aibn Accident Investigation Board Norway

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REPORT SL 2020/11

REPORT ON AIR ACCIDENT AT RØLDALSFJELLET IN ULLENSVANG MUNICIPALITY, VESTLAND COUNTY, NORWAY ON 17 FEBRUARY 2019 INVOLVING A ROBINSON R44 II, LN-ORH

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As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

Photos: AIBN and Trond Isaksen/OSL

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AIR ACCIDENT REPORT

Type of aircraft:	Robinson Helicopter Company R44 II
Nationality and registration:	Norwegian, LN-ORH
Owner:	Hegerland Maskin AS
Operator:	Private
Commander:	1, deceased
Passengers:	1, deceased
Accident site:	In steep mountainous terrain near Eskjeflota between Røldal and Seljestad in Ullensvang municipality, Vestland county Norway, position 59° 51,1549 N 6° 43,1697 E
Accident time:	Sunday, 17 February 2019 at 1525 hours

All times given in this report are local time (UTC + 1 hour) unless otherwise stated.

NOTIFICATION

On Monday 18 February 2019, at 0335 hours, the Joint Rescue Coordination Centre Southern Norway (JRCC-S) notified the Accident Investigation Board Norway's (AIBN) on-call accident inspector of a helicopter accident between Røldal and Seljestad. A Sea King rescue helicopter had located the helicopter about 25 minutes earlier. The helicopter, which had been missing since Sunday evening, was discovered in steep and challenging terrain. It was later confirmed that both people on board had died.

On the same day, two accident inspectors set off for Røldal and started their investigation. In accordance with ICAO Annex 13, Aircraft Accident and Incident Investigation, the US National Transportation Safety Board (NTSB) was notified of the accident as a representative of the manufacturing country. The European Aviation Safety Agency (EASA) and the Civil Aviation Authority of Norway were also notified.

SUMMARY

On Friday 15 February 2019, the commander, accompanied by his wife, flew a Robinson R44 II helicopter from their residence in Karmøy to their holiday cabin in Røldal. They were planning to return to Karmøy on Sunday afternoon. However, flying conditions were poor.

The commander had installed a GoPro camera on the instrument panel on the helicopter's right-hand side. The camera recorded the entire flight, from just after take-off until the crash occurred five minutes later. The video shows that, shortly after take-off, the helicopter entered an area with low clouds and poor visibility. In increasingly poor visibility the flight continued for about three minutes until the commander stopped and turned the helicopter around while it was more or less hovering. The helicopter then made a turn to the right and continued flying for about 10 seconds before all visual references disappeared from the video.

The flight continued for 84 seconds with no visual camera references outside the cockpit. The terrain became visible again for two seconds before the helicopter dived and crashed into the terrain with great force. Both people on board died instantly. The commander was inexperienced. He had only 77 hours of flight experience, of which 60 were at a helicopter pilot training center in Florida, USA, in conditions that were vastly different from those encountered in the Norwegian mountains in winter. There is much to indicate that preparations for the flight in question were largely based on the "try and see" principle, and that their plan B was to turn back or land if the weather deteriorated.

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 On Friday 15 February 2019, the commander, accompanied by his wife, flew a Robinson R44 II helicopter from their residence in Karmøy to their holiday cabin in Røldal, Vestland. The commander had told an acquaintance that the flight took 40 minutes. The couple planned to spend their weekend in their holiday cabin at Røldal Terrasse, near Røldal Ski Center, and return to Karmøy by helicopter on Sunday afternoon. The commander landed the helicopter in a parking lot near the cabin and parked it there for the weekend (cf. Figure 7).

1.1.2 At approximately 1100 hours on Sunday 17 February, the commander talked to one of his cabin neighbors and asked if he could use his electricity outlet for the helicopter's engine heater. The commander had already checked the helicopter over and the two neighbors talked for a while. As the neighbor understood it, the commander thought the weather was too bad to return home, but that it, according to the weather forecast, would improve around 1400–1500 hours.

1.1.3 In the afternoon on the day of the accident, about 2 hours before the commander was planning to return to Karmøy, a friend came for a visit to the cabin. He was the commander's former instructor at the helicopter pilot training center in Florida (USA). He was traveling by car from Risør to Bergen. He was aware that the commander was planning to fly the helicopter back on the same afternoon. During the visit, they discussed the flying conditions based on the available weather information, and what route to take home. On the previous Friday, the commander and his wife had flown through the mountain pass between Seljestadjuvet and Røldal Ski Center. The friend was under the impression that the commander wanted to return to Karmøy along the same route. While talking, they confirmed that there were low clouds in the terrain north of the ski center. However, there were some glimpses of the sun further south with only a few low clouds above Røldalsvatnet lake. The commander indicated that he would make a precautionary landing should the weather deteriorate. They also discussed the possibility of flying via Sauda (the Sauda route).

1.1.4 While talking, they heard and spotted a helicopter from Fonnafly AS over the ski center, heading for the valley leading to Ullshaug and Eskjeflota. This was the same route that the commander was planning to fly. Shortly after, they heard a helicopter pass and thought it was another Fonnafly helicopter heading in the same direction. Later on it was found that the last helicopter that they heard was the first Fonnafly helicopter that had turned back due to poor visibility northwest in the mountain pass (cf. Figure 1). The friend stated to the AIBN that the observation of the Fonnafly helicopter indicated that it was possible to take the preferred flight route.

1.1.5 The commander of the Fonnafly helicopter has explained to the AIBN that he stopped the helicopter near the top of the ski center as he found that the weather conditions were too poor to continue the flight. In retrospect, the friend has expressed regret to the AIBN that he did not interfere more in the decision process when they discussed the weather conditions and the imminent flight. However, he was not in a formal position to intervene.

