Accident
Investigation Board
Norway

Issued February 2020

REPORT SL 2020/04

REPORT ON AVIATION ACCIDENT IN ISFJORDEN ON SVALBARD, NEAR BARENTSBURG, 26 OKTOBER 2017, WITH Mil Mi 8AMT, RA-22312 OPERATED BY CONVERS AVIA AIRLINES JSC

This report has been translated into English and published by the AIBN to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

Photos: AIBN and Trond Isaksen/OSL

TABLE OF CONTENTS

REPORT ON

Aircraft:	Mil Mi 8AMT helicopter
Nationality and registration:	Russian, RA-22312
Owner:	LLC Otkrytaja lizingovaya kompaniya (lessor) / State Trust Arcticugol (lessee)
User:	Convers Avia Airlines JSC[1], Russia
Crew/AC Commander:	3, all perished
Passengers:	5, all perished
Accident site:	Isfjorden, Svalbard. 78°7'16.24"N 14°14'32.77" E – the calculated point of the helicopter impact with the water surface. 78° 7'13.59"N 14°14'36.48"E – the helicopter position on the seabed.
Time of accident:	Thursday, 26 October 2017, at 15:08

All time indication in this report is given in local time (UTC +2 hours) unless otherwise specified.

NOTIFICATION OF THE ACCIDENT

26 October 2017 at 16:29, the Accident Investigation Board Norway (AIBN) was notified by the state-owned airport operator Avinor at Svalbard Airport in Longyearbyen (ENSB), that a Mil Mi 8AMT helicopter with registration RA-22312 and route number CVS312 en route from Pyramiden to “Barentsburg” landing site on Heerodden was missing.

In accordance with ICAO Annex 13, “Aircraft Accident and Incident Investigation”, Accident Investigation Board Norway notified the investigation authority in Russia[2], since both the persons on board, the operating company and the helicopter were Russian. IAC appointed an accredited representative who, together with advisors, arrived at Longyearbyen on October 28. They have assisted AIBN in this investigation.

The AIBN traveled to Svalbard on 27 October, and began work. This also involved contracting a suitable vessel for searching on the seabed and salvaging the helicopter wreck. While the search for the helicopter wreck was ongoing, planning meetings, collecting information and interviews with personnel from Svalbard Airport and the “Barentsburg” landing site at Heerodden were done. The helicopter was found at a depth of 209 m in Isfjorden on 29 October.

[1] Further in this report, “Convers Avia JSC” is used.
[2] IAC/MAK is the designated investigation authority in the Russian Federation. Further in this report “IAC/MAK” is used.

SUMMARY

A helicopter from the helicopter company Convers Avia JSC had conducted a flight for the Trust Arktikugol mining company from Pyramiden to the "Barentsburg" landing site[3] at Heerodden and was in the final stages of approach for landing when the accident occurred the 26 October 2017. At this time, the tower officer at Heerodden had reported the visibility to be approximately 1000 m horizontal, and approximately 100 m vertical in snow showers. Further, the wind was reported from Heerodden to be easterly approximately 1-2 m/s. The helicopter left the Svalbard Airport AFIS[4] frequency at 15:06 and contacted Heerodden. The tower officer at Heerodden lost contact with the helicopter and notified AFIS at Svalbard Airport that the helicopter was missing. Personnel who were outdoors at Heerodden heard that the helicopter went into the sea. Extensive search for the helicopter with large resources was initiated, also with assistance from the Russian authorities. The helicopter was found on 29 October 2017 at approximately 209 m deep about 2.7 km out in Isfjorden northeast of Heerodden. All eight on board lost their lives. Only one of those on board was found. He was found on the seabed approximately 150 m southwest of where the helicopter wreck was found. An extensive search was conducted with ROV's over a larger area with negative results. The helicopter was lifted on 4 November 2017. Cockpit Voice Recorder and GPS units were secured and brought to IAC/MAK for downloading data and audio files. After a period of search, fragments of the Flight Data Recorder (FDR) was found. The FDR disintegrated during the accident due to the mechanical impact from the main rotor blades, affecting the FDR and the tail boom. The internal memory module was not found.

The helicopter wreck was transported by sea from Svalbard to the offshore oil industry logistics base at Dusavika near Stavanger for further investigation by AIBN together with IAC/MAK representatives and specialists from the helicopter design company. These investigations resulted in no findings that could explain the accident

This was a VFR flight, and none of the pilots had instrument ratings.

The AIBN has concluded that the accident occurred after the loss of visual references. The collision with the sea surface was with little energy, and everyone on board got out of the helicopter. None of the occupants had adequate equipment for survival in the cold water.

The AIBN proposes four safety recommendations in connection with this investigation:

One recommendation is given to the Russian Aviation Authority (SCAA) concerning monitoring of the company Convers Avia JSC.

One recommendation is given to Convers Avia JSC concerning monitoring of the company's operations at Heerodden.

One recommendation is given to the Civil Aviation Authority Norway (CAA-N) concerning emergency equipment on multi-engine helicopters operating at Svalbard and desolate areas.

One recommendation is given to the Civil Aviation Authority Norway concerning helicopter operations during the polar night at Svalbard. These should be performed as instrument flights (IFR).

---

[3] The landing site is at Heerodden, approx. 3.5 km north of Barentsburg. From here on named Heerodden.
[4] Aerodrome Flight Information Service

1. FACTUAL INFORMATION

1.1 Course of events

1.1.1 The description of the helicopter flight on 26 October 2017 along the route from Heerodden to Pyramiden with return to Heerodden has been made based on the data recorded by the GPS unit installed in the helicopter, the Cockpit Voice Recorder, and on the results of the investigations.

1.1.2 The Mil Mi 8 AMT helicopter with registration number RA-22312 and call sign CVS312 was operated by the Russian helicopter company Convers Avia Airlines JSC. The helicopter was based at Heerodden, and carried out transport flights between Trust Arktikugol coal mining company's landing sites at Heerodden near Barentsburg, Pyramiden and Svalbard Airport Longyearbyen (ENSB).

1.1.3 In the period before the accident, RA-22312 was flown on October 10, October 17 and October 25. The helicopter was refuelled with 535 liters of JET A1 at Svalbard Airport, Longyearbyen on October 25.

1.1.4 The mission on October 26 was to fly the management group of Trust Arktikugol from the helicopter landing site at Heerodden to Pyramiden where the management group were to hold a meeting with personnel at Pyramiden. The helicopter should return to Heerodden before the meeting was over. For practical reasons, three scientists were picked up as passengers for the return flight to Heerodden.

1.1.5 The investigation did not reveal findings that indicate technical deficiencies on the helicopter or helicopter systems prior to or during this first flight on 26 October 2017.

1.1.6 RA-22312 took off to return to Heerodden from Pyramiden at. 14:43. The helicopter's departure weight was 9,855 kg, including a helicopter crew of three, and five passengers. Two of the passengers were technicians who were tasked with performing technical maintenance on the helicopter when it was away from the base. The fuel quantity at the time of departure was 1,574 kg.

1.1.7 The helicopter's centre of gravity was, at the time of takeoff, within the limits set in Mi 8AMT FCOM[5].

1.1.8 Before takeoff, the Commander decided that the First Officer should be "Pilot Flying" on this flight.

1.1.9 RA-22312 took off from Pyramiden at 14:43:19, eastbound, turned right to 200-220 degrees, after climbing to 200 meters' altitude. Until 14:57:10 the flight continued with altitude variations between 190 and 260 meters and headings of 220-230 degrees with a speed between 200 to 220 km/h.

1.1.10 At 14:45:58 RA-22312 contacted AFIS at Svalbard Airport Longyearbyen (ENSB). The Commander reported that they were at Pyramiden, and that they were continuing to Barentsburg at 600 ft with 8 persons on board, and that they would call back when passing "reporting point Bravo inbound" (see Figure 1). AFIS ENSB confirmed the information and gave the atmospheric pressure at the airport as QNH 995. RA-22312

[5] Flight Crew Operations Manual

again confirmed that they would report at reporting point “Bravo” and confirmed QNH 995.

1.1.11 At 14:46:58 the Heerodden tower officer contacted RA-22312 and informed about the weather conditions at the heliport, where there were snow showers, horizontal visibility 1000 meters and vertical visibility 100 to 120 meters. RA-22312 confirmed this information.

1.1.12 At 14:50:01 the Commander requested activation of the “anti-icing system”, whereupon the flight engineer informed that the “anti-icing system” was in “auto mode”. The Commander then requested that all “anti-icing”[6] should be switched on.

1.1.13 RA-22312 passed “reporting point Bravo” at 14:54:29. The Commander reported that RA-22312 was “abeam Bravo” to AFIS at Svalbard Airport Longyearbyen, and that they would report “reporting point Alpha outbound”. AFIS confirmed this report.

Figure 1: Reporting points ALPHA and BRAVO. Map: © The Norwegian Mapping Authority

1.1.14 At 14:57:10 RA-22312 started the approach to Heerodden and initiated descent from an altitude of approximately 235 meters. Immediately afterwards, the tower officer at Heerodden was contacted with a request for an update on the wind conditions at the heliport. It was stated that the wind was 1 to 2 m/s from approximately 080 degrees, almost no wind.

1.1.15 At 14:58:59, from an altitude of 145 meters, and with a speed of approximately 200 km/h, RA-22312 climbed back to approximately 200 meters’ altitude. The approach to Heerodden then continued at 200 to 215 meters’ altitude with heading 225 degrees and a

[6] The anti ice system on the Mil MI 8AMT heats the main and tail rotor blades leading edges, and the engines air intakes.

somewhat varying speed of between 190 and 210 km/h. 20 km from Barentsburg, at 15:01:22, the First Officer alerted the Commander that they were about to pass “reporting point Alpha”. The Commander then contacted Longyearbyen tower. He reported that RA-22312 was “abeam Alpha” and that the next position report would be 5 NM from Heerodden. The Commander further informed the crew about “approach path”, radar altimeter status, and the areas of responsibility of each of them during approach, as well as details on the landing platform. This was done at 15:02:13. At that time RA-22312 was approximately 17 km from Heerodden.

1.1.16 At 15:02:35 RA-22312 was called up by the tower officer on Heerodden who reported that the wind was now from 090 degrees, 1 to 2 m/s, horizontal visibility 1000 meters or less, perhaps 900 meters, and that the vertical visibility was approximately 100 meters. The Commander then confirmed and ordered 15:03:05 descent to 100 meters’ altitude. The descent was initiated at 15:03:45 with heading 220 degrees. The distance to the landing platform was now 10 NM. During the descent, speed, heading and distance were constantly monitored and read out by the Commander.

1.1.17 At 15:03:43 the “Ice Formation Annunciator” came on, and the flight engineer on board the helicopter confirmed to the Commander that the system in question was manually activated and that electricity consumption were within allowable limits.

1.1.18 At 15:04:43 the Commander requested that horizontal flight should be reestablished and that no further descent should take place. The altitude was then 90 meters, and the vertical speed indicator (VSI) was monitored and verified to be 0 m/s. Immediately after this, the tower at Heerodden called up RA-22312 and reported that QNH on the landing platform was 743 millimeters[7]. RA-22312 confirmed.

1.1.19 At 15:05:26 RA-22312 called up AFIS Svalbard Airport and reported that they were going to establish radio contact with Heerodden. The Commander also reported that RA-22312 was now 5 NM “inbound” Heerodden and that radio contact was established.

1.1.20 During the seconds that followed, from 15:05:51 to 15:06:41, the helicopter climbed to an altitude of 140 meters, which the Commander pointed out to the First Officer. At the same time both pilots adjusted the pressure on their altimeters to 743 mm and thereby coordinated the altimeter setting. Their heading was at this time 200 degrees, and the Commander then asked the First Officer to establish a speed of 90 km/h, but corrected this to 80 km/h. The Commander then called out that the altitude was now 200 meters, that they were climbing, and at the same time requested descent to 80 meters’ altitude. The First Officer confirmed that he had made the correction and started the descent.

1.1.21 During the time interval from 15:06:50 until the time of the accident, RA-22312 continued to descend in addition to reducing the speed, and at the same time the heading shifted more and more towards the left to 170 degrees. At 15:07:48 the radio altimeter “altitude alert signal” (400 Hz tone) sounded[8], and the helicopter was still losing altitude with heading 170 degrees. The distance to Heerodden was now approximately 2 km. At this point in time the helicopter’s altitude was 40 meters, with a speed of 50 km/h, while the heading shift towards the left continued. The CVR recording shows that the Commander at 15:07:53 made the First Officer aware of the significant change of

[7] 743 mmHg which equals 996 Hpa
[8] The radio altimeter alarm was set at 60 m.

direction. RA-22312 impacted the water surface at time 15:08:04 at the calculated coordinates of 78º 07' 16,24" N 14º 14" 32,77' E.

1.1.22 The officer on duty in the tower at Heerodden has explained to the AIBN that based on the distance to nearby light sources he could with good certainty say that the horizontal view was approximately 1 000 m. He further stated that when the helicopter was less than 5 NM (9.2 km) from the helicopter base, he could hear the noise from the helicopter for approximately 30 to 40 seconds. He believed that the sound from the helicopter was normal before it suddenly disappeared. He perceived the situation as serious and immediately called up the helicopter, both on the normal radio frequency and the emergency frequency 121.5 MHz, without receiving an answer.

1.1.23 Another person was also in the tower when this happened. When the sound of the helicopter disappeared, the person went out onto the tower balcony and shouted that he thought the helicopter had gone down. The tower officer then called the coal mine rescue group in Barentsburg. Then he contacted the Trust Arktikugol (the mining company), which came 10 to 15 minutes later with a fire truck and doctors. He received help from an english-speaking scientist who was at the premises to explain to AFIS at Svalbard Airport what had happened. They confirmed the message received and that help would be organized from there.

1.1.24 A helicopter technician, who was standing outside the hangar at Heerodden at the time in question, has explained that he at 15:05 heard the sound of the helicopter. He specified to the accident investigators that it was a normal and permanent helicopter sound/humming from both engines and the rotor. He also said that at approximately 15:07 he heard the sound of something apparently striking against the sea surface, and that the sound of the helicopter soon after that was gone. Since it was snowing that day, he could see neither the navigation/anti-collision lights on the helicopter, nor the contours of the helicopter. When the sound disappeared, he and an electrician working at the base got into a car and drove off in the direction the sound had come from to see if they could spot anything from land. They walked along the shore, but it was snowing, it was getting darker, and they didn't spot anything. At 15:12, the helicopter technician contacted the helicopter company management and reported to them what had happened.

1.2 Personal injuries

Tabell 1: Personal injuries

Injuries	Crew	Passengers	Others
Perished[9]	3	5	
Serious			
Light/none			

1.3 Aircraft damages

The helicopter was destroyed. For further detail, see chapter 1.12.3.1.

1.4 Other injury or damage

None

[9] Only one of the 8 on board the helicopter was found.

1.5 Personnel information

1.5.1 Commander

Male, 43 years. Helicopter pilot education in 1995, employed in Convers Avia JSC from 2010, initially as first officer on Mi 8. He obtained commander’s privilege in 2014 on Mil Mi 8T and type rating on Mil Mi 8AMT in 2015. On 12 October 2017 he was checked out by the company for autumn and winter operations. He had valid license as aircraft commander on the helicopter type in question. The Commander did not have instrument rating.

Table 2: Flying hours, the Commander[10]

Flying hours	All types	On type
Last 24 hours	1:05	1:05
Last 3 days	2:10	2:10
Last 30 days	6:25	6:25
Last 90 days	114	6:25
Total	8 265	114

1.5.1.1 On 10 October 2017, the Commander was to perform his routine skill test under the supervision of one of the company's examiners. This was planned to be done when the Commander was to begin his work period.

1.5.1.2 The examiner, who was in his work period on Svalbard, had requested early release for family reasons. The skill test was supposed to be completed before the examiner traveled home.

