not wearing seatbelts. Use of seatbelts, especially in connection with take-off and landing, is elementary to reduce injuries. The Accident Investigation Board believes that both the engineer and the passenger would probably have survived if they used seatbelts and had been buckled into their seats. The forces of the crash were modest, relatively speaking. Each individual impact was survivable if the two persons had been secured to their seats and not tossed around.

2.5.2.2 When the helicopter fell backwards on the ground, the passengers that were not buckled in their seats were most likely thrown backwards in the cabin/cargo compartment with great force. The g-forces that occurred were powerful enough to tear loose the fuel tank in the cargo compartment. The Accident Investigation Board believes that mere chance decided who died or was injured and who hit soft objects and avoided injury. The engineer was pushed against the door between the cockpit and cabin/cargo compartment and was therefore probably still unharmed at this stage.

2.5.2.3 When the helicopter tipped over, the left side of the cockpit was smashed in. The commander sat buckled up, but had minimal protection against impact from the left. The engineer, however, was thrown out of his seat and suffered major crushing injuries. If he had been buckled in his seat, the chances of survival would have been significantly increased.

2.5.2.4 The fact that the engineer did not use his seatbelts is a cause for concern. The fact that the engineer involved in the accident near Pyramiden in 1991 was not buckled up either (see Chapter 1.18) may indicate that this attitude to use of seatbelts has been persistent over a long period. Also the flight technician and several of the passengers in the cabin/cargo compartment, did not wear seatbelts. The Russian aviation authorities should therefore, in discussion with the relevant operators, consider measures to increase the use of seatbelts, particularly if this safety problem is commonplace also outside of Svalbard.

2.5.3 <u>Alarm and the rescue operation</u>

2.5.3.1 A lot of the flight operations on Svalbard take place in areas that are difficult to access under more or less extreme conditions. The fact that the accident took place on a heliport with significant resources in the immediate vicinity was crucial in limiting the extent of the accident. There were witnesses to the accident and the emergency services were therefore quickly alerted. The Governor's office, for instance, received notification of the accident as early as 13 minutes after it happened.

2.5.3.2 The emergency beacon did not transmit any signals in connection with the accident. This is most likely due to the automatic activation mechanism not being exposed to sufficient loads in the vertical plane of the helicopter (see Item 1.15.3). This had no practical consequences, as the accident happened near witnesses who could raise the alarm. If a similar accident were to take place far from built-up areas, manual activation of the emergency beacon could have been important.

2.5.3.3 The helicopter did not catch fire, and the response time for the fire and rescue services was therefore not decisive. However, if a fire had started, the transport time from Barentsburg to Cape Heer could have been critical. The Accident Investigation Board therefore believes that the Trust Arktikugol mining company should consider whether the fire and rescue services should have higher preparedness with a presence at Cape Heer in connection with helicopter landings and take-offs.

3. CONCLUSION

The Accident Investigation Board believes that the flight up to the landing on Cape Heer proceeded normally. However, loose snow, possibly combined with gusts of wind, posed challenges in connection with the landing itself. During the landing, the flight crew used an unsuitable method, which resulted in the loss of necessary visual references. The balked landing was carried out with clear deficiencies in the crew cooperation. The crew lost control of the helicopter and hit a hangar wall. The collision had serious consequences, partly due to persons not being buckled up with seatbelts.

3.1 Investigation results

a) The aircraft was registered in accordance with the regulations and had a valid airworthiness certificate.

b) In this investigation, the AIBN has not uncovered technical failure or irregularities in the aircraft that could have had an effect on the course of events.

c) The crew members had valid licences and privileges for the helicopter type.

d) The flight up to the landing on Cape Heer proceeded normally.

e) It had snowed earlier in the day and there were snow showers in the area. This resulted in reduced visibility and loose snow formed on the landing site.

f) The original helipad to the east on the heliport had not been cleared of snow. The landings therefore took place on a concrete platform between the hangars The Accident Investigation Board believes that the accident could have been avoided if the helipad had been cleared of snow and used.

g) The crew was prepared for the helicopter whirling up snow during the landing, and had agreed to notify each other if visual references were lost.

h) The crew used an unsuitable method during the landing, resulting in loss of visual references.

i) After being asked by the engineer and first officer, the commander aborted the landing. There was a breakdown in crew corporation, where after the first officer and the engineer took passive roles.

j) During the balked landing, the helicopter moved to the left equivalent to a course deviation of approx. 50° to the left in relation to the planned course.

k) The deviation occurred when the helicopter flew a distance of approx. 100 meters without visual references. The Accident Investigation Board cannot establish whether the deviation was caused by the wind, insufficient pedal compensation during increased power output from the engines, or a combination of these factors.

l) The helicopter hit the east side of the hangar at a relatively low speed. The helicopter tail then turned left and the helicopter fell backwards on the ground south of the hangar.

m) The AIBN believes that both the engineer and the passenger might have survived the accident if they had used seatbelts.

4. SAFETY RECOMMENDATIONS

In this report, the Accident Investigation Board has found a major improvement potential in passengers and crew members using seatbelts during take-off and landing. As this is a basic safety issue which Russian aviation authorities should already be aware of, the Accident Investigation Board will refrain from issuing a safety recommendation.

The Accident Investigation Board Norway

Lillestrøm, 21 Februar 2013

APPENDICES

Appendix A: Relevant abbreviations

Appendix B: Graphs from the flight data recorder (FDR)

APPENDIX A

RELEVANT ABBREVIATIONS

AFIS	Aerodrome Flight Information Service
BKN	BroKeN – weather code for broken clouds
BSL	Civil Aviation Regulations (Norway)
CB	Cumulonimbus – weather code for clouds with showers
CVR	Cockpit Voice Recorder
FEW	Few – weather code for light clouds
FL	Flight Level
G	Vertical load caused by the acceleration of gravity 1G corresponds to the gravity acceleration on earth.
GPS	Global Positioning System
hPa	hectopascal
IAC	Interstate Aviation Committee
ICAO	International Civil Aviation Organization
KT/kt	Nautical Mile(s) (1852 metres) per hour
M	Minus – weather code for temperatures below 0 °C
METAR	METeorological Aerodrome Report – routine weather observations
MHz	megaHertz
N	north
Q	QNH - Weather code for altimeter setting related to the pressure at sea level
RMK	ReMarK – supplementary information in weather codes
SCT	ScatTered – weather code for scattered clouds
SFC	SurFaCe – weather code for ground level
SHSN	SHowerSNow – weather code for snow shower
AIBN	The Accident Investigation Board Norway
SN	SNow – weather code for snow
TAF	Terminal Aerodrome Forecast
TEMPO	Weather code for temporary
UTC	Universal Time Coordinated
VRB	VaRiaBle – weather code for variable
VCSH	ViCinityShowers – weather code for rain in the vicinity
VFR	Visual Flight rules
VHF	Very High Frequency
VV	VerticalVisibility – weather code for vertical visibility
Z	Zulu hour (UTC) – universal standard time
E	east

APPENDIX B

GRAPHS FROM FDR

The graphs show, from the top:

- Rotor rpm (olive green)
- Main rotor blade angle (deep red)
- Helicopter pitch (green)
- Helicopter roll (dark blue)
- Speed (blue)