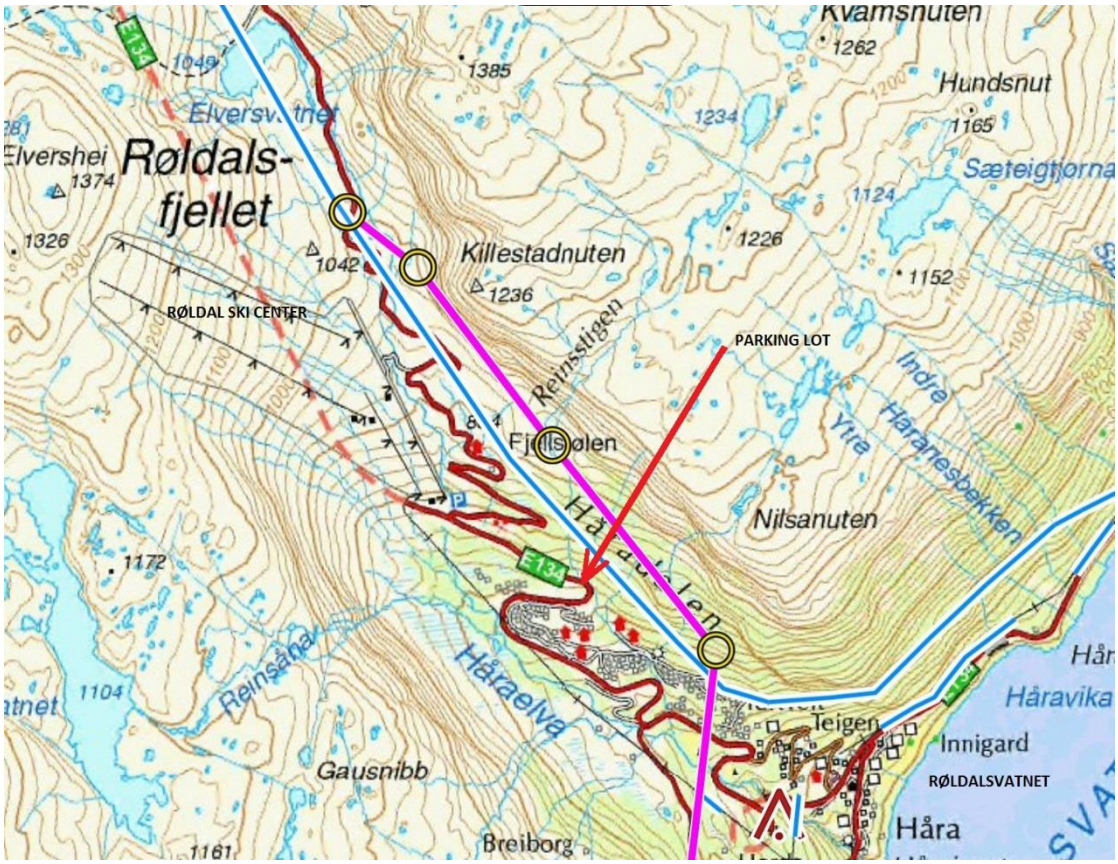

Figure 1: The magenta line shows the Fonnafly helicopter flight track. The pilot turned back at the point indicated by the last yellow circle, as he considered visibility to be too poor to continue the flight. The power line that runs through the valley is indicated by a blue line. Source: Fonnafly AS

1.1.6 The commander decided to conduct the flight as planned, and they all left the cabin at approximately 1500 hours. The friend got in his car to continue his journey to Bergen, while the commander and his wife walked toward the helicopter to prepare it for the flight.

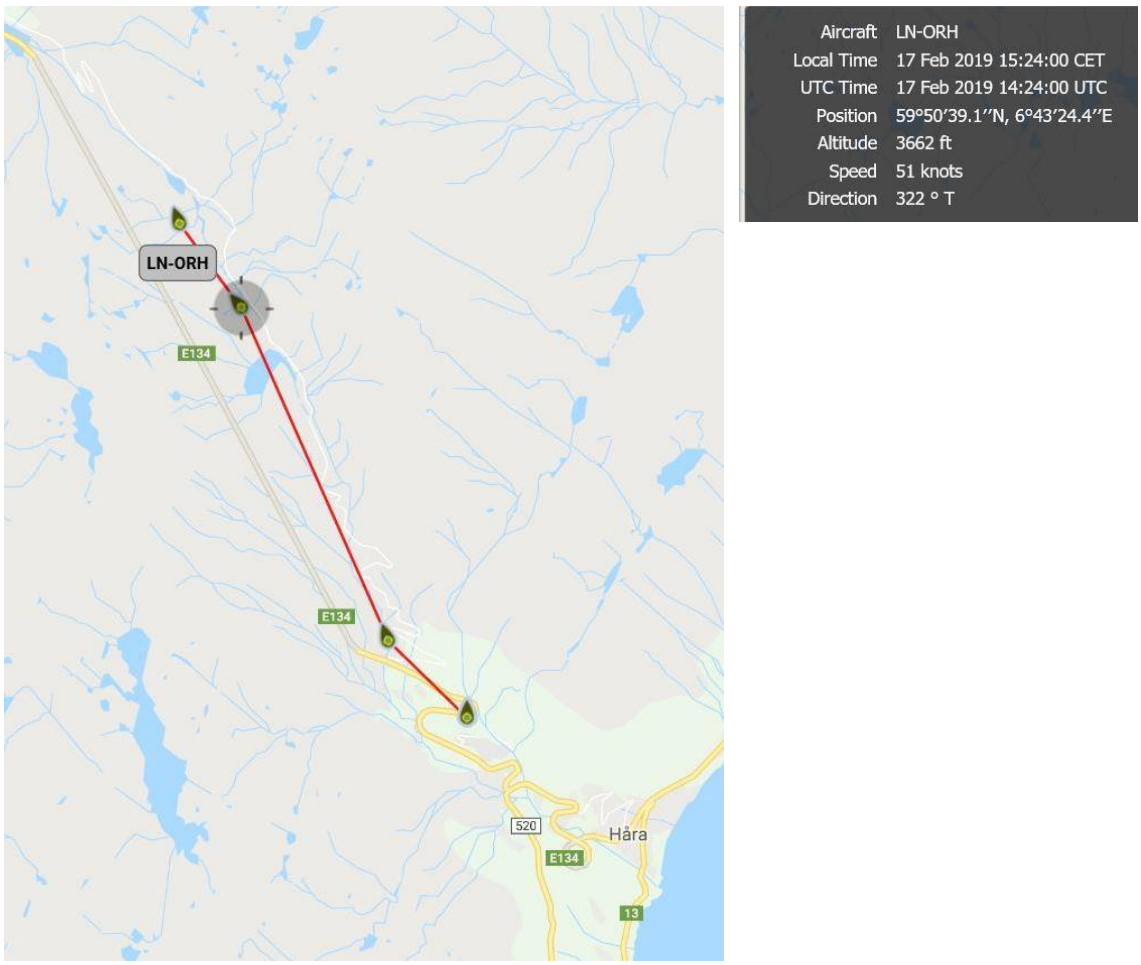

Figure 2: The LN-ORH's track and position at 1524 hours, approximately five minutes after take-off from the parking lot at Røldal Terrasse (the information in the black text box shows the helicopter's penultimate position on the map). Source: Former owner of the helicopter (Spidertrack)