1.5.1.3 The validity of the Commander's previous skill test expired on 24 December 2017, but the company's policy was that such tests should be performed 2-3 months prior to the expiry of the skill test.

1.5.1.4 The examiner decided that he could postpone this skill test until the next time he started a new work period since the new period began before the pilot's skill test expired. However, he chose to sign out a new skill test in the Commander's logbook without the test being executed. He did this without informing Convers Avia JSC.

1.5.1.5 The examiner traveled on the same plane to the mainland as the Commander arrived with. Furthermore, it appears in the CVR recording that no skill test were performed on board the helicopter on October 10.

1.5.2 First Officer

Male, 39 years. Pilot education in 2004, employed in Convers Avia JSC from 5 April 2017 as First Officer on Mil Mi 8. On 5 October 2017 he was checked out by the company for autumn and winter operations. He had valid certificates for service as aircraft commander on the helicopter type in question. The First Officer did not have instrument rating.

[10] On type is Mil Mi 8AMT while All types are Mil Mi 8T, Mi 8MTV and Mi 8AMT.

Table 3: Flying hours, First Officer

Flying hours	All typee	Type in question
Last 24 hours	1:05	1:05
Last 3 days	2:10	2:10
Last 30 days	12	12
Last 90 days	43	12
Total	3 790	1 646

1.5.3 Flight Engineer

1.5.3.1 Male, 39 years. Technician's education in 2000. Received his flight engineer's certificate in 2005 and was employed in Convers Avia JSC from 18 April 2016 as flight engineer. On 5 October 2017 he was checked out by the company for autumn and winter operations.

Table 4: Flying hours, flight engineer

Flying hours	All types	Type in question
Last 24 hours	1:05	1:05
Last 3 days	2:10	2:10
Last 30 days	12	12
Last 90 days	69	12
Total	4 413	59

1.6 Aircraft

1.6.1 General

The helicopter type Mil Mi 8 is a medium size transport helicopter with two turbine engines. It is produced in a number of varieties. From 1961 more than 17 000 units have been produced, which makes this the world's most common helicopter type. The helicopter type has a five-bladed main rotor that rotates clockwise, viewed from above. The model in question, Mil Mi 8AMT, differs from previous versions in that it has a three-bladed tail rotor mounted on the left side of the tail boom and stronger engines. The helicopter is equipped with electric main and tail rotor blade de-icing.

1.6.2 Data

Type: Mil Mi 8AMT

Serial number: 171C00643116106U

Year of Production: 2013

Engines: 2 x MOTOR SICH TV3-117VM

Length of fuselage: 18.17 m

Diameter, main rotor: 21.29 m

Revolutions, main rotor: 192 revolutions per minute

Maximum takeoff mass: 13,000 kg

Actual takeoff mass:	9,557 kg
Center-of-gravity position:	82 mm +/-25 mm (within limits given in Mil Mi 8 AMT FCOM)
Total flight hours:	447 hours
Fuel:	Jet A-1
Fuel quantity at the time of the accident:	1,276 kg[11]

1.6.3 Wind limitations

Mi 8 AMT, like most other helicopters, has a “maximum wind speed limit for hovering, takeoff and landing”, as it is described in the Mi 8AMT “Flight Manual, fig. 2.1.2”.

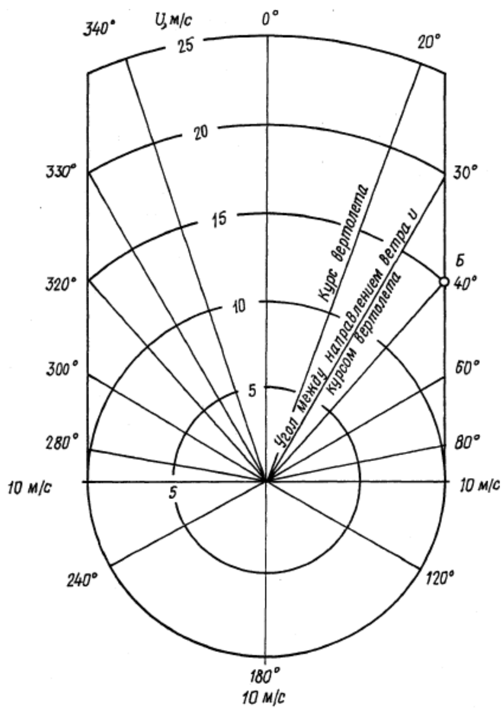


Figure 2: Illustration from Mi 8AMT Flight Manual fig. 2.1.2 – “Maximum wind speed depending on its direction relative to the course of the helicopter while hovering, takeoff and landing.”

1.6.4 Weight and balance

At the time of the accident, the weight and balance of the helicopter was within the limitations given in the helicopter type’s flight manual.

1.6.5 Additional information

According to the technician on the helicopter base, there were no outstanding technical remarks on the helicopter. There are also no indications in the audio recordings stored on

[11] AIBN has sampled the fuel from the fuel tanks at Svalbard Airport without finding deviations that could have contributed to the accident.

the voice recorder (CVR) that technical errors occurred during the flight from the landing site at Heerodden to Pyramiden or on the way back to the time of the accident.

1.7 The weather

1.7.1 General

AIBN has, in this investigation, collected weather data from the Hydrometeorological Observatory in Barentsburg, the Svalbard airport weather service, as well as information on the weather conditions in the area in question, conveyed to the pilots from the tower at Heerodden and witnesses who were present at the helicopter base. Additionally, weather information was retrieved from the Meteorological Institute in Tromsø and from the Commander on one of Lufttransport Super Puma helicopters that flew in the same area only some 10 minutes earlier. The temperature in the sea was approximately 2 °C.

1.7.2 Hydrometeorological Observatory Barentsburg

Hydrometeorological Observatory Barentsburg informed that the weather on the day in question was:

At 1200 (UTC): *"Wind: Still, 0 meters per second, moderate snow, visibility 2000 meters with cloud base 300 – 600 m and air temperature -2.6 degrees Cº."*

At 1500 (UTC): *"Wind: Still, 0 meters per second, heavy snow, visibility 1000 meters with cloud base 300 – 600 m and air temperature -2.1 degrees Cº."*

1.7.3 The weather services at Svalbard Airport

The weather service at Svalbard Airport forecast the following weather on 26 October 2017 in WX-INFO bulletin:

> *A low pressure is developing in the Fram strait, moving towards east. This will give some snow in west areas during the day. In north regions cloudy or partly cloudy and mainly dry, becoming snow in the afternoon. On the east coast cloudy with snow, around Bjørnøya cloudy and mainly dry.*

The forecast for area 1, which includes Isfjorden and Heerodden, was:

> *Weather: NIL BECMG SCT SN, Surface wind: E 10 – 20 KT, Clouds: BKN 2000´-4000´, Tops: FL 070 LAYERS ABV, 0 – isotherm, SFC Ice: NIL, Turb: NIL*

The forecast did not give any information on ground visibility conditions.

1.7.4 Weather update from the tower at Heerodden to the helicopter

The radio communication from 15:02:41 to 15:03:03, between the tower at Heerodden and the RA-22312 Commander, reveals information on the actual weather conditions at the landing platform. The tower reported that there was an easterly wind of 1 to 2 m/s, visibility 1000 meters or down towards 900 meters, and the vertical visibility approximately 100 meters. The tower officer at Heerodden then informed that he had had visual contact with the Norwegian helicopter that flew by, and that visibility at that time had been 1000 meters and vertical visibility 100 meters. He further informed that they were preparing the landing area, and that 2 cm of new snow had fallen, and they should be alert, since the landing area was covered with snow. During conversations with AIBN, the helicopter technician who was present at the helicopter base at Heerodden, informed that within a short period of time a total of approximately 15 cm of snow had fallen at the base.

1.7.5 The Meteorological Institute in Tromsø

The Meteorological Institute in Tromsø informed that the surface wind in Isfjorden, according to Isfjord Radio, was from the east-northeast, 16 knots, gusting 18 knots, at 14:00.

1.7.6 Report from the Commander on LT92 Super Puma[12]

LT92 Super Puma was out on a training mission and passed Heerodden, after a simulated approach, between 2:50 and 3:00 pm, i.e. approximately 10 min before RA-22312. The Commander on LT92 described the local weather conditions as:

> *Quite strong wind from the east, intense blowing snow and low visibility, the only challenge that day was the dense snow showers and the strong wind, which led to some turbulence. Additionally, twilight started setting in at around 1500 hrs.*

The Commander of LT92 also commented that there could be significant local variations in weather conditions in the area.

1.7.7 Format of weather forecasts from the weather services at Svalbard Airport

1.7.7.1 The Meteorological Institute has a weather service office at Svalbard Airport (ENSB). The office is staffed with one person. According to the agreement between the Meteorological Institute and Avinor, the office will provide METAR and TREND notifications in the office's opening hours in addition to a briefing service for Svalbard. The Office also makes TAF proposals for ENSB to the 12 o'clock term, as well as proposals for the TAF for Svea (ENSA) for the 3 weekly terms it is issued. The TAFs for Svalbard are issued by the aviation weather services in Tromsø.

1.7.7.2 The Meteorological Institute issues area alerts in the form of "low-level SIG-WX"[13] maps and IGA[14] forecasts. However, IGA forecasts are not issued for Svalbard. Local visibility conditions do not appear in "low-level SIG-WX" maps for "ground to FL[15] 150" unless there are larger areas with reduced visibility. Such areas are marked in the "low-level SIG-WX" maps with yellow markings around.

1.7.7.3 As a service for the local users, the weather service office at Svalbard Airport prepares a custom area warning, WX-INFO, where Svalbard is divided into 4 areas. This alert is issued early in the day when the hosting service office is open and distributed to the lending site at Heerodden, Lufttransport, AFIS in Svea and in Ny-Ålesund. The warning contains information about the synoptic[16] weather situation, METAR (with any trend),

[12] LT92 is the call sign for a Super Puma AS 332 L1 helicopter operated by Lufttransport for the Governor of Svalbard (Sysselmannen)
[13] SIG-WX means "Significant Weather Chart". The format is defined in ICAO Annex 3
[14] IGA-prognosis (International General Aviation) is a weather forecast format for a defined area
[15] FL – Flight Level
[16] Synoptic weather situation is the weather situation for a larger geographic area based on several local weather forecasts.

SYNOPS, TAF, weather, ground wind, cloud base, cloud tops, 0-isotherm, icing, turbulence, wind at 3000 ft, wind FL050, wind FL070, wind FL100, plus any additional info.

1.7.7.4 WX-INFO did not contain information on visibility conditions at ground level, but after the accident with RA-22312 in October 2017, visibility conditions were included in the area forecasts in the WX-INFO messages in February 2018.

1.7.7.5 The custom format WX-INFO contains information that could also have been published in the AIRMET format as specified in ICAO Annex 3. ICAO Annex 3 chapter 7, paragraph 7.2.1 describes the purpose of the AIRMET format in the following manner:

> *AIRMET information shall be issued by a meteorological watch office in accordance with regional air navigation agreement, taking into account the density of air traffic operating below flight level 100. AIRMET information shall give a concise description in abbreviated plain language concerning the occurrence and/or expected occurrence of specified en-route weather phenomena, which have not been included in Section I of the area forecast for low-level flights issued in accordance with Chapter 6, 6.5 and which may affect the safety of low-level flights, and of the development of those phenomena in time and space.*

1.7.7.6 In Norway, AIRMET has historically not been used, and deviations from ICAO Annex 3 (ref. AIP GEN 1.7.3) have been reported. An assessment has been made that other alerts (SIG-WX maps and IGA forecasts, in addition to ICE MESSAGE) have met the user requirements and that the traffic density has not required the use of the AIRMET. In 2012, the use of ICE MESSAGE to notify MOD ICE was stopped since this was not an international format, and one started to use AIRMET for MOD ICE. Other weather conditions were believed to have been covered by IGA forecasts and SIG-WX maps. For Svalbard, IGA forecasts are not made, so the meteorological office at Svalbard Airport makes a custom weather situation report in the form of WX-INFO.

1.7.7.7 As of 2 January, 2020 EU Regulation 2017/373[17] has come into force. In this connection, the Civil Aviation Authority Norway (CAA-N) has made a review of the warnings in use in Norway. In low traffic density areas such as Svalbard the requirement for IGA is not applicable. However the CAA-N has proposed to establish requirements for area forecasts both in form of SIG WX maps and a graphic forecast (as a replacement for IGA). This format is intended to be available also for the Svalbard area.

1.8 Navigational aids

1.8.1 Ground based navigational aids

Ground-based aids for navigation at the helicopter base was a Non-Directional Beacon (NDB) with callsign “EN” placed approximately 1150 meters east of the tower.

1.8.2 Navigational aids in the helicopter

The helicopter was equipped with an A-037 radio altimeter, an 8A-815C weather radar, nav/glideslope receiver (KNS-53), a KN-53 radio distance finder and a VOR/DME/ILS monoblock unit, and a BMS-Indicator multifunctional system. In the cockpit, a Garmin

[17] Easy Access Rules for Air Traffic Management/Air Navigation Services (Regulation (EU) 2017/373)

GPS 276C and a Garmin GPS 695C GPS were also installed. These GPS receivers were not part of the standard helicopter equipment.

1.9 Communication

1.9.1 The helicopter had two ORLAN 85ST VHF radios, which were normally set for communication with Heerodden (126.000 MHz) and Longyearbyen (118.100 MHz).

1.9.2 The primary communication between the helicopter and the tower at Heerodden took place at 126,000 MHz. If necessary, the tower at Heerodden used 118,100 MHz to request the helicopter to switch to 126,000 MHz for updating, for example, local weather conditions on the helicopter base.

1.9.3 The landing site at Heerodden was also equipped with an automatic radio direction finder indicating from which direction a VHF transmission came from (QDM/QDR).

1.9.4 During the first part of the flight from Pyramiden, there was communication between RA-22312 and AFIS at Svalbard Airport. RA-22312 reported “abeam” reporting point A and 5 NM before Heerodden where contact was established with the landing site’s tower. On the last part of the flight there was communication between RA-22312 and the tower officer at Heerodden.

1.10 Aerodrome information

1.10.1 The landing site at Heerodden is located 3.5 km north of Barentsburg. The landing site was built during the 1970s with two hangars, an administration building and a control tower. The landing site at Heerodden was then modern and adapted for a high level of activity. In recent years, however, the landing site shows signs of lack of maintenance, and the activity has been limited to operating one helicopter. The Civil Aviation Authority Norway of that time gave permission to use the landing site for non-general use on 1 August 1980.

1.10.2 The landing site at Heerodden was equipped with a NDB, which was operational on the day of the accident. The helicopter was not equipped with Ground Proximity Warning System (GPWS). According to Convers Avia JSC was this the reason for the limitation on instrument flying given by the Russian Aviation Authority. In the certification document for Heerodden developed by “Convers Avia JSC”, the day and night minimas for takeoffs and landings were: 450 m visibility vertically, and 5000 m visibility horizontally. The NDB equipment installed on the landing site was not included in the landing site’s certification document.

1.10.3 The landing site at Heerodden lies approximately 25 m above sea level and approximately 100-150 m from the sea shore.

1.10.4 At the time of the accident, the tower at Heerodden was equipped with an automatic meteorological station measuring temperature, relative humidity, pressure, wind speed and direction.

1.10.5 The landing site lies in “non-controlled airspace, class G”. The tower basically only performed services for “Convers Avia JSC” and was only manned in connection with the company’s flights. For Lufttransport, which performs helicopter operations for the

Governor of Svalbard, Heerodden is to be considered as an unmanned helicopter landing area.

1.10.6 The assessment of the actual meteorological conditions in the area of the landing site is conducted by the Commander of the helicopter and the tower duty officer, based on visual references and data provided by the automatic meteorological station.

