Norwegian Safety Investigation Authority

Issued June 2022

REPORT AVIATION 2022/04

Report on the air accident on the E18 road in Eidanger, Vestfold and Telemark county, Norway on 17 June 2021 involving a Robinson R44 Raven I helicopter, LN-OGT

The Norwegian Safety Investigation Authority (NSIA) has compiled this report for the sole purpose of improving aviation safety.

The object of the NSIA's investigations is to clarify the sequence of events and causal factors, elucidate matters deemed to be important to the prevention of accidents and serious incidents, and to issue safety recommendations if relevant. It is not the NSIA's task to apportion blame or liability under criminal or civil law.

This report should not be used for purposes other than preventive aviation safety work.

Photo: Private

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

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Air accident report

Table 1: Data relating to the incident

Type of aircraft:	Robinson Helicopter Company R44
Nationality and registration:	Norwegian, LN-OGT
Owner:	Helikopterdrift AS, Kjeller
Operator:	Private
Commander:	Fatally injured
Passengers:	None
Accident site:	On the road shoulder of the E18, 2.5 km northwest of the Norwegian Public Roads Administration's inspection site at Lannerheia in Eidanger, Porsgrunn municipality, Vestfold and Telemark county (059.112°N / 009.727°Ø)
Time of accident:	Thursday 17 June 2021, at 2254 hours.

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

Notification

At 2337 hours on 17 June, the Joint Rescue Coordination Centre for Southern Norway (JRCC-S) notified the Norwegian Safety Investigation Authority's (NSIA) duty officer that a helicopter with registration LN-OGT had flown into a power line crossing the E18 road near Langangen and crashed. The commander, who was alone on board, was fatally injured. It was also stated that signals from the emergency location transmitter had been registered at 2256 hours. Personnel from the NSIA arrived at the accident site at 0130 hrs that night.

In accordance with ICAO Annex 13 'Aircraft Accident and Incident Investigation', the NSIA notified the National Transportation Safety Board (NTSB) in the USA, the country of manufacture. The European Aviation Safety Agency (EASA) was also notified.

Summary

The commander was asked to transport a person from Fornebu to Kvinesdal. He agreed and planned the flight despite the fact that rain and thunderstorms were forecast in the area. During the return flight from Kvinesdal, he continued flying at low altitude after the visibility and light conditions deteriorated. Due to the weather conditions, the commander landed north of Tveitvatnet lake between Bygland and Åmli, but continued, as he believed the weather to be improving. Several witnesses observed the helicopter flying at low altitude shortly before it hit a power line crossing the E18 road at 13 metres height at Eidanger. After cutting two cables, the helicopter fell to the ground and the commander died instantly. The NSIA does not have information that can provide an obvious explanation to why the commander continued to fly despite the bad weather.

About the investigation

Purpose and method

The purpose of this investigation has been to clarify what happened during the flight and try to understand the factors that may have influenced the commander's decisions. The NSIA also hopes that the investigation can be a source of learning for the aviation community and thereby prevent recurrence.

The accident and the circumstances surrounding the accident have been investigated and analysed in line with the NSIA's framework and analysis process for systematic safety investigations (the NSIA method[1]).

The investigation report

The first part of the report, 'Factual information', describes the sequence of events, related data and information gathered in connection with the accident, what the NSIA has investigated and related findings.

The second part, the 'Analysis' part, contains the NSIA's assessment of the sequence of events and contributing causes based on factual information and completed investigations/examinations. Circumstances and factors found to be of little relevance to explaining and understanding the accident are not discussed.

The NSIA's conclusions are described at the end of the report.

[1] *See https://www.nsia.no/About-us/Methodology*

1. Factual information

1. Factual information

1.1 History of flight

1.1.1 THE FLIGHT TO KVINESDAL

A person who was at Fornebu needed to get to Utsikten Hotel in Kvinesdal in the evening of 17 June 2021. His plan was to get a lift with a helicopter that was undergoing maintenance at Sandefjord Airport Torp (ENTO). When the helicopter was not finished in time, he contacted a friend and asked whether anyone else was available to fly him to Kvinesdal. The administrator of LN-OGT (hereinafter referred to as the owner of the helicopter) was contacted through acquaintances. At 1041 hours, the owner contacted the person who later became the commander and asked him whether he would like to fly to Kvinesdal in the afternoon. The commander did not mind, and direct contact was established between the commander and the passenger.

The details of how the commander planned the flight are not known, but his cohabitant has later confirmed that the commander used both his own computer[2] and aviation literature in connection with the planning.

The commander arrived at Kjeller, where LN-OGT was parked, and conducted the daily inspection of the aircraft. He signed for this in the helicopter's journey log book at 1805 hrs. The amount of fuel was stated to be 100%, i.e. a full tank (180 litres). The commander also took three cans containing a total of 60 litres of fuel that he placed at the back of the cabin. He did not submit a flight plan to the air traffic service[3].

A web camera at Kjeller shows that LN-OGT took off at 1839 hrs. According to the passenger, the agreement was for the commander to give notice 15 minutes before take-off, and to land on the gravel pitch near Telenor Arena at Fornebu in Bærum. There was no mention of any payment for the flight. The helicopter landed near Telenor Arena at approximately 1850 hrs and took off again about two minutes later.

The passenger has stated to the NSIA that the flight went as expected. The map in figure 2 shows the place of names referred to below. According to radar data, the helicopter flew in a more or less straight line towards Kvinesdal, passing Bø i Telemark and the southern end of Byglandsfjorden lake, among other places. The helicopter gradually climbed to 3,300 ft.[4] The weather was very good, and there was occasionally a tailwind of approximately 10 kt. The commander and the passenger talked extensively during the flight. The commander also explained some of the features of the navigation software on his iPad. Among other things, he showed that power lines were indicated. During the conversation, the commander did not mention anything about being concerned about the weather on the return flight.