1.1.7 The commander of LN-ORH had installed a GoPro camera on the instrument panel on the helicopter's right-hand side. The camera recorded the entire flight, from just after take-off until the crash. A video recording made by a witness at the ski center shows that the helicopter took off in a southwesterly direction from Røldal Terrasse at 1519 hours. It then made a right turn heading northwest in the direction of the top of the ski lift at Røldal Ski Center and Røldalsfjellet (cf. Figure 3).

1.1.8 The video from the cockpit shows that, shortly after take-off, the helicopter entered an area with low clouds and poor visibility. The flight continued at low altitude along a power line for about three minutes until the visibility was so poor that the commander stopped and turned the helicopter around while it was more or less hovering. The video shows that after completing a right turn, the helicopter kept going for another 10 seconds before all visual references disappeared. A low-rotor-speed warning sounded briefly, and shortly after the sounds from the rotor started to fluctuate. At the same time, the vibration level increased significantly. Five seconds before the helicopter flew into a rock face, the low-rotor-speed warning sounded briefly again.

1.1.9 In the video, there was an 84-second period where the terrain outside the cockpit cannot be seen. The sequence from the terrain reappears in the gray light and until the helicopter crashed into the side of the mountain, lasted for two seconds. In this period, the helicopter

rolled approximately 90° to the left. If we compare the contours in the terrain to the image in the video, it seems the helicopter made a partly inverted dive. The entire flight lasted just under 5 minutes. Below are some still images from the video.

Figure 3: LN-ORH shortly after take-off from the parking lot. Source: Video from the helicopter

Figure 4: LN-ORH about to pass the top of the ski slope at Røldal Ski Center. Two power line pylons can just be seen in the center of the photo. Source: Video from the helicopter

Figure 5: The LN-ORH flying along the power line at a low altitude. One pylon to the right and the next pylon are barely visible near the middle of the photo. Source: Video from the helicopter

Figure 6: The LN-ORH has stopped and is about to initiate a right turn. Source: Video from the helicopter

1.1.10 An Armed Forces Sea King rescue helicopter located the helicopter wreckage in mountainous terrain at Røldalsfjellet near Eskjeflota around 0309. Both people on board were found dead.

1.2 Injuries to persons

Table 1: Injuries to persons

Injuries	Crew	Passengers	Other
Fatal	1	1	
Serious			
Minor/none			

1.3 Damage to the aircraft

The helicopter was destroyed in the impact with the mountain (cf. Chapter 1.12.2 for more details).

1.4 Other damage

The helicopter crashed into the side of a mountain and some of the fuel leaked out in connection with the impact.

1.5 Personnel information

1.5.1 The commander, 46 years old, gained his private helicopter pilot license from a helicopter pilot training center in Florida. His first instruction flight took place on 6 August 2018. The training took place in accordance with the FAA and EASA requirements. An American Privat Pilot Rotorcraft license for helicopters was granted on 20 September 2018 and an EASA private pilot license for helicopter (PPL(H)) was issued on 2 November 2018. His R44 type rating was valid until 30 September 2019.

1.5.2 The commander held a Class 2 medical certificate, as well as a medical certificate for light aircraft (LAPL) which was valid until 25 June 2020.

1.5.3 The commander had completed 60 hours of flight training in Florida. Of these 5:12 hours were simulated instrument time (hood time). Almost all lessons took place with one instructor (cf. section 1.1.3). According to the log, he had subsequently completed 16:24 hours on LN-ORH in Norway during the period from 24 November 2018 to 5 February 2019. The AIBN has no information indicating that the commander flew the helicopter during the period from 5 February to 15 February 2019. The accident flight was the commander's second flight to Røldal Terrasse.

1.5.4 The commander was self-employed, and his company had recently won a major contract. It had been agreed that work on this contract was to start the morning after the accident.

Table 2: Flying experience commander[1]

Flying experience	All types	On type
Last 24 hours	0:05	0:05
Last 3 days	0:45	0:45
Last 30 days	4:50	4:50
Last 90 days	17:10	17:10
Total	77:10	77:10

[1]Some uncertainty related to the number of flight hours after 5 February 2019

1.6 Aircraft information

1.6.1 General

Robinson R44 II is a single-engine light helicopter equipped with a Lycoming IO-540-AE1A5 air-cooled, six-cylinder, fuel injected engine. It accommodates one pilot and three passengers. The helicopter is only approved for daytime flying according to the visual flight rules (VFR day).

Manufactured:	2008
Serial number:	12553
Max allowed take-off mass:	1,134 kg
Approved fuel type:	Avgas 100LL or Avgas 100/130
Maximum flight hours:	Approx. 3 hours
Cruise speed for maximum range:	100 kt
Maximum speed:	130 kt
Total flight time:	1,915.5 hours

The helicopter is equipped with a visual and audible warning system which activates if the rotor speed drops below 97%.

1.6.2 LN-ORH

1.6.2.1 The LN-ORH was registered in the name of the commander's contractor firm Hegerland Maskin AS. The helicopter was purchased from Rossi Helicopter AS in Trøndelag county in November 2018. The plan was that the helicopter later would be phased in and operated by the helicopter company Nor Aviation AS. However, the commander chose to operate the helicopter privately until the formalities about the phase-in were in place.

1.6.2.2 According to the hour meter in the cockpit, the LN-ORH had a total flight time of 1,915:30 hours at the time of the accident. Technical documentation made available to the AIBN shows that, at the time of transfer of ownership from Rossi Helicopter AS to Hegerland Maskin AS on 23 November 2018, the helicopter had a total flight time of exactly 1,900 hours.

1.6.3 Maintenance

1.6.3.1 While Rossi Helicopter AS owned the helicopter, maintenance was performed by Midt Norsk Helikopterservice AS. The last 100-hour inspection was conducted by No1 Flightengeneering AB in Järpen, Åre, Sweden on 6 November 2018 at 1,866.9 hours flight time.