1.10.7 Local weather and visibility conditions around the landing site were reported continuously by the duty officer in the tower to the helicopter.

1.10.8 WX-INFO issued in the morning on the day of the accident did not provide any information on expected visibility conditions at ground level (see Figure 3).

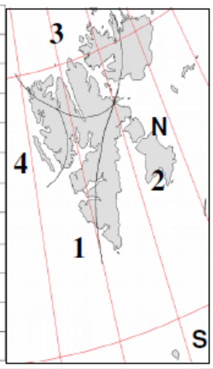
WX-INFO VER02.16 26.10.2017

A low pressure is developing in the Fram strait, moving towards east. This will give some snow in west areas during the day. In north regions cloudy or partly cloudy and mainly dry, becoming snow in the afternoon. On the east coast cloudy with snow, around Bjørnøya cloudy and mainly dry.

VÆRTJENESTEN
SVABARD LUFTHAVN
Meteorologisk institutt

OBSERVATIONS 06UTC

ENSB	11009KT 9999 FEW020 BKN030 M03/M07 Q1000 NOSIG=
ENSA	
ENAS	12008KT 9999 FEW018 BKN025 M02/M07 Q1000=
NY ÅLESUND (NP)	15005KT 9999 BKN020 M02/M06 Q1000=
ENBJ	17006KT 9999 BKN028 03/02 Q0999=
ENHO	07006KT 9999 FEW020 SCT060 M01/M04 Q1003=
PYRAMIDEN	28002KT M04/M08 Q1001=
BARENTSBURG	08002KT 9999 OVC020 M03/M07 Q1001=
HORNSUND	09010KT 9999 SCT015 00/M02 Q1000=
KAPP HEUGLIN	19010KT M05/M08 Q1003=
ISFJORD RADIO	09010KT M01/M05 Q1001=
SØRKAPPØYA	10015KT 02/M01 Q1000=



ENSB TAF	2606/2706 12008KT 9999 FEW020 BKN035 BECMG 2613/2615 12018KT TEMPO 2610/2702 4000 -SN BKN014=
ENSA TAF	
ENBJ TAF	2606/2615 05008KT 9999 FEW015 BKN025 TEMPO 2606/2615 BKN012=

WX 06UTC - 18UTC

WX / AREA	1	2	3	4
WEATHER	NIL BECMG SCT SN	N PART: NIL BECMG SN S PART: NIL	NIL BECMG SN LATE	NIL BECMG SCT SN
SFC WIND	E 10–20KT	N PART: SE 10–20KT S PART: S 05–15KT	S 05 – 15KT	E 05-15KT
CLOUDS	BKN 2000' – 4000'	N PART: BKN 1500' – 2500' S PART: BKN 1500' – 2500'	BKN 1500' - 2000'	BKN 2000' – 4000'
TOPS	FL070 LAYERS ABV	N PART: FL060 LAYERS ABV S PART: FL090	FL060	>FL100
0°-ISOTHERM	SFC	N PART: SFC S PART: 2500'	SFC	SFC
ICE	NIL	N PART: LCA LIGHT/MOD S PART: LCA MOD	NIL	LCA MOD
TURB	NIL	N PART: NIL S PART: NIL	NIL	NIL

UPPER WINDS/TEMP VALID 12UTC

	1		2		3		4	
WIND 3000'	230 10KT	M05	N PART: 190 10KT S PART: 230 15KT	M07 M00	210 10KT	M07	180 20KT	M05
WIND FL050	230 10KT	M10	N PART: 220 10KT S PART: 240 20KT	M10 M04	210 10KT	M12	200 15KT	M08
WIND FL070	210 10KT	M13	N PART: 260 10KT S PART 250 20KT	M13 M08	250 15KT	M14	210 10KT	M13
WIND FL100	220 15KT	M17	N PART: 240 15KT S PART: 230 25KT	M15 M12	250 15KT	M17	220 15KT	M18

OTHER INFO

Figure 3: WX INFO bulletin for the day of the accident. Source: The weather service at Svalbard Airport

1.11 Flight recorders

1.11.1 Cockpit Voice Recorder

1.11.1.1 The helicopter was equipped with a P-507M voice recorder (Cockpit Voice Recorder – CVR). The unit had serial number 16188. The recorder stored four channels digitally on memory chips. There was a channel for each of the three flight crew members and a separate channel for the area microphone in the cockpit. The recorder was placed in the ceiling in the aft section of the cabin. There were no visible exterior damages on the unit when salvaged by the AIBN. The unit was removed and soaked in distilled water. The unit was not equipped with an acoustic transmitter (Underwater Locator Beacon – ULB), which could have enabled a search for the unit, and in this case also the helicopter, using a hydrophone.

1.11.1.2 The unit was transported to IAC/MAK in Moscow for downloading of the audio files. An inspector from AIBN was present during the downloading. All four audio files were intact and of good quality. The information was important for the investigation.

1.11.1.3 The audio files from the last phase of the flight registered communication between the pilot who was Pilot Flying (FO in the table below) and the Commander (PIC in the table below) who was Pilot Monitoring (see Figure 4):

13:06:31,1	13:06:32,2	PIC / КВС	Set speed 90.
13:06:32,7	13:06:33,6	FO / 2П	Set 90.
13:06:34,8	13:06:36,9	PIC / КВС	Better 80. Altitude 200, you are climbing.
13:06:46,7	13:06:47,5	ВАТС/ДБ	(312)?
13:06:47,3	13:06:49,4	PIC / КВС	Heading 200, distance 4.
13:06:56,0	13:06:57,3	PIC / КВС	Set speed 80.
13:06:57,6	13:06:58,6	FO / 2П	Set 80.
13:07:06,4	13:07:08,1	PIC / КВС	Descend to altitude 80.
13:07:08,2	13:07:08,8	FO / 2П	Descending.
13:07:08,6	13:07:09,3	PIC / КВС	Distance 3.
13:07:12,7	13:07:13,2	FO / 2П	On heading.
13:07:15,0	13:07:17,8	PIC / КВС	Heading 200… 195.
13:07:18,2	13:07:19,3	FO / 2П	195.
13:07:19,6	13:07:20,2	PIC / КВС	On heading.
13:07:20,6	13:07:22,6	FE / БМ	Altitude 150, speed 80.
13:07:23,2	13:07:24,7	PIC / КВС	Descend to 80.
13:07:25,0	13:07:25,8	FO / 2П	Descending.
13:07:28,1	13:07:29,2	PIC / КВС	Distance 3.
13:07:33,5	13:07:35,1	PIC / КВС	Speed 60, set 70.
13:07:35,2	13:07:36,4	FO / 2П	60, 70.
13:07:37,2	13:07:39,0	FE / БМ	Altitude 100, speed 70.
13:07:39,9	13:07:40,9	PIC / КВС	That is OK, maintain it.
13:07:42,7	13:07:44,7	FE / БМ	Altitude 80, speed 60.
13:07:43,5	13:07:44,7	PIC / КВС	OK, horizontal [flight] .
13:07:47,9	13:07:48,7	FE / БМ	Altitude...
13:07:48,3	13:07:54,3		***Sound signal. F=400 Hz.***
13:07:49,3	13:07:50,4	FE / БМ	60.
13:07:51.4	13:07:52.2	PIC / КВС	Distance 2.
13:07:53,2	13:07:54,6	PIC / КВС	You've totally deviated from the heading.
13:07:55,0	13:07:55,9	FE / БМ	Altitude 40.
13:07:56,3	13:07:56,7	PIC / КВС	Hush.
13:07:58,3	13:07:59,2	FE / БМ	(Hush).
13:07:58,9	13:08:00,5	PIC / КВС	Where? Where? Hush *(expl).*
13:08:01,2	13:08:02,0	FO / 2П	(To the right) to the horizon…
13:08:01,2	13:08:01,8	Crew / Э	*(illeg).*
13:08:02,0	13:08:02,3	Crew / Э	*(illeg).*
13:08:02,3	13:08:02,8	Crew / Э	*(expl).*
13:08:03,1	13:08:04,1		***Change in sound effect.***
13:08:03,5	13:08:04,1	Crew / Э	*(illeg).*
13:08:05,1	13:08:06,2	Crew / Э	Help (there).
13:08:08,3	13:08:08,6	Crew / Э	*(expl).*
13:08:08,9	13:08:10,1	Crew / Э	*(expl).*
13:08:11,8			***End of record.***

Figure 4: Transcript of CVR recordings. Source: IAC/MAK

1.11.2 Flight Data Recorder

1.11.2.1 The helicopter was equipped with a Flight Data Recorder (FDR), model BUR-3-2 with memory module ZBN-1-3. The FDR was mounted in a separate container fixed underneath the helicopter tail boom (see Figure 5). The unit was not equipped with an acoustic transmitter (Underwater Locator Beacon – ULB), which could have enabled a search for the unit using a hydrophone.

Figure 5: Location of CVR and FDR. Photo: Alexey Reznichenko. Illustration: AIBN

1.11.2.2 The Flight Data Recorder was hit by a main rotor blade during the sequence of the accident, and it was struck loose from its mounting in the pod underneath the tail boom (see Figure 6).

Figure 6: Fragment of FDR casing stuck in the leading edge of a main rotor blade. Photo: AIBN

1.11.2.3 One day after the helicopter was lifted from the seabed, fragments of the flight data recorder was found at the sea bottom at a distance of 80 to 90 meters from where the helicopter fuselage had been on the seabed. The casing of the protected memory unit (i.e. Crash-Survival Memory Unit, CSMU) and the top covering lid of the CSMU were found approximately 40 meters from each other. The internal memory module was not found (see Figure 7). Analysis of registered data from the FDR was therefore not possible.

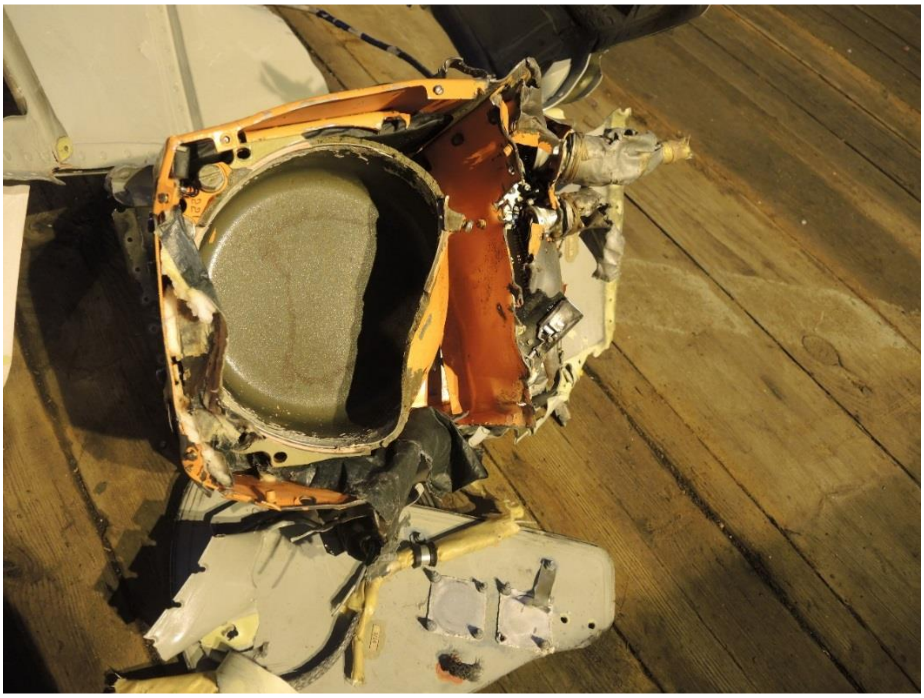


Figure 7: Destroyed BUR-3-2 FDR with empty CSMU casing. Photo: AIBN

1.11.2.4 ICAO Annex 6 Appendix 4 para 1.1 c describes the requirements to, among other things, underwater acoustic transmitters (ULB):

> *Non-deployable flight recorder containers shall have securely attached an automatically activated underwater locating device operating at a frequency of 37.5 kHz. At the earliest practical date, but not later than 1 January 2018, this device shall operate for a minimum of ninety days.*

The accident happened before 1 January 2018, thereby the final date for implementation was not reached.

1.11.3 GPS units

1.11.3.1 The helicopter was equipped with two portable GPS units: A Garmin 695C unit and a Garmin 276C unit. Both units were put in containers with distilled water and transported to IAC/MAK in Moscow for downloading of data. A representative from AIBN was present when the units were downloaded. It proved that the Garmin 276C unit did not contain data for the last flight.

1.11.3.2 The Garmin 695 unit contained data for the flight from Pyramiden to Heerodden. In Figure 8, the flight track from Pyramiden towards the Heerodden is plotted in Google Earth.

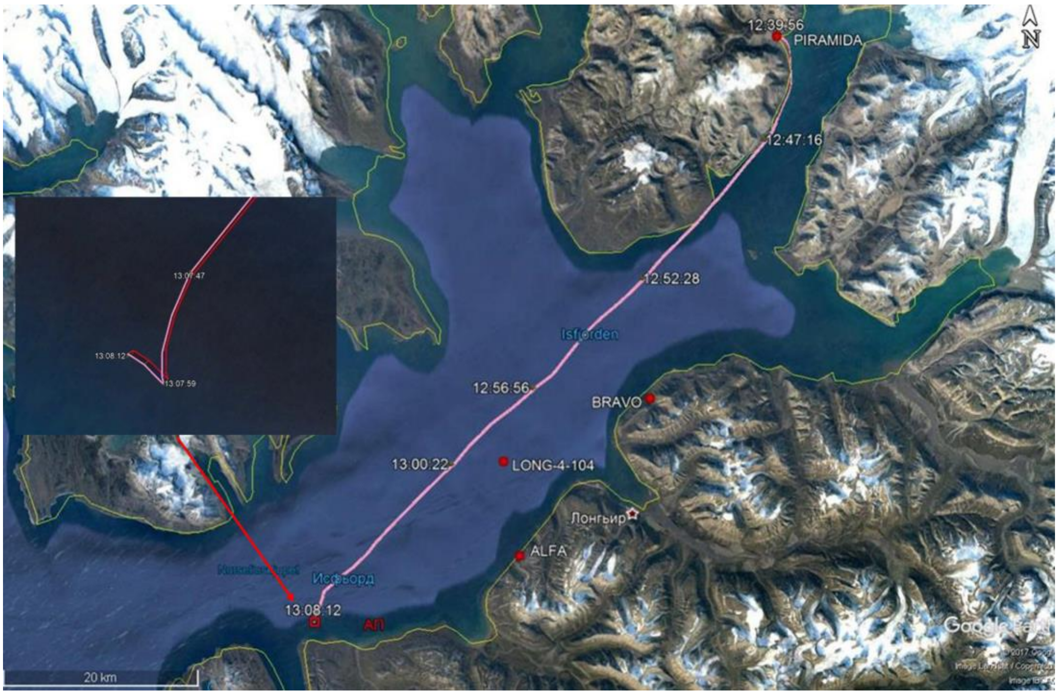


Figure 8: Plotted track from Pyramiden to Heerodden. Source: IAC/MAK

The parameters calculated ground speed, calculated ground track heading and flight altitude are provided in Figure 9.