1.6.3.2 After the ownership of the LN-ORH was transferred to the commander, the plan was to transfer maintenance responsibility for the helicopter to Nor Aviation AS. However, Nor Aviation AS was not asked to perform any maintenance during the period prior to the accident. If such maintenance had taken place, it would have been logged in the *Aircraft*

Flight Log. The log was not recovered after the accident. However, it is unlikely that such maintenance took place during the approximately 15 hours that the commander operated the helicopter after he assumed ownership of it.

1.6.3.3 During the period Midt Norsk Helikopterservice AS was responsible for maintenance of the LN-ORH, such maintenance was performed in accordance with the requirements for commercial air transport. The Civil Aviation Authority did not receive a request for a new maintenance program after the change of ownership and transfer to private operation. This means that the LN-ORH did not have an approved maintenance program and was consequently not airworthy according to the Norwegian Civil Aviation Authority. The maintenance requirements for private operation of the helicopter is less rigid.

1.6.4 Mass and balance

1.6.4.1 The helicopter was last weighed on 9 March 2017. It was then 1,645.2 lb with an arm of 105.67 in. The maximum take-off mass is 2,500 lb.

1.6.4.2 The two people on board did not bring with them any significant amount of baggage. It has not been possible to determine how much fuel was on board. Assuming the helicopter carried 190 lb of fuel, the mass may have been 2,200 lb and the center of gravity at approx. 97.6 in. This is well within the limitations.

Figure 7: LN-ORH on the parking lot of Røldal Terrasse the same weekend the accident happened. Photo: Private

1.7 Meteorological information

1.7.1 Introduction

The AIBN has obtained weather reports from the Norwegian Meteorological Institute in connection with the accident. The AIBN also obtained descriptions of the local weather conditions from people at the Røldal Ski Center and from the commander of the Fonnafly helicopter.

1.7.2 The Norwegian Meteorological Institute

1.7.2.1 According to the Norwegian Meteorological Institute's weather forecast for Western Norway, the weather conditions on the day of the accident at 1400 hours were as follows:

- There was a low pressure northwest of Ireland and a high-pressure ridge extending from Poland to the northern parts of Sweden. A warm front extended from the southern parts of Sweden northwest toward Stad, and there was a cold front over the British Isles. There was a warm air sector in Western Norway south of Stad with

scattered drizzle and rain and low clouds locally. The temperature in the mountains was high for the time of year, ranging from minus 2 to plus 1 °C at an altitude of 1,000 to 1,300 meters. In the lowlands, the wind was in a southeasterly to southwesterly direction whereas in the mountains, the wind was in a southerly to southwesterly direction.

- The wind gauge in Røldalsfjellet, Elvershei, located at 1,370 meters above sea level, was inoperative on the day of the accident. However, the Sandhaug wind gauge, located at a somewhat lower altitude of 1,250 meters above sea level, showed an average wind speed of 6.2 to 10.2 m/s and the strongest wind gusts of 7.0 to 11.5 m/s during the period from 1300 hours to 1600 hours.

- In the same period, the Kvitegga, Dimmelsvik gauge, located at 660 meters above sea level, showed an average wind speed of 13.6 to 17.2 m/s with gusts between 21.7 and 25.3 m/s. In the mountainous area where the accident occurred, the average wind speed was most likely between 10.2 and 17.2 m/s with maximum wind gusts between 17.2 and 25.3 m/s during the period in question.

- The vertical profiles for Sauda, Odda and Sandhaug tourist lodge showed a humid air mass below 5,000 to 6,000 feet. It is highly likely that there were low clouds in the mountainous area where the accident occurred.

- Mountain wave models (MTW) showed an average wind speed from a southerly direction of approximately 10 to 15 m/s at 1,500 meters above sea level, with moderate turbulence west of the accident site.

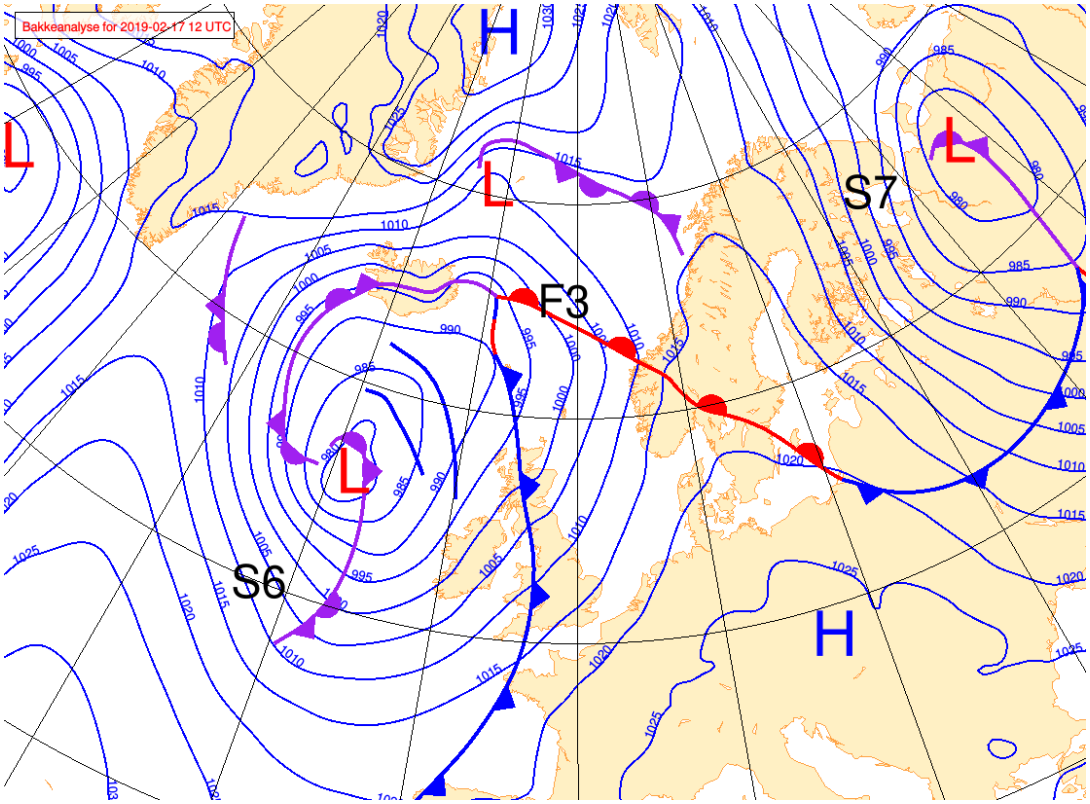

Figure 8: Ground analysis from the Norwegian Meteorological Institute at 1300 hours local time (12 UTC).

1.7.3 TAF for Bergen (ENBR), Sørstokken (ENSO) and Haugesund (ENHD)[2]

ENBR 170500Z 1706/1806 15012KT 9999 BKN008 BECMG 1707/1709 FEW012 BKN020 TEMPO 1709/1718 BKN012 BECMG 1709/1712 16018G28KT TEMPO 1800/1806 4000 -RA BR BKN008=

ENBR 170614Z 1706/1806 15012KT 9999 FEW008 BKN030 TEMPO 1709/1718 BKN012 BECMG 1709/1712 16018G28KT TEMPO 1800/1806 4000 -RA BR BKN008=

ENBR 170942Z 1709/1806 15012KT 9999 FEW008 BKN025 TEMPO 1709/1718 3000 DZRA BR BKN007 BECMG 1709/1712 16018G28KT TEMPO 1800/1806 4000 -RA BR BKN008=

ENBR 171100Z 1712/1812 15012KT 9999 FEW005 BKN015 TEMPO 1712/1806 3000 -DZRA BR BKN007 BECMG 1715/1717 16020G30KT=

ENSO 170800Z 1712/1719 16012KT 9000 FEW007 BKN015 PROB40 1712/1717 3000 BR BKN007 TEMPO 1715/1719 16020G30KT=

ENSO 171400Z 1715/1719 16015KT 9999 FEW008 BKN020 PROB40 1715/1717 3000 BR BKN007 TEMPO 1715/1719 16020G30KT=

ENHD 170500Z 1706/1715 15008KT 9000 FEW007 BKN015 TEMPO 1706/1715 3000 BR BKN004 BECMG 1708/1710 16020KT TEMPO 1712/1715 15025G35KT=

ENHD 170800Z 1709/1718 15018KT 9000 FEW007 BKN020 TEMPO 1709/1717 3000 BR BKN004 TEMPO 1712/1718 15025G35KT=

ENHD 171100Z 1712/1721 16018KT 8000 FEW005 BKN015 BECMG 1712/1714 17022G35KT PROB40 1712/1721 3000 -DZ BR BKN004=

ENHD 171400Z 1715/1723 16018G28KT 8000 SCT004 BKN008 PROB40 1715/1717 3000 BR BKN004 BECMG 1717/1719 SCT010 BKN020 TEMPO 1720/1723 BKN009=

1.7.4 METAR for Bergen (ENBR), Sørstokken (ENSO) and Haugesund (ENHD)[2]

ENBR 171020Z 14014KT 6000 -RADZ FEW005 BKN009 07/05 Q1012 TEMPO BKN020 RMK WIND 1200FT 14023KT=

ENBR 171120Z 15015KT 9999 FEW008 BKN014 07/05 Q1012 NOSIG RMK WIND 1200FT 14026KT=

ENBR 171220Z 17014KT 9999 VCSH FEW008 BKN015 08/06 Q1011 NOSIG RMK WIND 1200FT 14025KT=

ENBR 171250Z 15015KT 9999 SCT015 BKN020 09/06 Q1011 TEMPO BKN014 RMK WIND 1200FT 14025KT=

[2] All times given in this chapter are Universal Time Coordinated (UTC).
For an explanation of meteorological abbreviations, see: https://www.ippc.no/ippc/index.jsp

ENBR 171320Z 15013KT 9999 SCT018 BKN023 09/06 Q1011 TEMPO BKN014 RMK WIND 1200FT 14026KT=

ENBR 171350Z 15013KT 9999 SCT018 BKN025 10/06 Q1010 TEMPO BKN014 RMK WIND 1200FT 15024KT=

ENBR 171420Z 15016KT 9999 SCT018 BKN025 10/06 Q1010 TEMPO BKN014 RMK WIND 1200FT 15024KT=

ENSO 171120Z 16014KT 9999 BKN017 09/06 Q1013=

ENSO 171250Z 15015KT 9999 SCT017 10/07 Q1012=

ENSO 171320Z 15015KT 9999 SCT017 10/07 Q1011=

ENSO 171350Z 16014KT 9999 SCT018 10/07 Q1011=

ENSO 171420Z 16015KT 9999 SCT018 BKN023 10/07 Q1011=

ENHD 171020Z 16017KT 9999 BKN009 08/06 Q1014=

ENHD 171120Z 15019KT 6000 BKN004 08/06 Q1013=

ENHD 171250Z 16018G32KT 9000 BKN006 08/07 Q1012=

ENHD 171320Z 15021G32KT 8000 BKN005 08/07 Q1012=

ENHD 171350Z 15019G30KT 6000 BKN004 08/07 Q1012=

ENHD 171420Z 15017G27KT 7000 BKN004 08/06 Q1012=

1.7.5 IGA prognoses[2]

IGA PROG 170900-171800 UTC Feb 2019 NORWAY FIR COAST AND FJORD AREAS W OF E00730 AND S OF N6200

WIND SFC: SE-S/10-20KT COT, VRB/05-10KT FJORDS. BECMG 25-35KT COT N-PART, 20-25KT COT S-PART

WIND 2000FT: S/25-35KT COT N OF ENZV, ELSE SE-S/10-20KT. BECMG 30-40KT COT N OF ENZV, 40-55KT COT N OF SOGNEFJORD, 20-30KT FJORDS

WIND/TEMP FL050: 220-260/20-25KT S OF ENZV FIRST HR, ELSE 180-220/25-35KT. BECMG 35-45KT COT N OF ENHD, LATE 45-50KT COT N OF SOGNEFJORD. TEMP: MS03-PS06, COLDEST FIRST HR