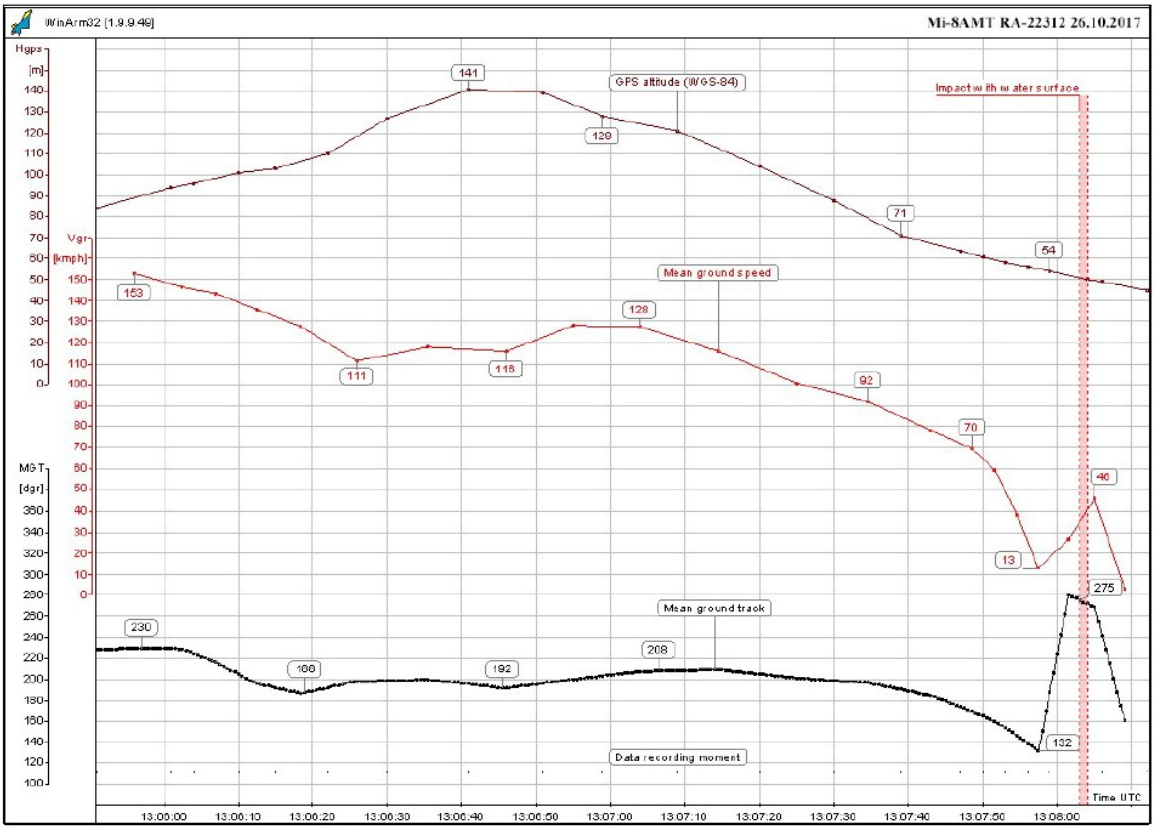


Figure 9: Plotted calculated parameters for the accident flight. The vertical, red line indicates the time of impact with the water. Source: IAC/MAK

1.11.3.3 During the last minutes of the approach towards Heerodden, the speed was reduced from approximately 200 km/h down towards 13 km/h. During this phase of the flight, the helicopter turned towards a more south/southeasterly heading relative to the normal heading of approximately 200 degrees, which is usual during approach towards Heerodden when arriving from Pyramiden. The helicopter, in the course of the last minute before the accident, turned left to a heading of 135 degrees. The distance from the helicopter base was then approximately 2.5 km. Data from the last seconds of the flight show a quick turn to approximately 275 degrees. The data from the last stage are most likely unreliable since the helicopter's movements and attitude may have had an impact on the GPS antenna's reception conditions.

1.11.4 Other sources

1.11.4.1 NORSAR[18] and the KRSC ("Kola Regional Seismological Center") have a cooperation within the fields of seismology and infrasound in the High North and Arctica. Within the framework of this cooperation, three seismic and infrasound sensors have been installed in Barentsburg and at Heerodden.

1.11.4.2 Based on triangulation of data from these sensors, it has been possible to pinpoint a quite precise location and the correct time when the helicopter impacted the water. Further it has been possible to estimate the helicopter's changes in speed relative to the infrasound microphone's location near Heerodden. The helicopter's main rotor generates a sound frequency of 16 Hz. The Doppler effect would alter this frequency depending on whether the helicopter is approaching or moving away from the sound sensor or alters its speed. In a report from NORSAR on what their sensors captured at the time of the accident, a time/frequency diagram appears, which supports the speed data registered by the Garmin GPS 695 unit, that is: that the helicopter immediately before the impact with the water had a very low speed (see Figure 10).

---

[18] NORSAR – Norwegian Seismic Array

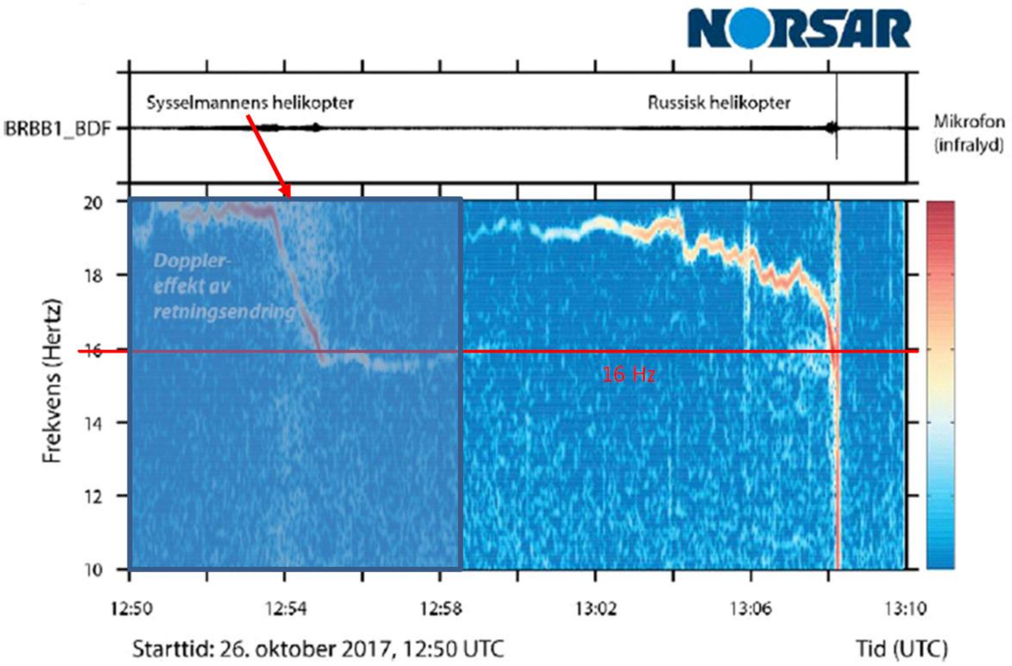


Figure 10: Time/frequency spectrum of infrasound signals from the accident helicopter. Source: NORSAR

1.12 The accident site and the aircraft wreck

1.12.1 The accident site

1.12.1.1 The accident site in Isfjorden, northeast of Heerodden is calculated to be in position 78°07’16.24”N 14°14’32.77”E. The helicopter wreck was found on flat, sandy bottom at a depth of 209 meters at 78°07’13.59”N 14°14’36.48”E. Parts and loose equipment were found near where the main portion of the helicopter lay on the bottom (see Figure 11).

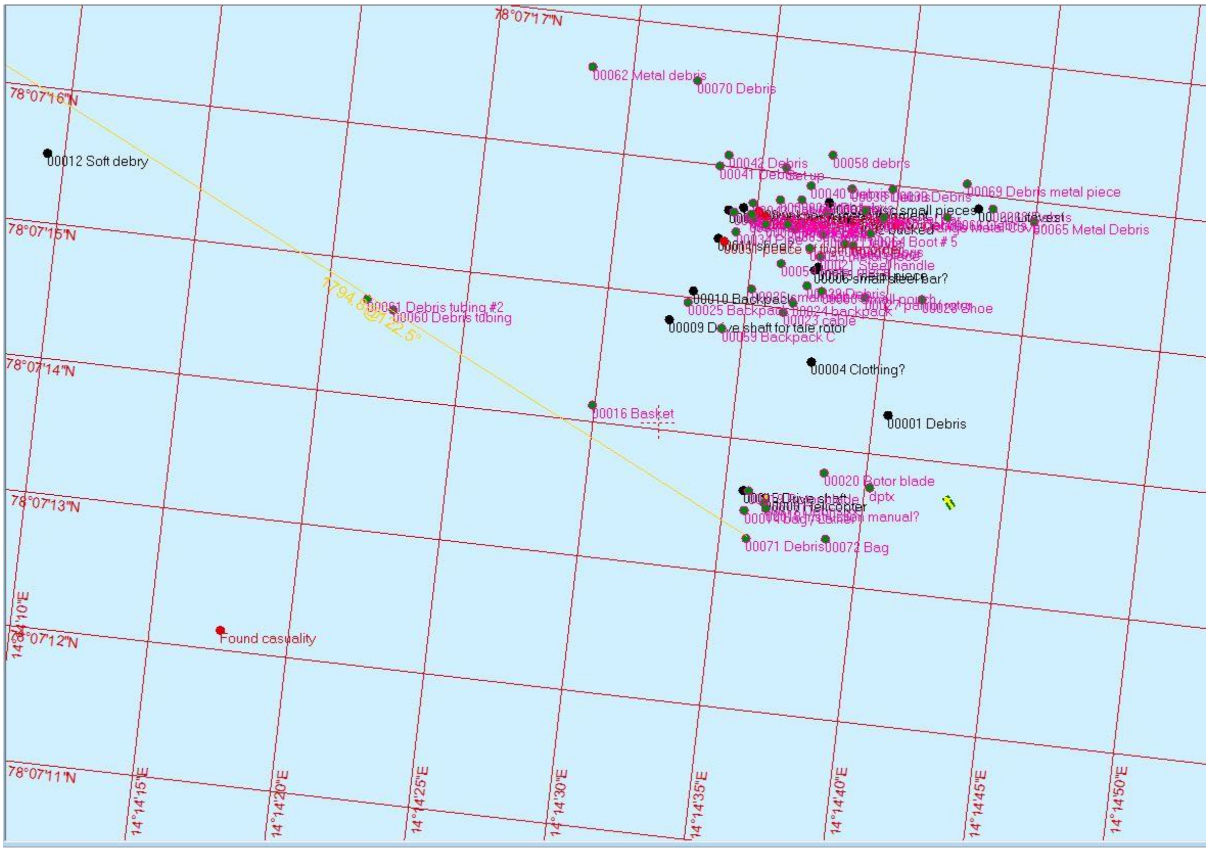


Figure 11: Mapping of objects found on the seabed. Source: Maersk Forza

1.12.2 Salvaging

1.12.2.1 AIBN contracted "Maersk Forza" on behalf of the Governor of Svalbard and AIBN. "Maersk Forza" is a vessel for underwater constructions. It is the oil industry that primarily uses this type of vessels to execute underwater work. The ship is equipped with a helideck, a 250-ton crane and two ROVs[19].

1.12.2.2 Immediately after arrival at Svalbard, the ship with its equipment joined the search for possibly deceased persons from the helicopter. The salvage of the helicopter started when its search mission was terminated.

[19] ROV – Remotely Operated Vehicle

Figure 12: Maersk Forza. Photo: Deepocean

Both ROV's had two manipulator arms and were well suited to attach the lifting gear to the helicopter, which lay at a depth of 209 meters (see Figure 13).

Figure 13: Maersk Forza ROV with manipulator arms. Photo: AIBN

1.12.2.3 Representatives from the helicopter design company were present on board the Maersk Forza during the lift operation and gave advice on how the lifting gear should be attached on the helicopter. The helicopter lay upside-down on the bottom. Using the ROV's manipulator arms, a chain was threaded in between the main rotor's pitch links[20] and around the main rotor shaft. The lifting hook from the ship's main crane was connected to the chain. When the lifting started November 3, the helicopter rolled over and remained hanging by the chain, which was around the main rotor shaft. The helicopter was then lifted up and early the night 4 November it was on board the Maersk Forza (see Figure 14).

Figure 14: The helicopter is lifted on board. Photo: The Governor of Svalbard

1.12.3 The helicopter wreck

1.12.3.1 The main fuselage was intact, whereas the aft part of the tail boom was found by its side. Damages to the underside of the helicopter indicate that it hit the water with the aft part of the main fuselage (Figure 15).

[20] Pitch links: Control rods that changes the angle of attack of the main rotor blades.

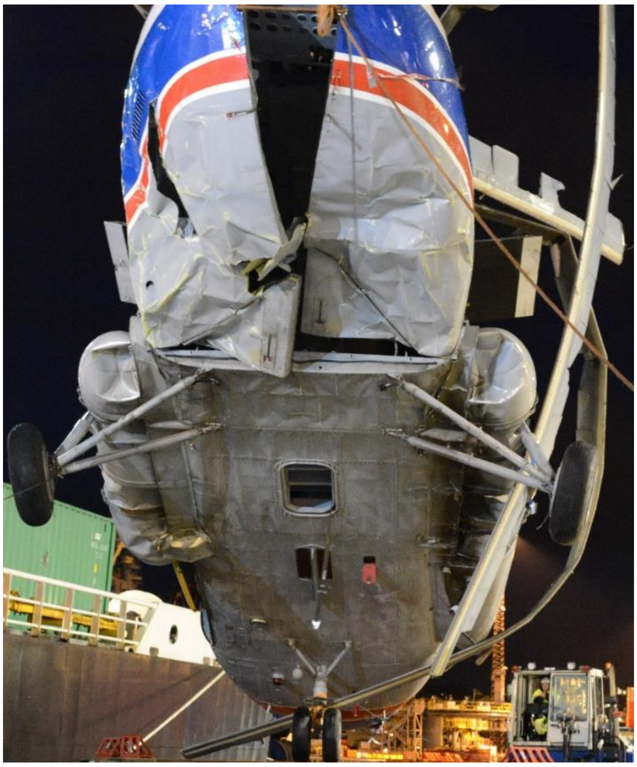


Figure 15: Damages to the underside of the helicopter. Photo: AIBN

1.12.3.2 The aft part of the central fuselage section had damages that probably occurred when the helicopter first hit the water surface, and when it later hit the sea bottom. The damages that occurred is shown in Figure 15, Figure 16 and Figure 17.

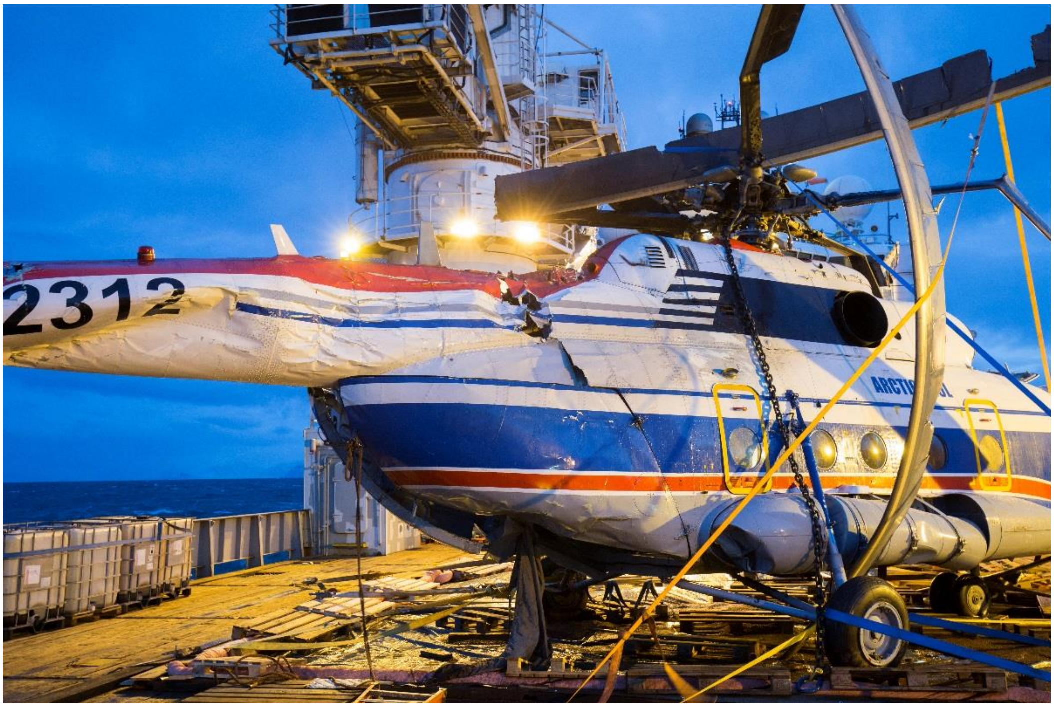


Figure 16: Structural damage on the fuselage on the right hand side. Photo: AIBN

Figure 17: Structural damage on the left hand side between the main fuselage and the tail boom. Photo: AIBN

1.12.3.3 The damages on the tail boom caused by impact of one or several main rotor blades occurred prior to the impact with the water surface. Due to the absence of FDR data, the actual attitude (roll and pitch) of the helicopter prior to the accident cannot be determined. The main rotor blade strike on the tail boom also hit the FDR unit which was damaged. (see Figure 18).