WIND/TEMP FL100: 240-270/25-35KT N-PART FIRST HR, ELSE 40-50KT. LATE BECMG 210-240/40-50KT. TEMP: MS06-MS04

WX: SCT RA/RADZ N OF SOGNEFJORD, LCA BR COT S-PART, ELSE NIL

VIS: LCA 2-5KM IN BR, LCA 3-9KM IN RA/RADZ, ELSE +10KM

CLD: FEW-SCT 0400-1500FT, SCT-BKN 1500-4000FT, LCA BKN-OVC 0400-1500FT

0-ISOTHERM: 3500FT-FL080, LOWEST FIRST HR

ICE: NIL/FBL, OCNL FBL

TURB: FBL, OCNL FBL/MOD

1.7.6 Witness at Røldal Ski Center

There were several witnesses at Røldal Ski Center on the day of the accident. One of them, a friend of the commander, was with the commander on Saturday 16 February 2019. At the time, the commander said he found the flying conditions in the Røldal mountains challenging, as there was a strong wind coming from above and between the mountains. The witness has stated that after take-off the helicopter first flew in the direction of Røldalsvatnet lake, before turning around heading back toward Røldal Terrasse. It then headed in the direction of Røldal Ski Center, keeping right, as seen from Røldal Terrasse. The helicopter then disappeared into low clouds at the top of the ski center. He also stated that there was fog at the bottom of Røldal valley.

1.7.7 Fonnafly AS

The commander who flew the Fonnafly helicopter described the weather conditions at the top of Røldal Ski Center and in the mountain pass between Røldalsfjellet and Killestadnuten as very poor. He said there were low clouds all the way to the ground and he saw that the high-voltage power lines just east of the ski center disappeared in the fog. Due to the poor flying conditions, he turned back and chose a different route.

1.8 Aids to navigation

The flight was conducted according to the visual flight rules. This means that distance to clouds and visibility to the ground are required. The commander may also have used an iPad or a cell phone with a navigation program.

1.9 Communications

The commander did not have radio contact with any Air Traffic Services during the flight.

1.10 Aerodrome information

Not relevant

1.11 Flight recorders

Flight recorders were not mandatory and not installed in the helicopter. The commander had installed a camera, and the video from the cockpit has been especially useful for understanding how the accident happened. The LN-ORH was equipped with a tracker that provided useful information in connection with the search (cf. section 1.15.2).

1.12 Wreckage and impact information

1.12.1 The accident site

1.12.1.1 The LN-ORH crashed into a partly snow-covered escarpment near Eskjeflota in Røldalsfjellet between Røldal and Seljestad in Vestland. The mountainside faced southwest and had a slope of approximately 50°. The accident site is approx. 1,170 meters above mean sea level (3,840 ft), about 150 meters above the old road at the bottom of the mountain pass.

1.12.1.2 Before crashing, the helicopter flew along a power line that runs through the valley. The distance between the pylons is usually about 200 meters but varies between 170 and 330 meters.

Figure 9: The accident site. Red arrow points at the wreckage. Photo: The police

1.12.2 The helicopter wreckage

1.12.2.1 The helicopter wreckage was mainly in one piece resting on the slope of the mountain, partly buried in snow, 2–3 meters below the presumed point of impact. Minor parts of the helicopter were scattered in the snow.

1.12.2.2 The helicopter wreckage was sling loaded down by helicopter the day after the accident. It was then brought to the AIBN's premises in Lillestrøm for further examination. However, some parts were buried in the snow and were not discovered until after the snow had melted. This was mainly parts of the instrument panel and some instruments.

1.12.2.3 The helicopter wreckage has been examined with particular focus on the flight controls, rotors, engine, and power train. The investigations have not identified any technical faults with the helicopter or any of the helicopter systems that had an effect on the course of events.

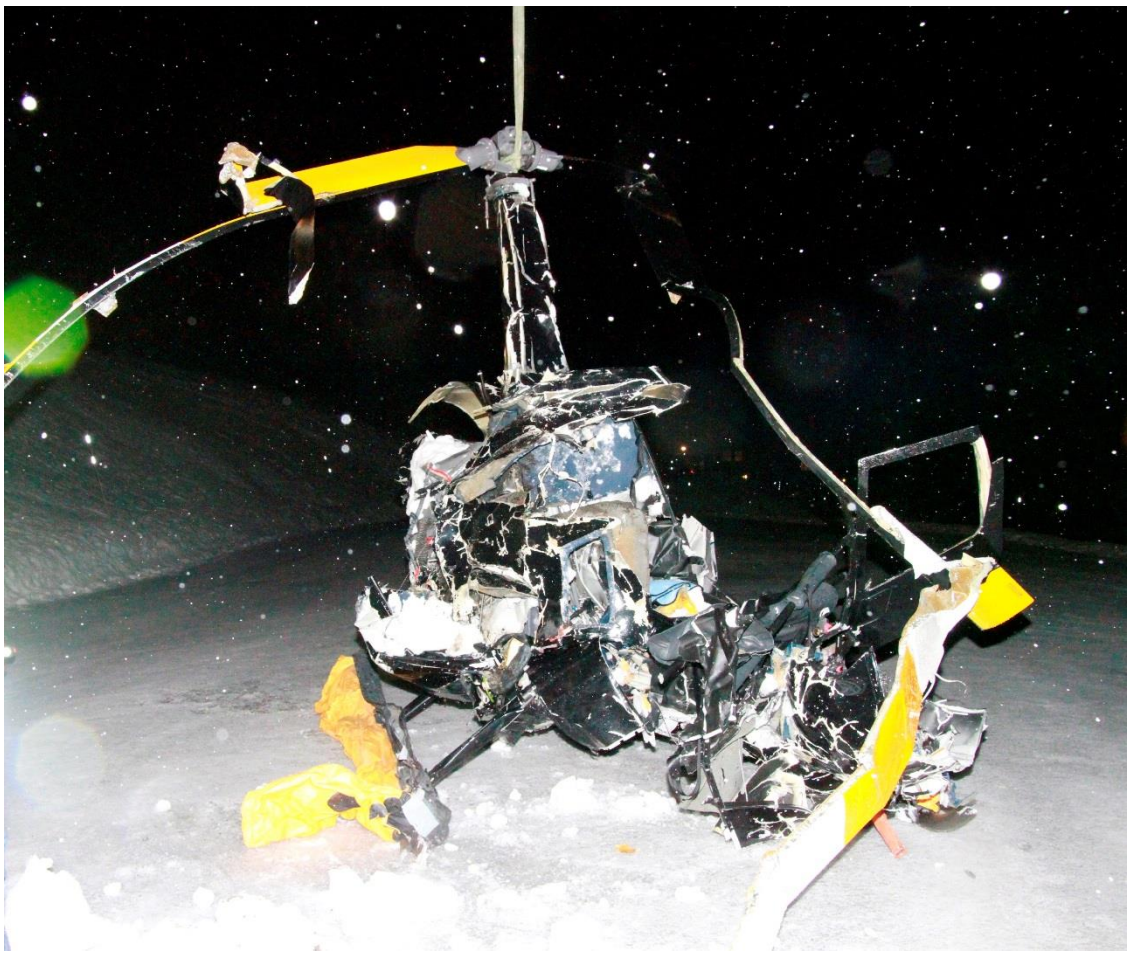

Figure 10: The helicopter wreckage after it was brought down from the mountain. Photo: The police

1.13 Medical and pathological information

1.13.1 The Gade Laboratory for Pathology in Bergen performed an autopsy of the two deceased persons. The autopsy report concluded that they had both died instantly due to severe trauma.

1.13.2 There is no information to indicate that medical conditions were a contributing factor to the accident.

1.14 Fire

No fire occurred.

1.15 Survival aspects

1.15.1 The helicopter was equipped with a Kannad 406 AF Compact Emergency Locator Transmitter. The transmitter activated automatically as intended, but the antenna cable was torn off the antenna when the helicopter crashed, and no emergency signals were therefore transmitted.

1.15.2 The helicopter search area was established based on information from a tracker which the former owner of the helicopter still had access to (cf. Figure 2).

1.15.3 The helicopter was equipped with four-point seat belts. The seat belts had been partly torn from their attachments as a result of the accident. The two people on board did not wear helmets.

1.16 Tests and research

None.

1.17 Organizational and management information

The flight in question is defined as a private flight, which means that the commander is personally responsible for complying with relevant laws and regulations.

1.18 Additional information

1.18.1 The flight took place in uncontrolled Class G airspace. The joint European rules *"SERA.5001 VMC visibility and distance from cloud minima"* state the following:

- When flying below 3,000 ft above mean sea level (MSL), flight visibility must be minimum 5 km and the aircraft must be clear of clouds. Helicopters may be permitted to operate with a flight visibility down to 1 500 m[3].

- Flights operating at between 3,000 ft and 10,000 ft above mean sea level must have a minimum 5 km flight visibility. Furthermore, the distance to clouds must be 1,500 m horizontally and 300 m (1,000 ft) vertically.

1.18.2 *"SERA.5005 Visual flight rules"* stipulate that the minimum flight altitude is 500 ft.

1.19 Useful or effective investigation techniques

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

2. ANALYSIS

2.1 Introduction

The video from the cockpit shows how the accident happened. The video is unusual as it displays in detail how the flight progressed through increasingly poor visibility until the fatal accident occurred. It documents that the weather conditions in the area were unsuitable for flying. In our analysis below we therefore focus mainly on aspects that may explain why the commander chose to start his flight to Karmøy on the afternoon in question, and why he did not turn back before he had lost all visual references.

2.2 History of the flight

2.2.1 The video shows that the flight conditions were marginal already at the top of Røldal Ski Center. After this, the flight took place in visibility conditions that were below the minimum requirements. The initial part of the flight took place below and later above 3,000 ft (MSL). Early during the flight, the helicopter encountered visibility conditions

[3]When permitted by a competent authority, this can be reduced to 800 meters.

that meant that only two power line pylons were visible at a time. The flight continued at the same speed even after only one pylon was visible at a time. Simultaneously, the helicopter was no more than barely one pylon height above the pylons. This is far below the minimum requirements (cf. Chapter 1.18). One factor that made the situation worse was that the flight took place in a snow-covered area with partly blurred terrain contours. This means that there were few visual references even before the helicopter entered clouds.

2.2.2 The video shows that the commander flew along the power line and continued without turning back until only a few bare patches of mountain were distinguishable from all the whiteness. The AIBN would characterize the flight as a typical example of "pressing on" in poor weather and this may be associated with the commander's level of experience (cf. Chapter 2.3). After the helicopter entered clouds and the visual references disappeared, it may seem as if the commander lost control of the helicopter. It is a well-known fact in aviation that pilots without sufficient instrument flight training quickly lose control without the necessary visual references. Maintaining control is even more difficult in a helicopter. Helicopters are especially unstable at low speeds and visual references are particularly important.

2.2.3 Rotor speed variations, periods with low rotor speed, fluctuating vibration level and rotation along the longitudinal axis just before impact are all factors that support the theory that the commander completely lost control of the helicopter during the period without visual references. The extensive damage to the helicopter shows that the speed at the time of impact must have been relatively high.

2.2.4 It is difficult to say for certain what the wind conditions were like in the area and whether these may have had an impact on the flight. However, the video does not indicate that the wind was a contributing factor to the accident.

2.3 The commander's level of experience

2.3.1 The flight training in Florida took place in conditions that were vastly different from those encountered when flying in the Norwegian mountains in wintertime. The training from Florida may have taught the commander to operate the helicopter satisfactorily. The commander also had five hours of instrument flight training. This is in no way sufficient to handle a sudden transition to instrument flying. In other words, his total experience provided a very limited basis for managing the challenges that he encountered on the day of the accident.

2.3.2 An important prerequisite for operating a helicopter safely is to understand one's own limitations, i.e. to understand what visibility and visual references are required. In gradually deteriorating visibility conditions, the commander must be prepared to turn back in time. The commander had very little experience with Norwegian flight conditions.

2.3.3 The AIBN believes that the commander, with his limited experience from Florida, did not have the required qualifications to assess and handle the dangers he might encounter on his return to Karmøy. However, the AIBN fails to comprehend why the commander did not recognize the danger signals and turn back or landed precautionary earlier. With this in mind, it may seem that the commander displayed a high willingness to take risks when

he continued his flight into the mountain pass. Pilots with such limited experience should allow themselves wide safety margins.

2.3.4 There are minimum requirements in place to help pilots make the correct decisions (cf. Chapter 1.18). The video shows that the commander flew well below the 500 ft minimum altitude and that visibility during the flight was way below the 1,500-meter requirement. One important lesson to learn from the accident is that these requirements are not just theoretical, but highly relevant decision-making tools.