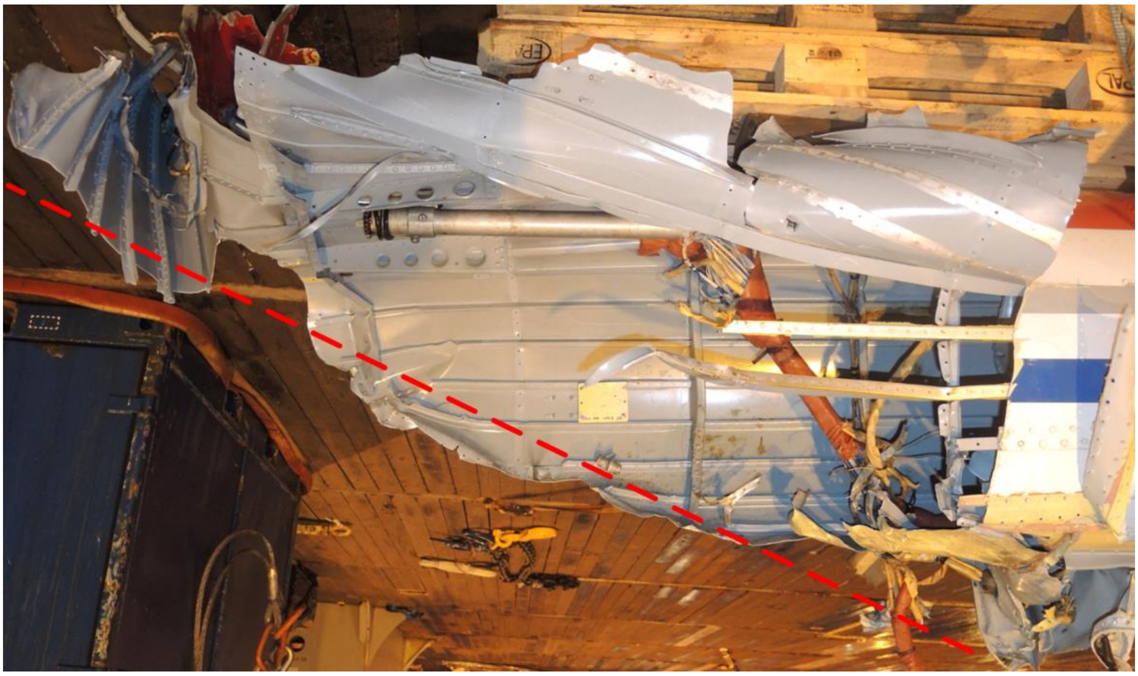


Figure 18: Severed tail boom. The dotted, red line indicates the rotational plane of the main rotor blades when the tail boom was broken upwards. (The photo is turned upside down to show the tail boom in the right direction.) Photo: AIBN

1.12.3.4 The helicopter was transported by boat from Svalbard to the offshore logistics base at Dusavika in Stavanger for further investigation. The accredited representative of the IAC/MAK was accompanied by three advisors from the helicopter design company. A comprehensive technical examination of the helicopter's dynamic components, avionics, control systems and engines was performed in cooperation with the AIBN. No technical malfunctions were found that could explain the cause of the accident.

1.12.3.5 A mechanical component in the helicopter flight control system was removed for further metallurgical investigation due to breakage in a bolt and deformation (see Figure 19). This investigation was conducted by the Aviation Register of the Russian Federation. It turned out that these damages were caused by overloads that occurred as a consequential damage at the impact on the water surface.

1.12.3.6 The signs of overloads in the flight control system necessitated a more detailed inspection of the lateral control channel mechanical linkage in order to look for possible structure damage and distortion. This inspection was coordinated by the IAC/MAK Accredited Representative and performed by maintenance personnel from the helicopter operator Convers Avia JSC in august 2019 under the supervision of AIBN. It was concluded that the visual inspection on site did not reveal any mechanical damages. Two components were removed for further inspection for signs of overloads.

1.12.3.7 The inspection focused on a broken bolt attaching P/N 8A-5103-250 Lateral Control Bellcrank to P/N 8A-5103-100 Shaft by the means of a half clamp attaching the bellcrank to the splined end of the shaft (See Figure 19).

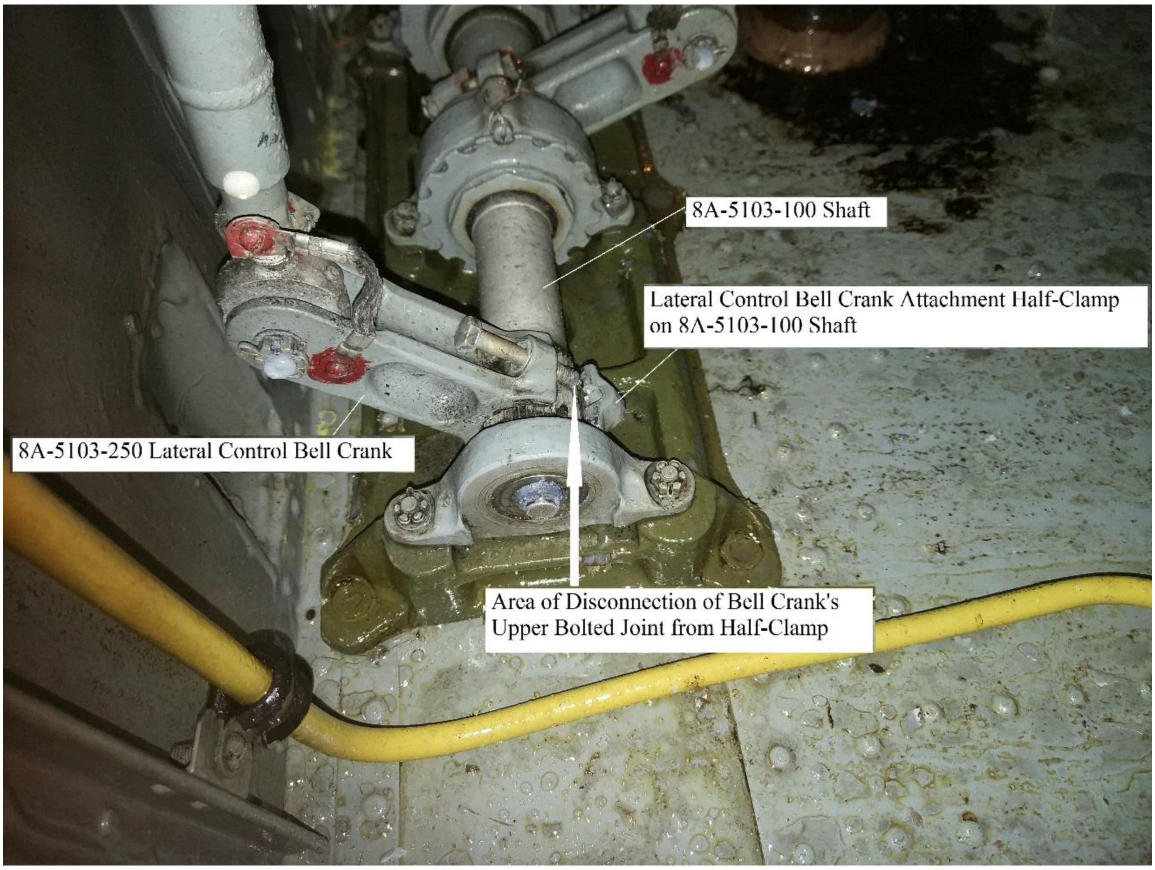


Figure 19: Failed bolt in Lateral flight control linkage. Photo: IAC/MAK

1.12.3.8 The damage on the bolt attaching the Lateral Control Bellcrank was found to be caused by excessive torque executed on the bolt when the unit of longitudinal, directional and collective pitch control system (P/N 8A-5103-220) was assembled. This particular installation had no specific requirement for torque value established in the design documents when this helicopter was manufactured. This value had generally been perceived to be equal to 8 Nm in compliance with the Industrial Standard OST 100017-89 requirement.

1.12.3.9 The Mil Moscow Helicopter Plant sent an official letter to the companies operating the helicopter type addressing the necessity of performing an unscheduled inspection of the control rods, brackets, levers and bellcranks of the flight control linkage for mechanical damage as well as presence and serviceability of the bolted joint stops. According to information gained from the operators, no findings have been revealed.

1.12.3.10 In order to prevent possible occurrence of such problems in the future, the Mil Moscow Helicopter Plant has added requirements in the respective design documents concerning standard torque values for all bolted joints on the bellcranks attaching them to the unit for longitudinal, lateral, directional and collective pitch control system.

1.13 Medical and pathological circumstances

The only person that was found, was brought to the University Hospital of North-Norway HF, Diagnostics clinic – Clinical pathology for post-mortem examination. AIBN also requested medical professional assistance from the Institute of Aviation Medicine at the University of Oslo to be present during the autopsy. The deceased was not found to have any injuries which would indicate that he was physically unable to evacuate the helicopter unaided. The report concludes that the cause of death was drowning, possibly combined with hypothermia. Analysis of the tests that were taken of the deceased did not reveal any intoxicants, drugs or a heightened content of carbon monoxide.

1.13.1 Hypothermia

The Institute of Air Medicine at the University of Oslo (FMI) has described how subcooling works in the following way:

> *As a homeothermic organism, we humans operate optimally when the central parts of our body have a temperature of about 37 ºC. We maintain this temperature by balancing heat production and heat dissipation. In cold environments, both physiological and behavioral changes will help maintain this constant body temperature. Transport of heat around the body occurs via the bloodstream. An early response to exposure to cold to reduce heat loss is to reduce blood flow to the peripheral parts of the body.*
>
> *The heat loss is determined by the temperature gradient between the environment and the body. In addition, moisture towards the body will also be important. It is four ways the body can deliver heat: Convection / heat flow, radiation, conduction/heat conduction and evaporation. In normal conditions, the greatest heat loss from the human body will occur via convection / heat flow. Immersed in water however, it is the conduction that is the deciding factor. Heat will be led from the body and to the environment that is in direct contact with the body's surface, and water conducts heat 20 - 30 times faster than air.*

Immersion in cold water is therefore an extreme challenge for us humans. It is common to divide such an event into four different phases. It is important to be aware that each of these phases is life-threatening, and the outcome can be fatal in each of these phases. The four phases are:

1. Initial cold shock (0-3 min)

2. Short-term exposure (3-30 min)

3. Long-term exposure (more than 30 minutes)

4. Post immersion response (during and after rescue)

The dangers associated with each of the first three steps are caused by the cooling of different parts of the body, starting with the cooling of the skin (initial response) and further spreading through the muscles that are closest to the body surface, especially in the arms and legs (short-term exposure). Finally, the cooling will spread to the body's core (long-term exposure). Previously, immersion in cold water was associated with the development of hypothermia, but it is only after one has come through the first two phases of the immersion that one is in a time phase where it is natural to talk about hypothermia.

Initial cold shock is one of the strongest stimuli we can be exposed to. The response will come about immediately and be strongest after approximately 30 seconds and will last for up to three minutes. The response greatly affects circulation and breathability. There will be an immediate contraction of peripheral blood vessels throughout the body that will increase blood flow back to the heart due to the hydrostatic pressure from the water around. At the same time, one will have an immediate increase in heart rate, with the result that blood pressure increases. This increases the strain on the heart. For people with heart disease, this can be fatal. Individuals with high blood pressure are at risk of developing a heart failure, or stroke. It will also increase the level of hormones that may affect the heart rhythm of vulnerable individuals. It is also known that immersion of the face can lead to an immediate cardiac arrest in some exposed individuals.

A sudden cooling of the skin will also initiate a respiratory response. This response is an almost instantaneous "gasp" which in turn will trigger a violent hyperventilation. This in turn will create both dizziness and confusion during the first phase of an immersion. This gasp is also so large that the ventilation will be close to the total lung capacity of the individual. Breathing fast on almost total lung capacity is basically heavy and very uncomfortable. When in water, the discomfort will be further enhanced, which may contribute to the feeling of panic in the individual who has ended up in the water.

Another important factor to be taken into account is that the ability to keep the breath is drastically reduced in cold water, from over one minute to well under ten seconds. If one is trapped inside a helicopter, the possibility of being able to swim out will also be very limited if there is no rescue equipment available to the person. It is the reduction in the ability to hold the breath that is considered the most dangerous response in an otherwise healthy individual. In addition, the risk of inhaling water, if the sea is in such a condition that waves will wash over the person has to be considered.

The probability for survival in cold water is illustrated in the following figure:

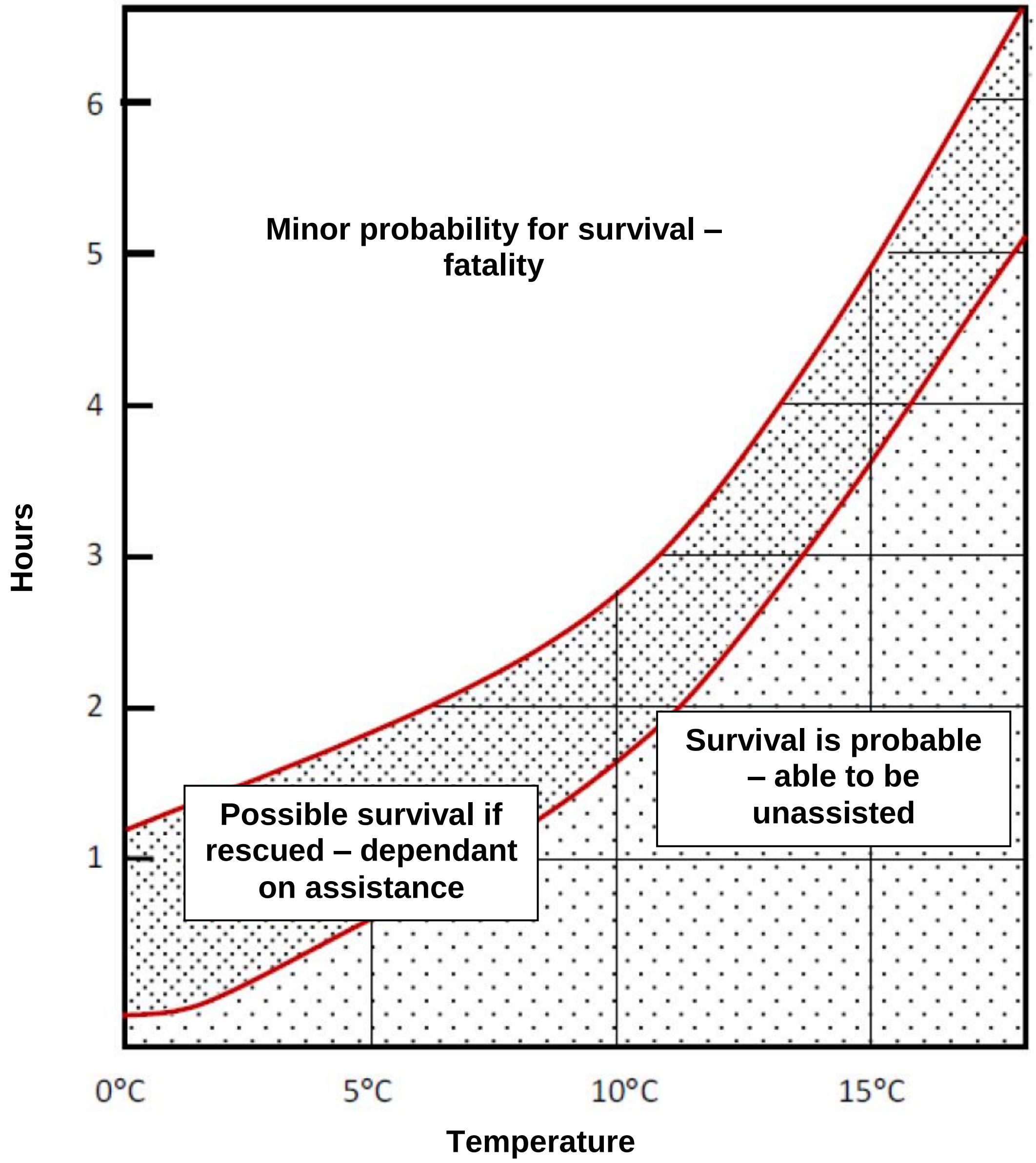


Figure20: Relationship between estimated survival time for an individual in standard winter clothing in different water temperatures.[21] The temperature in the sea was approximately 2 °C. Both crew and passengers wore standard winter clothing (1.15.2.4) Source: FMI and AIBN

1.14 Fire

There was no fire. One of the fire extinguishing bottles was released. The reason for this was a short circuit in the firing circuit caused by immersion in salt water when the helicopter ended up in the water.

1.15 Survival aspects

1.15.1 <u>The search and rescue operation</u>

1.15.1.1 Less than one hour after the time of the accident, boats were on their way to the accident area in Isfjorden to participate in the rescue operation. In addition, both helicopters, LT91

[21] Figure adapted from Barnett PW, 1962 and Thelma report 10-31

and LT92, which Lufttransport AS operates for the Governor of Svalbard were scrambled. The first helicopter was over the area approximately 1615, and the other helicopter was there approximately 1630. No objects were observed on the sea surface that indicated that RA-22312 had fallen into the water.

1.15.1.2 A local crisis response team was established in the hangar at Heerodden, and local area searches were organized. Two search groups, each of four persons, went east respectively towards Kapp Laila and inward along the Grønfjorden towards Barentsburg. They searched approximately 3 km in each direction without any observations.

1.15.1.3 In an evaluation report made by the Governor of Svalbard (December 2018), it transpires that the Governor was notified of the accident at 15:33, whereupon the Longyearbyen crisis management team was assembled. The Joint Rescue Coordination Center in Bodø took over the control of the search and rescue phase at 15:42. Subsequently, the amount of resources used to search for survivors escalated. The Governor of Svalbard have at their disposal 2 AS332L1 helicopters that are equipped for search and rescue. These helicopters have “Forward Looking InfraRed” (FLIR) search cameras for detection of objects with a temperature different than that of the surroundings. The Governor’s ship, “Polarsyssel”, was activated at 16:00.

1.15.1.4 A Bombardier Challenger aircraft from the Danish Air Force stationed on Greenland conducted search operations the same evening using its equipment. Several local boats came to the accident area the same evening to take part in the search. The smell of jet fuel was detected in the accident area. A Norwegian Air Force P-3 Orion and the Coast Guard vessels KV “Barentshav” and KV “Senja” arrived early the next morning to the area to take part in the search. It was decided to get an AUV[22] equipped with HUGIN[23] sonar up to Svalbard. It was transported by a C-130 Hercules from the Norwegian air force and arrived on October 27 in the evening. KV “Barentshav” became the platform for the operation of HUGIN. Searches using this AUV were started at 12:00 on October 28.

[22] AUV – Underwater Autonomous Vehicle
[23] On the time line in Figure 20, the AUV type is wrong. The correct model name is “HUGIN”.

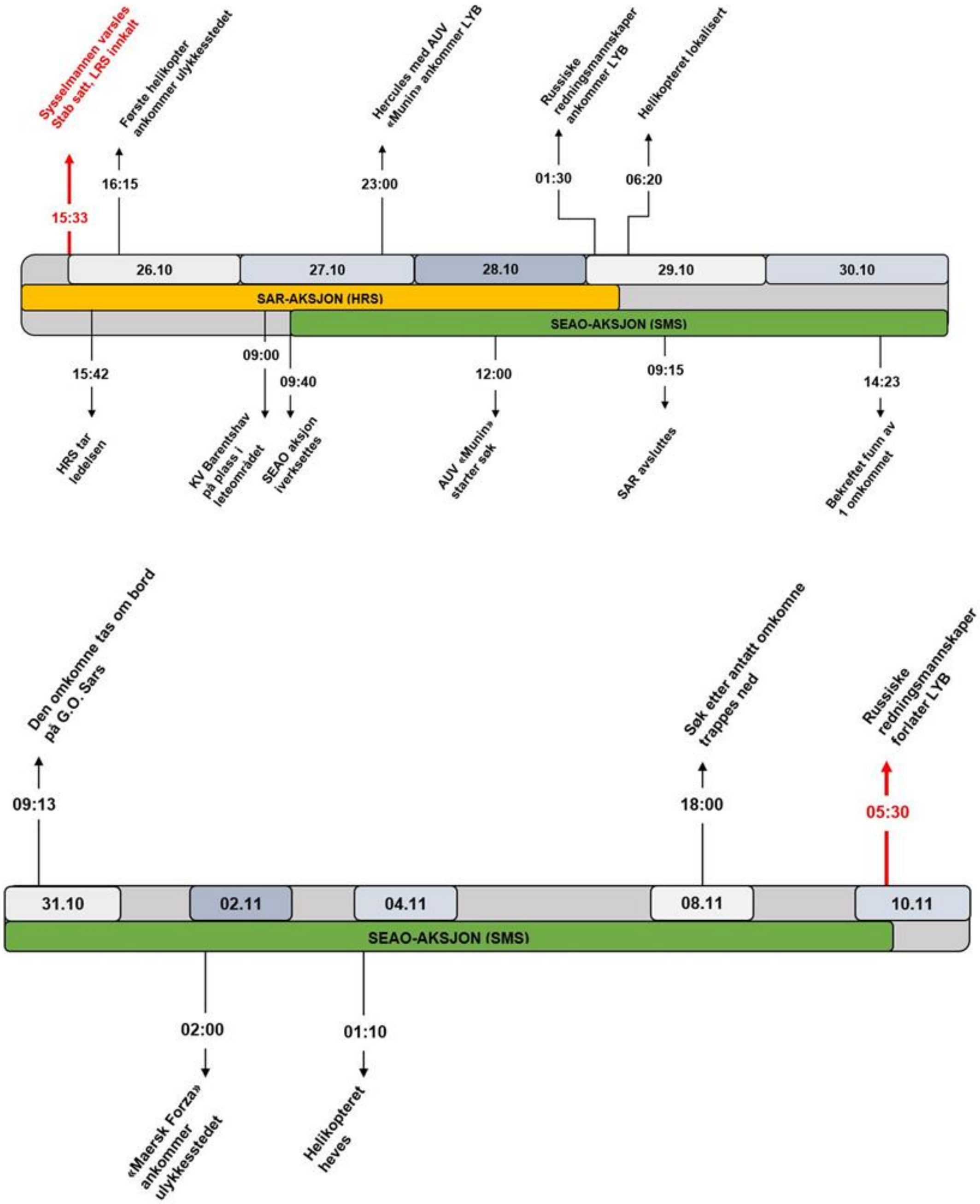


Figure 21: Time line from the Governor's evaluation report. Source: The Governor of Svalbard

The Institute of Marine Research's ship, "G.O. Sars", started searching in the area using an ROTV[24] in the afternoon of October 28. At 06:20 on October 29 "G.O. Sars" reported a possible find. This was later confirmed by KV "Barentshav". The deceased was later found and taken on board "G.O. Sars" at 09:13 on 31 October.

1.15.1.5 At 01:30 on October 29 a team from the Russian emergency ministry, EMERCOM, arrived. They had brought a ROV, scuba diving equipment and dinghies. These resources were among other things used to search along the shoreline, and the ROV was used for some search operations on the sea bottom. However the ROV did not have the necessary capability to fulfill this task.

[24] ROTV – Remotely Operated Towed Vehicle

1.15.1.6 The main part of the helicopter wreck was salvaged in the morning on November 4 and was hoisted aboard the Maersk Forza.

1.15.1.7 The search and rescue stage was concluded on October 29. A phase of search for missing persons presumed dead was started. Extensive searches along the shores on both sides of Isfjorden (see Figure 22Figure) were carried out. Several hundred kilometers of shoreline was examined by foot patrols, boats and scuba divers. No observations were made that could be connected to the accident. Despite the great efforts and extensive use of resources this search resulted in no findings. The search was stepped down on November 8 and terminated November 10.

Figure 22: Overview of shorelines searched after the accident. Source: The Governor of Svalbard

1.15.2 <u>Emergency equipment and evacuation</u>

1.15.2.1 RA-22312 crashed in the sea more than 2 km from land. The helicopter was not equipped with neither external Emergency Flotation Gear nor life raft. Such equipment was not required by aviation authority regulations.

1.15.2.2 In the helicopter's flight manual, which is developed by the helicopter design company, in chapter 6.10.1 the following is written about use of emergency equipment:

> ***COMMENTS****: During flights at a distance from the shoreline of no more than 25 km, it is enough to have on board only lifejackets for all crew members and passengers. Lifejackets must be put on before the flight.*

1.15.2.3 The helicopter design bureau has informed that after ditching the Mil Mi 8AMT can stay afloat for a short while if the fuselage is intact and without damages. In this accident the cargo doors in the aft of the cabin were deformed when the helicopter struck the water surface. The floor hatch for the cargo hook was not in place, thereby there was an opening in the floor as well. The cabin could thus fill up with water quickly (see Figure 23). Because of the weight of engines, main gearbox and main rotor, the center of gravity is so high that a helicopter without emergency flotation gear or sponsons is unstable and will easily capsize.

Figure 23: Deformed cargo doors due to impact with the water surface. The picture is taken looking towards the aft of the cabin and the cargo doors. Photo: The police

1.15.2.4 Neither crew nor passengers were wearing survival suits or lifejackets, only ordinary winter clothes appropriate for the weather conditions. After the helicopter wreck was salvaged, all but one of the helicopter’s lifejackets were found in their pockets underneath each seat. One lifejacket was found on the sea floor near the helicopter, and it had not been inflated.

1.15.2.5 At the time of the accident, the air temperature was approximately -2.5°C and the water temperature approximately +2ºC. Additionally, there was an easterly wind of approximately 15-20 knots, which generated waves. According to a report from the Institute of Air Medicine, exposed to these conditions without survival suit and without lifejackets meant that those on board probably only managed to stay on the surface for a few minutes (see also 1.13.1).

1.15.2.6 Of the eight persons on board, only one was found. The deceased was found at a depth of 200 meters approximately 150 meters to the southwest of the helicopter. Despite extensive searches with considerable resources, the remaining seven were not found. One can assume that they were taken away by the currents in Isfjorden.

1.15.2.7 At the time of the accident, the visibility was too poor see the coastline. Thereby it was difficult to know which direction to try to swim.

1.15.2.8 After the wreck was lifted on board, large loose rubber mats were found inside the cabin. According to the information AIBN was given, the mats were there to protect the cabin floor. These rubber mats were unknown to the company's engineering department at the head office in Tver in Russia (see Figure).

Figure 24: Black rubber mats in the helicopter cabin. The picture was taken facing forwards in the cabin. Photo: The police

1.15.3 Emergency locator transmitters

The helicopter was equipped with a COSPAS SARSAT ARM-406P emergency locator transmitter (ELT). This unit transmits at 406 MHz. In addition, the helicopter was equipped with an R-855 UM emergency radio with 121.5 MHz as operating frequency. The ARM-406 ELT and the R-855 UM emergency radio can be taken out of the helicopter for use after evacuation. According to the Joint Rescue Coordination Centre Bodø, no signal was received from the ARM-406P emergency beacon. The Commander of LT92 believed he heard a single beep that could be from an emergency beacon at that time. The R-855UM was found lying loose on the cockpit floor. However, the antenna was not deployed for use.

1.16 Special examinations

None.

1.17 Organization and management

1.17.1 General

According to the Svalbard Treaty of 1920, Norway has sovereignty over the Svalbard Archipelago. States that have signed the Svalbard treaty have the right to exploit the natural resources on the archipelago. The highest local authority on the archipelago is the Governor of Svalbard (Sysselmannen). The Russian company Trust Arktikugol started mining activities in Barentsburg in 1932. Barentsburg has since been a Russian mining town, and in 2017 it had a population of about 500. The highest Russian Authority is the Consul General.

1.17.2 Supervision

1.17.2.1 The Civil Aviation Authority Norway (CAA-N) supervises and inspects civil aviation in the same way on Svalbard as elsewhere in Norway. In accordance with the Norwegian Air Law, § 2-2 No. 3, commercial aviation within Norwegian territory requires approval from the CAA-N.

1.17.2.2 Convers Avia JSC in 2011 received permission from the CAA-N to provide helicopter services on behalf of Trust Arktikugol. Use of helicopters was to be limited to the mining company's economical and scientific activities. The CAA-N, based on the application, approved Convers Avia JSC to fly in connection with the mining company's activities.

1.17.3 Regulations

1.17.3.1 It follows from Regulations of 23 November 1973 No. 3427 on Aviation in Svalbard, § 1, that the Civil Aviation Law and related regulations apply to Svalbard unless otherwise stated in the individual regulations. In Norway, the common European aviation (EASA) rules were applied under the EEA agreement, but Svalbard is not covered by the EASA rules. This means that if the EASA rules are to be applied to Svalbard, they must be incorporated as a part of the national Norwegian regulations.

1.17.3.2 All air operators, both Norwegian and foreign, who have established operations at Svalbard, must have a permit from the CAA-N, cf. Regulations on aviation in Svalbard, § 2. For foreign operators, such permission is referred to as "traffic permit". The CAA-N can, through such a traffic permit, describe conditions for the foreign operator's activities, the CAA-N wants the operator to comply with.

1.17.3.3 BSL[25] D 1-8 sets requirements for emergency equipment for single engine aircraft flights and additional requirements for flights on Svalbard. Similar requirements for multi-engine helicopters are not described.

1.17.3.4 The CAA-N has started work on regulations to provide additional requirements for different types of aviation in Norway beyond what follows from the EASA regulations. There are already such additional requirements for offshore helicopter operations laid down in BSL D 2-3. It can also be mentioned that the Ministry of Transport, at the request of the CAA-N, imposes additional requirements on emergency escape equipment for multi engine helicopters flying on the Bodø-Værøy scheduled passenger route. This is based on the fact that this is flying under demanding climatic conditions. In the ongoing work by CAA-N on the new regulations, the current regulations is debated and relevant updating of the regulation for flights on Svalbard is suggested and currently in a consultation process.

1.17.4 The helicopter company

1.17.4.1 Convers Avia JSC received its Air Operator's Certificate (AOC) in 1995. The company has its base airport at Zmeyovo airport near the city of Tver, northwest of Moscow. The

[25] Regulations for Civil Aviation issued by the CAA-N

company operates approximately 30 helicopters of the types Mil Mi 8T, Mil Mi 8MTV, Mil Mi 8AMT, Mil Mi-2 and Robinson 44.