2.4 Factors that impacted the decision to fly

2.4.1 Flight preparations

2.4.1.1 Prior to the flight, the commander and his friend discussed the weather forecast. The available meteorological information shows that the weather was challenging (cf. Chapter 1.7). The forecast predicted relatively strong winds, clouds down to 400 ft, drizzle and fog several places in the relevant area. The AIBN is of the opinion that the weather forecast was a good reason for canceling a flight from Røldal to Karmøy on the day in question.

2.4.1.2 The AIBN has learned from several of its previous helicopter accident investigations that helicopter pilots often plan their flights according to a “try and see” principle. This entails keeping open the option of turning back or finding a temporary landing site en-route. In recent years, we have seen fewer helicopter accidents where the pilot's decision to press on despite poor weather and loss of visual references has been a contributing factor. This may indicate that Norwegian commercial operators now have a more mature attitude to safety in general and to the loss of visual references in particular. The commander operated the helicopter privately and was not affected by the corrective attitudes that seem to have gained a foothold among commercial operators.

2.4.1.3 There is much to indicate that preparations for the flight in question were largely based on the “try and see” principle, and that the commander’s plan B was to land if the weather deteriorated. Previous accidents have shown that such alternative plans often lead to high risks, because pilots tend to continue until visibility also is too poor to perform the landing.

2.4.1.4 The final decision to take off was in all likelihood based on the misunderstanding that two helicopters from the commercial helicopter operator Fonnafly took the same route. However, this was in fact one helicopter which turned back due to poor visibility and thus passed the area twice.

2.4.2 The instructor's influence

As the AIBN understands it, the commander and his former instructor were in doubt as to whether it was possible to conduct the flight to Karmøy on the afternoon in question. Although his friend no longer had a formal role as instructor, it is reasonable to assume that the commander trusted the signals that he may have given. The fact that his more experienced friend did not directly advise against flying, may have been a contributing factor in the commander's decision to try to fly northwest over Røldalsfjellet mountain in the direction of Seljestad.

2.4.3 "Plan Continuation Bias"

One factor that may have contributed to the commander's decision to fly from Røldal was a desire to get home on Sunday evening. The commander had entered into a major contract on behalf of his contractor company and the work was due to commence on the morning after the accident. It would have been possible to return home by alternative means of transport, but it might have entailed some practical problems. It may also have been impractical to leave the helicopter on the parking lot where nobody could keep an eye on it. A number of accidents related to poor weather conditions are known to possibly have been caused by a self-induced desire to complete the flight although it should have been aborted. The AIBN does not discount the possibility that the commander's desire to get to Karmøy on Sunday night at the latest may have influenced his decision to complete the flight. This phenomenon is known as "Plan Continuation Bias" [4].

2.5 Survival aspects

2.5.1 Considering the extensive damage to the helicopter and the autopsy reports, the AIBN believes that it would have been impossible to survive the accident even if the two on board had worn helmets.

2.5.2 The accident can be added to a number of accidents where the emergency locator transmitter (ELT) did not transmit any signals due to damage or the position of the antenna. In this case, the emergency locator transmitter would not have contributed to a speedy rescue or survival. However, it would have contributed to earlier notification and localization of the wreckage. Flight following often provides useful information and can be a good supplement to emergency locator transmitters.

3. CONCLUSIONS

3.1 Primary conclusion

3.1.1 A video from the cockpit shows that the weather conditions in the accident area were unsuitable for flying. The helicopter crashed 84 seconds after the camera did not show any visual references outside the cockpit.

3.1.2 The commander was inexperienced. The flight training in Florida took place in conditions that were vastly different from those encountered in the Norwegian mountains in wintertime. The AIBN believes that the commander did not have the required qualifications to assess and handle the dangers he might encounter on his return to Karmøy. There is much to indicate that preparations for the flight in question were largely based on the "try and see" principle, and that the commander's plan B was to land if the weather deteriorated.

[4] The tendency of people to continue with an original course of action in spite of changing conditions that require a new plan. The phenomenon is often observed when a person directs his or her attention toward completing a plan in order to achieve a desirable result and/or prevent negative consequences of not adhering to the plan, combined with consciously or unconsciously playing down the risk of continuing.

3.2 Investigation results

a) The AIBN has not found faults or irregularities in the helicopter that could have affected the course of events.

b) The aircraft's mass and the location of its center of gravity were within the limits.

c) The commander had a valid license and type rating for operating a Robinson R44 aircraft.

d) The commander only had 77 hours of total flight experience and was thus inexperienced.

e) A warm front extended from the southern parts of Sweden northwest toward Stad. There was a warm air sector in Western Norway south of Stadt with scattered drizzle and rain and low clouds locally.

f) Prior to the flight, the commander and his former flight instructor discussed the flying conditions based on the available weather information and choice of flight route in mind.

g) The commander had an important meeting on Monday morning, and this may have influenced his decision to proceed with the flight.

h) The final decision to take off was in all likelihood based on the misunderstanding that two Fonnafly helicopters took the same route.

i) The video shows that the flight conditions were marginal already at the top of Røldal Ski Center.

j) The flight proceeded at low altitude with visibility well below the minimum requirement of 1,500 meters and in an area with partly blurred terrain contours.

k) The AIBN would characterize the flight as an example of pressing on despite bad weather.

l) During the period without visual references the commander completely lost control of the helicopter.

m) Both people on board died instantly.

4. SAFETY RECOMMENDATIONS

The Accident Investigation Board Norway issues no safety recommendations in connection with this investigation.

The Accident Investigation Board Norway

Lillestrøm, 17 June 2020

APPENDICES

Appendix A: Abbreviations

APPENDIX A: ABBREVIATIONS

AIBN	Accident Investigation Board Norway
EASA	European Aviation Safety Agency
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration, USA
ft	Feet – (0.305 m)
IGA	International General Aviation (weather forecast)
in	Inch (2.54 cm)
kt	knot(s) – Nautical Mile(s) (1 852 m) per hour
lb	pound(s) (0.454 kg)
METAR	Meteorological Aerodrome Report
m/s	meter per second
MSL	Mean Sea Level
N	North
TAF	Terminal Aerodrome Forecast
UTC	Coordinated Universal Time
E	East