1.17.4.2 The company's market is mainly in Russia, where they provide services to the oil industry, tourism industry, transport companies and local district authorities. In addition, Convers Avia JSC operates in Arctic areas and in Africa, the Middle East and Afghanistan.

1.17.4.3 Convers Avia JSC took over the helicopter contract with Trust Arktikugol in 2011 from the helicopter company GazAvia (formerly Spark +).

1.17.4.4 Convers Avia JSC helicopter operations on Svalbard are based on visual flight rules (VFR). Both pilots on the RA-22312 were approved for VFR flights only. Procedures for planning and execution of flight with regard to weather conditions have been set forth in the company's "Combined Flight Operations Manual"[26]:

> ***Flight Performance. Procedures for flight crew under standard flight conditions for every phase of flight.***
>
> ***Cruise Flight***
>
> *In case of inadvertent encountering of hazardous weather phenomena, the flight crew must comply with the recommendations, provided in the Combined Flight Operations Manual*
>
> *In case of signs of approaching the zone with hazardous weather phenomena or in case of receiving the associated information, the PIC[27] must take measures in order to avoid entering into this hazardous zone, if the flight in the expected conditions is not allowed by the Combined Flight Operations Manual. In case it is impossible to continue the flight to the desired destination due to the hazardous weather phenomena, the PIC can perform the landing at the alternate airdrome or return to the departure airdrome.*
>
> *In case of the communication available, the PIC must inform the ATC on the decision taken and on the flight crew actions, and the ATC must take the necessary measures to provide further flight safety.*

1.17.4.5 Procedures for "Pilot flying" (PF) and "Pilot Monitoring" (PM) are described in the company's Operations Manual (OM) "General Section":

> *Depending on the flight conditions and the variants of the pilots' interaction, the piloting divided into active piloting and monitoring.*
>
> ***The Pilot Flying:***
>
> - *provides the helicopter piloting by operating the helicopter controls, or, by maintaining the desired flight mode by means of the autopilot system,*
> - *issues commands for the control of the helicopter systems;*
> - *monitors the radio communication exchange.*

[26] This manual is a composite document consisting of "Flight Crew Operations Manual" (FCOM), "Aircraft Flight Manual" (AFM), and partly "Flight Crew Training Manual" (FCTM), and "Operations Manual" (OM).
[27] PIC – Pilot In Command

The Pilot Monitoring:

- *during takeoff, approach and landing keeps his/her hands slightly on the helicopter controls; in case of the deviation from the desired parameters to the allowable limit values, reports on the above-mentioned deviations and, operating the controls, assists in eliminating these deviations;*
- *maintains the radio communication exchange;*
- *keeps himself/herself constantly ready to take over the helicopter control either on command or in case of the unexpected incapacitation of the Pilot Flying;*
- *operates and monitors the helicopter systems.*

1.17.4.6 Procedures for Go-Around as described Operations Manual chapter 17:

Go-Around

If further approach is unsafe, the PIC must perform the go-around maneuver.

The PIC must abort the descent and continue the missed approach (perform the go-around) (or for example, return to the alternate airport), if:

- *there are a hazardous weather conditions;*
- *prior to the established reliable visual contact with the approach lights or other visual reference along the landing heading, the decision altitude/height warning and (or) hazardous ground proximity warning have (has) been triggered;*
- *the visual contact with the approach lights (runway lights) or ground reference has been lost during the descent below the DA/H or MDA/H;*
- *the calculated approach and landing parameters do not ensure a safe landing.*

In case the approach and landing to the controlled-space aerodrome have not been cleared on reaching the height of 60 m above the aerodrome, but not below the DA/H or MDA/H, the missed approach (go-around) procedure shall be performed.

On completion of the missed approach (go-around) procedure, the PIC makes a decision on either repeating the approach and landing or divert to alternate airport, pending on fuel reserves and weather conditions.

1.17.4.7 The company's audit of the helicopter operations at Heerodden was carried out through an internal audit program. According to the airline, audits were performed quarterly on the base. These audits were conducted according to established checklists.

1.18 Other information

1.18.1 VFR operations and flight safety

1.18.1.1 In 2016, the US Federal Aviation Authority (FAA) held a “Rotorcraft Safety Conference” where one part dealt with analysis of 104 helicopter accidents during the period 2009 - 2013. This shows that 16% of accidents are caused by accidental entry into too poor visibility to be able to fly VFR. (Unintended flight into Instrument Meteorological Conditions - UIMC). Not anticipated deterioration of weather conditions is the main reason for coming in such a situation. The UIMC was the second most common triggering factor. The most common factor was Loss of Control (LOC) of the helicopter.

1.18.1.2 According to Eurocontrol's "Helicopter Point in Space Operations in Controlled and Uncontrolled Airspace - Generic Safety Case Report", released 7 March 2019, additional factors affecting aviation safety are the following (the factors relevant to Svalbard are included):

- *Helicopter not approved for IFR operations: flights in bad weather conditions cannot be conducted. This seriously reduces the number of rotations. Operators hesitate to convert to IFR due to high and often long routing IFR routes, resulting in increased risk for VFR operation in poor weather and/or inadvertent IMC. Inadvertent IMC has been one of the highest causes of accidents – with operators often not investing in training and certifying for this capability;*
- *The transition of daylight towards night is recognized as being difficult to handle for the pilot as its vision and the sharpness of contrast starts to diminish rapidly;*
- *Changing weather conditions (in or near mountains, forests, sea) can rapidly lead to dangerous situations for the crew and passengers;*
- *technical issues such as de-icing and anti-icing equipment, etc.*
- *the missing helicopter dedicated IFR Infrastructure*
- *missing local low weather information*
- *missing accurate obstacle and terrain data*

1.18.2 "Point in Space" (PinS) operations

Eurocontrol's "Helicopter Point in Space operations in controlled and uncontrolled airspace - Generic Safety Case Report" describes this concept as follows:

> *The Point-in-Space (PinS) concept is a flight operation based on GNSS[28] and designed for helicopter only. It relies on the possibility for the pilot to conduct flight under Instrument Meteorological Conditions (IMC) to/from a Point-in-Space (PinS) and not directly to/from the heliport. Those procedures enable to implement IFR procedures on non-instrument FATO (Final Approach and Take-Off) located on aerodromes or isolated heliports as well as landing locations.*
>
> *Another interest of the PinS concept is the flexibility to position the PinS in order to deal with heliports generally located in obstacle-rich environments (heliports on hospitals for instance). For approach, this flexibility allows a lower obstacle clearance height (OCH) than with the direct procedure due to the position of the MAPt[29] which can be located away from the FATO and makes the missed approach less critical regarding the obstacles.*
>
> *Two kinds of PinS operations are possible: PinS departure operations and PinS approach operations. The scope of this document covers all published procedures, including the ones with possible restrictions of use (e.g. restricted for some operations only or to some operators only).*

[28] GNSS – Global Navigation Satellite System, generic term for all types of satellite navigation systems.
[29] Missed Approach point

1.18.3 “Plan continuation bias”

A known risk factor that has contributed to several accidents is known as “get-home-it is”. This has been a triggering cause of many fatal accidents worldwide, and involves a strong tendency to want to continue as planned, despite the fact that the situation is changing along the way and should have initiated a reassessment of the original plan (see SL REP 2020/03). Examples of this may be changes in the weather situation or technical problems with the aircraft, which indicate that one should have landed as soon as possible. “Plan continuation bias” can, in many cases, also include an element of investing time, money, and effort to reach a destination, and feeling reluctant to consider this investment lost by changing the original plan.[30] The tendency to want to continue despite the fact that the situation has changed can be a deliberate decision, but it can also be an unconscious influence on how to perceive and judge the situation, cf. website Skybrary:

> *Plan Continuation Bias is the unconscious cognitive bias to continue with the original plan in spite of changing conditions.*

The tendency to want to continue, despite the situation having changed, seems to be stronger as the end of a task approaches, such as when approaching an airport. It is especially flying under VFR conditions that increase the risk of accidents, where in order to arrive, one fly into such poor visibility conditions that visual references are lost. In such circumstances, the danger of losing control of the aircraft increases dramatically.

1.19 Useful or effective examination methods

None.

2. ANALYSIS

2.1 Introduction

2.1.1 The AIBN's investigations and interviews with persons involved do not give any indication of technical failure of the helicopter or any of its systems prior to the accident. On the other hand, there are circumstantial factors indicating that safety problems related to operational conditions in a challenging weather situation contributed to the accident. Based on available information, the AIBN concludes that the helicopter hit the water surface with the tail portion of the fuselage first at low or no speed forward. This indicates the loss of visual references in poor visibility with subsequent loss of control over the helicopter. Therefore, in the analysis, focus will be on general operational conditions, weather conditions and the change in visibility conditions during the approach, which probably led to the loss of visual references. In addition, the survival aspect will be discussed.

2.1.2 Based on weather information collected from several sources, a comprehensive assessment of the weather conditions during the critical part of the flight, shows that it was possible to fly according to visual flight rules outside of the heaviest snow showers. AIBN has, however, learned that in the area in question there may occur substantial local

[30] Arkes & Blumer, 1985

variations in weather conditions, which may quickly be of importance for whether a flight should be continued or discontinued.

2.2 Executing approach to Heerodden

2.2.1 The air crew had operational experience from Svalbard, and thus also experience with how weather conditions can change in Isfjorden. Stationed at Heerodden, their assignment was to execute transport missions between the coal mining company's bases in Barentsburg, Pyramiden and Svalbard Airport Longyearbyen. The AIBN concludes that this flight was operationally routine for the flight crew.

2.2.2 Being familiar in an area can be both positive and negative, in relation to the risk that one can be exposed to, and how the assessments of the relevant weather conditions were handled in the decision-making process of the flight crew. It is often easier to "stretch longer" in a geographical area where one is locally known than if the flight takes place in an unknown area.

2.2.3 Only three and a half hours before the accident was a fact, they had flown the opposite way in daylight from Heerodden to Pyramiden with passengers. With the exception of the QNH (995 hPa) conveyed to RA-22312 when they checked in with AFIS at Svalbard Airport, no information has come to light indicating that the flight crew obtained weather information from AFIS at Svalbard Airport before taking off from Pyramiden.

2.2.4 The tower duty officer at Heerodden contacted RA-22312 three and a half minutes after departure from Pyramiden with information on deteriorating local weather conditions at Heerodden.

2.2.5 During the minutes that followed, the Commander requested that the "anti-icing" system be activated and that all "anti-icing" should be switched on. This may indicate that based on the most recent weather update from Heerodden, there existed an expectation of icing conditions up ahead, and that the Commander consequently wanted to assure himself that the system was activated. This must be viewed as good sense of judgement and a wish to be one step ahead, not least because the system alerted the crew of actual icing only 8 minutes later. AIBNs view is that everything indicates that the "anti-icing" system was working as it is designed to do, and the flight engineer on board the helicopter also confirmed that all parameters and power consumption were within allowable limits. There is, in other words, no indication that icing was a factor in connection with the accident.

2.2.6 The wind conditions further out in the fjord may have been different than the most recently reported wind from Heerodden. LT92 Super Puma passed Heerodden only 10 minutes before the time of the accident. The Commander on LT92 has stated that it was the dense snow showers, the powerful wind and some turbulence that constituted a challenge on the day in question. The Commander on LT92 has long experience as a helicopter pilot on Svalbard, and he pointed out that there can be major local differences when it comes to wind and weather boundaries.

2.2.7 Based on an overall assessment of available information, the Accident Investigation Board finds it likely that wind conditions in Isfjorden some kilometers north of Heerodden may have been quite different than on the landing site itself. It is therefore a probability that wind conditions contributed to the accident, by a combination of the helicopter’s low speed, low altitude and the changing wind conditions, including a tail wind together with a crosswind component.

2.2.8 The CVR recordings from the communication between the First Officer and the Commander indicate that the first phase of the approach towards Heerodden was controlled and routine. The Commander who was Pilot Monitoring called out speeds and heights. In the final phase, just before the accident, the First Officer had problems following the expected altitude profile and there were altitude and course variations, which was pointed out by the Commander. The radio altimeter audio warning was activated when the helicopter descended through 60 meters altitude. The communication in the last 10 seconds before the accident was characterized by the crew’s spatial disorientation. Nor did it appear from the recordings that the Commander intended to take over the control of the helicopter.

2.2.9 In this case, the visibility conditions were significantly lower than the minima that were set by Convers Avia JSC. It is conceivable that the crew of RA-22312 chose to continue the approach in the hope that they would get a “window” with better weather conditions closer to Heerodden since the visibility varied between snow showers. The tower operator's assessment of visibility near the time of the accident was horizontally approximately 900–1 000 m and vertically approximately 100 m. The conditions therefore facilitated the possibility of loss of visual references at low altitude and low speed.

2.2.10 The damages on the helicopter suggests that it has hit the water with low or no speed forward, and with a nose up pitch attitude. This indicates the crew’s loss of visual references in the poor visibility.

2.2.11 One factor that may have contributed to the accident can be that during the final phase of the flight, the crew unknowingly failed to adapt to the weather conditions that had deteriorated, thereby failing to abort the approach to Heerodden to either return to Pyramiden, or to Svalbard Airport under visual conditions. This is a well known syndrome called “get-home-it is”, or “plan continuation bias”. In summary, this means that one follows a set plan, even if there are changes that should have led to adaptation. This may explain that they continued the approach to the base at Heerodden even though the visibility was reported from the tower officer to be far below defined weather minima. It may be that a combination of “plan continuation bias” and lack of instrument ratings for the pilots could be factors that have contributed to the accident. The AIBN knows that the weather situation generally changes rapidly in Svalbard.

2.2.12 The accident flight took place at dusk. Parts of the winter season have limited daylight for VFR operations.

2.2.13 Svalbard has a climate with widely varying local weather conditions and associated variation in visibility conditions. During this accident, this has caused the RA-22312 during the last phase of a VFR flight to experience reduced visibility conditions. This probably led the pilots to lose the references to the ground at low speed, combined with an adverse wind component from behind. The AIBN believes that the flight crew stretched the safety margins defined by declared VFR weather minima so far that they did not have the opportunity to get out of the situation without climbing out into IMC conditions. The landing site at Heerodden did not have equipment for instrument approach, and the helicopter company allowed only VFR operations on Svalbard. The pilots flying the RA-22312 also did not have instrument ratings. When the tower at Heerodden reported visibility significantly less than the VFR minima defined for the landing site, they should have aborted the approach, and diverted either to Svalbard Airport where the approach could have been performed under visual conditions or to Pyramiden.

2.3 The survival aspect

2.3.1 RA-22312 crashed in the sea more than 2 km from land. Since none of the crew members or passengers were found in the helicopter after it was recovered, there is reason to assume that all of them had been able to evacuate the helicopter after it hit the water. Based on the autopsy report for the one person that was found on the sea bed, it can be assumed that the impact with the water did not cause the persons on board such injury that it would have disabled them to such a degree that they could not evacuate the helicopter.

2.3.2 RA-22312 had sustained damages to the underside of the fuselage, and the cargo doors in the aft of the cabin were severely deformed. These doors were deformed by the impact when the helicopter hit the water surface. The cabin must have been filled up with water quickly due to the deformed doors. It is reasonable to assume that the helicopter with its high positioned centre of gravity soon became unstable and overturned.

2.3.3 None of the passengers had put on the lifejackets that were placed in a pocket under each seat in the cabin. One of the lifejackets was found uninflated on the sea bottom. The rest were still in their pockets underneath the passenger seats. This also indicates that very little time elapsed from the helicopter hitting the water until it became necessary to evacuate. Based on the available information about the possibility to survive in water temperature of 2 °C, the AIBN believes that those on board had very little opportunity to survive without protection in the form of survival suits. Since RA-22312 was not equipped with external emergency floats or liferaft, everyone on board had to evacuate in to the sea. They only had normal winter clothing that did not prevent water ingress with rapidly following cold shock and hypothermia. It is very likely that they quickly lost the ability to stay afloat on the surface.

2.3.4 The floor of the cabin in the helicopter was protected by large and heavy rubber mats which were not secured. These had moved around in the cabin after the helicopter had overturned, and they were found in front of the cabin. These could have prevented evacuation in a different accident scenario. These rubber mats were unknown to the company's technical department at the head office.

2.3.5 Search and Rescue

2.3.5.1 The Governor of Svalbard’s helicopters came to the accident area within about an hour and started a surface search with infrared search equipment. Several local vessels came to the area and assisted in surface and shoreline searches. AIBN finds that the local resources that were available on short notice were used correctly, in view of the certainty that any survivors were at great risk of hypothermia. In this accident, unfortunately, the survivors lost their ability to stay on the surface within few minutes.

2.3.5.2 The helicopter was equipped with two emergency locator beacons. Because the impact forces were relatively small, these did not start to transmit. One of the emergency beacons was found on the floor of the cockpit, but it was neither manually activated nor was the antenna unfolded. This strengthens the certainty that everything happened quickly as they hit the sea surface.

2.3.5.3 The Danish and later the Norwegian air force arrived in the area with fixed wing aircraft that had suitable equipment for surface search within hours. Considerable maritime resources arrived in the area equipped with ROV's and AUV, which were used to search the sea bottom. The helicopter wreck was found using this equipment.

2.3.5.4 This search and rescue operation clearly shows that aircraft operating in the arctic region should be equipped with adequate emergency equipment which provides a better chance to survive until rescue is a fact. In addition to the aircraft's equipment, personal equipment such as life vests and clothing that protects from exposure to hypothermia in water should also be a part of the barrier that increases the probability of survival.

2.3.5.5 If the emergency locator beacons had started to transmit, they would only be detectable as long as they were over water. Emergency locator beacons are not detectable when they are submerged. Acoustic underwater locator beacons (ULB) will however transmit signals when submerged.

2.3.5.6 If the flight data recorder and/or cockpit voice recorder had been equipped with ULB, it could have shortened the search phase to locate the helicopter. However, such equipment would not have helped to save lives.

2.4 The company's organization

2.4.1 Several factors indicate that the company's procedures were not fully complied with. This investigation has uncovered proficiency testing incorrectly conducted for a pilot in October 2017, and locally made floor protection in the helicopter in the form of loose and heavy rubber mats, which could have complicated the evacuation of the helicopter. These rubber mats were unknown to the company's engineering department in Tver. Additionally, none of the persons on board were wearing lifejackets, which the helicopter design company's manual requires regardless of the distance from the shoreline. The impression AIBN is left with, is that the airline organization at Heerodden may have lived a life secluded from the helicopter company's main base in Tver, Russia, even though the landing site is subject to quarterly internal revisions. The AIBN proposes two safety recommendations in this connection.

EASA OPS requires general emergency equipment and raft for flight with a flight time exceeding 10 minutes from ashore. This particular flight was well within these margins, The helicopter was not equipped with neither emergency flotation gear nor life raft. Neither Russian nor Norwegian current regulations contain any requirements regarding such emergency equipment for multi-engine helicopters operated in polar areas. Bearing in mind how quickly hypothermia can develop in low water temperatures, AIBN is of the opinion the emergency equipment configuration for multi engine helicopters should be adapted to the climatic conditions through requirements given by the aviation authority.

2.4.2 According to the company's director after the accident, the issue of installing additional equipment and furnishings (i.e. life rafts, survival suits, emergency flotation gear, etc.) is currently being considered. This issue is being discussed with the supplier of the replacement helicopter. Without being completely comparable, it can be mentioned that such equipment is standard for all Norwegian helicopter operations to offshore oil production installations.

2.5 Flight Data Recorder

2.5.1 The flight data recorder in RA-22312 was not equipped with an underwater acoustic transmitter (ULB). This was not a requirement at the time of the accident. ICAO Annex 6 Appendix 4 “Flight Recorders” requires that such transmitters be mounted on these recorders no later than 1 January 2018. Therefore, the AIBN does not propose any safety recommendation on this subject.

2.5.2 The flight data recorder in RA-22312 was destroyed by a main rotor blade strike. AIBN is aware that there are alternative locations of this unit for the helicopter type. Accidents where the flight data recorder has been destroyed for other reasons have contributed to alternative solutions being designed. In this case, another location would have been better, but it is not correct by the Accident Investigation Board, based on this one accident, to propose another location.

2.6 Current regulations

2.6.1 Current Norwegian regulations do not set any special requirements for safety equipment for use in polar areas in multi-engine helicopters. However, there are requirements for such equipment in single-engine aircraft, and thus single-engine helicopters. The actual regulation applies to all single engine helicopter operations at Svalbard. AIBN believes that with the climatic conditions that exist in polar regions, it should be considered to make adjustments to Norwegian regulations that define suitable minimum requirements for personal equipment and safety equipment also on multi-engine helicopters when flying in such areas. The AIBN proposes one safety recommendation on this subject.

2.6.2 Helicopter operations that takes place on a full-year basis in Svalbard also takes place in the polar night season with the rapidly changing visibility and weather conditions that exist in the area. These are conditions that are known to lead to helicopter accidents. AIBN believes that in order to be able to carry out helicopter services on Svalbard year-round in a safer manner, the Civil Aviation Authority Norway must set requirements to be able to carry out such flights based on instruments flight rules if circumstances so warrant. Such a requirement can be reflected in the possibilities GNSS based PinS operations can provide. The AIBN proposes one safety recommendation on this subject.

3. CONCLUSION

3.1 Investigation results

A Mil Mi 8AMT helicopter on the way from Pyramiden to Heerodden at Svalbard crashed in Isfjorden outside Heerodden on 26 October 2017. The helicopter was in the last phase of the approach to the landing site when it hit the sea. This investigation shows that they had begun the approach even though the visibility was significantly less than that set as minima. AIBN concludes that the accident occurred after loss of visual references. The impact with the sea surface was with little energy, and everyone on board were able to evacuate the helicopter. None of the occupants had adequate survival equipment to survive in the cold water.

3.1.1 General

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

b) The aircraft's mass and center of gravity were within allowable limits at the time of the accident.

c) In the course of this investigation, no technical failures or irregularities have been found, that might have contributed to the course of events.

d) The helicopter, at the time of the accident, had 1,276 kg fuel on board.

e) The crew members had valid certificates and ratings on the helicopter type and can be characterized as experienced and well acquainted with the local area. They did not have instrument ratings.

f) The company's policy regarding flights on Svalbard was that only VFR flights were allowed.

g) The helicopter was equipped for instrument flights (IFR), but did not have Ground Proximity Warning System.

h) The helicopter was equipped with electric main and tail rotor blade de-icing.

i) The helicopter's flight data recorder did not have an underwater acoustic transmitter. ICAO requirements for such equipment came into force on 1 January 2018. Lack of such equipment made the search phase difficult.

j) The Flight Data Recorder in this accident did not have sufficient protection.

k) No signal was registered from the helicopter's emergency locator transmitters (ELTs).

3.1.2 The approach to Heerodden

a) The helicopter crew, en route from Pyramiden, received a weather update from the tower officer at Heerodden. Visibility was reported as being 900 to 1000 meters horizontal visibility and 100 m vertical visibility in snow showers. Current minima for Heerodden were 5000 meters horizontal visibility and 450 m vertical visibility.

b) The helicopter's anti-icing system was activated and confirmed to be operational by the crew well in advance on the way to Heerodden. The AIBN does not consider icing to have contributed to the accident.

c) Standard approach brief was routinely given approximately 6 minutes before the time of the accident.

d) During the stage immediately prior to the time of the accident, the helicopter shifted heading considerably to the left, altitude warning came on, the speed went down towards approximately 13 km/h, and the altitude was approximately 40 meters immediately prior to the time of the accident.

e) The First Officer was "Pilot Flying".

f) The Commander made the First Officer, who was flying the helicopter, aware of the considerable heading shift approximately 15 seconds before the time of the accident. However he did not take control of the helicopter.

g) Loss of visual references in poor visibility has probably led to the crew losing control of the helicopter. Probably, contributing factors were the combination of low airspeed, low altitude and changing wind conditions including tail- and crosswind components. Due to the absence of FDR data, it was not possible to come to a firm conclusion on the development of the last segment of the flight. Available data indicates that the pilots were exposed to spatial disorientation.

3.1.3 The accident

a) The damages on the tailboom, caused by impact of main rotor blades occurred prior to the moment when the fuselage and tail boom hit the water surface. The helicopter impacted the water surface with the aft fuselage section and forward part of the tail boom. The aft part of the tail boom was at this stage separated from the helicopter. The deformation of the central fuselage section and cargo doors show that the helicopter hit the water surface with a left bank and a nose-up attitude. Due to the absence of FDR data, the helicopter attitude before the impact with the water surface was not possible to be established based on FDR parameters.

b) The helicopter with its highly located centre of gravity probably overturned shortly after the impact with the water.

c) The FDR disintegrated due to the mechanical impact of the main rotor blades affecting it and the tail boom during the accident. Consequently, the data from the FDR have not been available for the investigation.

3.1.4 The survival aspect

a) The helicopter was not equipped with life raft and emergency flotation equipment. Such equipment was not made mandatory by the aviation authority.

b) All persons on board had to evacuate out into the water from the helicopter: They were not equipped with survival suits. The helicopter was equipped with lifejackets for all persons on board, but none were used by neither crew nor passengers during the flight from Pyramiden to Heerodden.

c) Given the water and air temperatures and wind conditions, within a few minutes, hypothermia made it impossible for the persons on board to stay on the surface.

d) Due to the weather conditions at the time of the accident, land was not visible from the accident site.

e) The first of the Governor's helicopters was over the scene of the accident at 1615 hrs, one hour after the accident. No traces of the helicopter or the fatalities were found on the sea surface.

f) After an extensive search both on land and in the sea, only one of the fatalities was found on the seafloor.

3.1.5 Organization and supervision

a) The investigation has revealed several deviations from company procedures in the helicopter company's organization at Heerodden. AIBN views this as possible indications that the local company organization in several fields may have developed local practices that do not coincide with the company's standards.

b) As a consequence of this accident, The Trust Arcticugol is currently considering the issue of installing additional emergency equipment (life raft, survival suits, emergency flotation gear, etc.) when a replacement helicopter is purchased for the flight operations at Svalbard.

3.1.6 Current Norwegian regulations

a) Current Norwegian regulations do not set any requirements for equipment for survival in arctic regions for multi-engine helicopters.

b) Current Norwegian regulations do not set any requirements for instrument capability for helicopter operations during the polar night at Svalbard.

4. SAFETY RECOMMENDATIONS

The Accident Investigation Board Norway issues the following safety recommendations[31]

Safety recommendation SL No. 2020/03T

The helicopter accident with Mil MI 8AMT RA-22312 in Isfjorden on 26 October 2017 occurred when approaching Heerodden. The AIBN's investigation found that the Convers Avia Airlines JSC organization at "Barentsburg" landing site at Heerodden had developed deviations in relation to the airline's procedures and standards, despite the fact that the base is subject to quarterly internal audits.

The Accident Investigation Board Norway recommends that Convers Avia Airlines JSC conducts a systematic audit of the company's organization at "Barentsburg" landing site at Heerodden and implements measures to achieve an expected good safety standard.

Safety recommendation SL No. 2020/04T

The helicopter accident with Mil MI 8AMT RA-22312 in Isfjorden on 26 October 2017 occurred when approaching Heerodden. The AIBN's investigation found that the airline's organization at the "Barentsburg" landing site at Heerodden had developed deviations in relation to the airline's procedures and standards, despite the fact that the base is subject to quarterly internal audits.

The Accident Investigation Board Norway recommends that the State Civilian Aviation Authority – SCAA ensure that Convers Avia Airlines JSC conducts a systematic audit, and defines expected safety standard and implements measures to obtain the expected good safety standard.

[31] The Ministry of Transport attends to presenting safety recommendations to the aviation authority and/or other involved ministries for consideration and follow-up, cf. Regulation on public investigations of aviation accidents and aviation incidents in civil aviation, Art. 8.

Safety recommendation SL No. 2020/05T

The helicopter accident with Mil MI 8AMT RA-22312 in Isfjorden on 26 October 2017 occurred when approaching Heerodden. No one on board used survival suits nor were they wearing life vests. The helicopter was not equipped with liferaft nor emergency floats. Today's national regulations do not set requirements for such emergency equipment for multi-engine helicopters when flying more than 10 minutes from the coastline. For single-engine aircraft, there is a requirement for such equipment when flying more than 3 minutes from the coastline. The AIBN's investigation shows the need for an extension of the existing regulatory requirements to also apply to multi-engine helicopters.

The Accident Investigation Board Norway recommends that the Civil Aviation Authority Norway extend the national regulations so that requirements are set for the use of adequate emergency equipment for all types of helicopters in mountains and desolate areas and on Svalbard. In addition, emergency floats should be used on helicopters when flying over sea irrespective of distance to the coastline on Svalbard.

Safety recommendation SL No. 2020/06T

The helicopter accident with Mil MI 8AMT RA-22312 in Isfjorden on 26 October 2017 near Heerodden, occurred during weather conditions that were reported to be significantly lower than the published weather minima for “Barentsburg” landing site at Heerodden. Convers Avia Airlines JSC allowed only VFR flights on Svalbard. In the demanding weather and at dusk, the pilots lost their visual references and subsequently lost control of the helicopter. Both rapidly changing weather and light conditions are risk factors that indicate the need to be able to fly according to instrument rules. The AIBN sees the need for all helicopter operations that take place during the polar night on Svalbard to be made with helicopters and crews capable of flying according to instrument flight rules.

The Accident Investigation Board Norway recommends the Civil Aviation Authority Norway to extend its regulations to helicopter operations on Svalbard that take place during the polar night to be adapted for instrument flight based for instance on GNSS PinS operations.

Accident Investigation Board, Norway

Lillestrøm, 5 February 2020

APPENDICES

Appendix A: Abbreviations

APPENDIX A: ABBREVIATIONS

AFIS	Aerodrome Flight Information Service
AIBN	Accident Investigation Board Norway
AIRMET	Airmen's Meteorological Information
AOC	Air Operator certificate
ATC	Air Traffic Control
AUV	Autonomous Underwater Vehicle
BSL	CAA-N regulations
CAA-N	Civil Aviation Authority Norway
CVR	Cockpit Voice Recorder
DA	Decision Altitude
EASA	European Aviation Safety Agency
ELT	Emergency Locator Transmitter
EMERCOM	The Russian Ministry of Emergency Situations
EEU	European Economic Area
FATO	Final Approach And Takeoff
FCOM	Flight Crew Operations Manual
FDR	Flight Data Recorder
FL	Flight Level
FLIR	Forward Looking InfraRed
GNSS	Global Navigation Satellite System
GPS	Global positioning System
hPa	hectoPascal
Hz	Herz
IAC	Interstate Aviation Comittee
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IGA	International General Aviation
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
JSC	Joint Stock Company
KV	Coast Guard
MAPt	Missed Approach point
MDA	Minimum Decision Altitude

METAR	Meteorological Terminal Air Report
MHz	MegaHertz
NDB	Non-Directional Beacon
NM	Nautical Miles
NORSAR	Norwegian Seismic Array
OCH	Obstacle Clearance Height
PIC	Pilot In Command
PinS	Point in Space
QDM	Code for magnetic heading to a radio station
QNH	Code for atmospheric pressure at sea level
ROTV	Remotely Operated Towed Vehicle
ROV	Remotely Operated Vehicle
SIG-WX	Significant weather chart
TAF	Terminal Aerodrome Forecast
TREND	Weather forecast for a major aerodrome
ULB	Underwater Locator Beacon
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VHF	Very High Frequency