When approximately five minutes remained of the flight, they flew into an area with poor visibility. The commander turned south towards Lyngdal, but approximately 30 seconds later, visibility was again good, with light rain, and the flight continued westward. Shortly after, they spotted the golf course east of the hotel, circled above the hotel once and landed in the car park outside the hotel at approximately 2025 hrs. The passenger went straight into the hotel and did not notice at what

[2] The tab for the planning tool ippc.no was active.
[3] This is not mandatory.
[4] Altitude registered by radar, which is stated in metres above mean sea level (MSL), as opposed to altitude above ground level (AGL).

time the helicopter took off again. Three empty fuel cans were found at the accident site, and it is likely that the commander re-fueled the helicopter before departing from the hotel.

1.1.2 THE RETURN TOWARDS KJELLER

An aircraft with transponder code 7000[5] was observed on radar in several places. There was very little traffic in the airspace in question, and it is highly probable that the observed aircraft was LN-OGT. The first radar data from the return towards Kjeller shows LN-OGT at an altitude of 2,000 ft by Utsikten Hotel at 2043 hrs. The helicopter started the return flight basically along the same route, but started to climb and turn into the area near Byglandsfjorden and Evje. For a period of approximately eight minutes, the helicopter was 1–2 NM into Kjevik TMA without obtaining clearance. After that, it followed a north-easterly course. At Moseid south of Byglandsfjorden lake, LN-OGT was registered on a northerly course at an altitude of 7,400 ft. At 2114 hrs, LN-OGT was registered as stationary at an elevation of 2,100 ft between Bygland and Åmli. The helicopter had then landed in a new cabin development area north of Tveitvatnet lake (see figure 1).

Figure 1: Photo of the helicopter north of Tveitvatnet lake, taken by the commander at 2141 hrs.

The NSIA has gained access to the commander's mobile phone. The log shows that there was contact between the commander and the owner of the helicopter on several occasions. The commander called the owner and explained that he had landed north of Tveitvatnet as he thought the weather was not looking good ahead of him. The owner of the helicopter has explained that he then checked available weather radar information online. He then informed the commander that the weather was bad with heavy rain in the area, and that he should expect to remain on the ground for at least three hours. The owner also sent him a link to the website www.accuweather.com. At 2150 hrs, the commander sent the owner a photo of the helicopter that showed where he was parked. Fifteen minutes later, the commander called and said that the

[5] *A standard code for flights in non-controlled airspace.*

weather had cleared enough to see the mountain peaks far away, and that he was considering continuing the flight.

At 2212 hrs, the commander sent a text message to the helicopter owner saying '*Taking off now*'. The owner was surprised by the decision and responded '*Fly safe. Don't push the limits!*'. After take-off, the helicopter set a south-easterly course, reaching the coast at Risør. At Risør, the altitude had decreased to 600 ft, and, flying onwards, the helicopter was just occasionally visible on the radar. From 2224 hrs until the time of the accident, the commander and the owner spoke on the phone twice. Among other things, the commander explained that visibility was good although it was raining, but that it was starting to get dark. One of the last things the commander said was that he was going to land at Langangen.[6] The owner of the helicopter has explained that, during the last registered call, he barely communicated with the commander due to the poor reception and that the call was cut off at 2254 hrs. Shortly thereafter, the owner called the commander again, but there was no answer. After four or five attempts, he suspected that something had happened, and shortly after, he received a call from helicopter operator Helitrans AS informing him that an emergency location transmitter belonging to LN-OGT had been triggered.

The last radar data from the helicopter were registered immediately before the crash. The altitude was 1,000 ft and the ground speed was 50 kt. At 2254 hrs, the helicopter collided with a power line, and the helicopter fell to the ground, fatally injuring the commander.

1.1.3 WITNESSES

There were several witnesses to the flight, and the NSIA has been given access to the witness statements taken by the police. Most describe a dark helicopter flying at unusually low altitude in poor weather. There was heavy rain and lightning in the area. The helicopter seemed to be following the E18 road and was observed by some witnesses flying just above the treetops. Several of the witnesses commented on the loud noise from the helicopter. One witness stated to the police that the helicopter was following the E18 at an altitude of approximately 50 metres above the ground when it passed the power line crossing the road at Søndbøvann, just west of Sannidal in Kragerø municipality. The witness believes that the helicopter must have passed under the power line, which in this location runs more than 60 metres above the road.

At least seven witnesses have explained to the police that they saw a flash of light when the helicopter hit the high-voltage power line. A witness who saw the helicopter thought that she saw a lightning strike and heard a loud bang from the area where the helicopter crashed. One witness stated that he saw the helicopter fly in a circle immediately before hitting the power line.

Another witness stated to the NSIA that he heard the helicopter passing at low altitude above the roof of his house at Øvaldvegen on the western side of the Eidangerfjord. He went out on the terrace and continued watching the helicopter as it flew north along the shoreline at low altitude. At Olavsberget Camping, the helicopter turned to the south-east and flew over the footbridge to Kattøya island. It passed over the diving tower with what appeared to be little clearance. It then climbed to the north-east, over the residential area in Hasler. Coming up to the E18 road, the helicopter turned to the south-east again. Seconds later, the witness saw a strong flash of light and heard a bang. He immediately realised that an accident had happened and called the emergency number (112). It was raining and getting dark, and he only saw the lights of the helicopter before it hit the high-voltage power line. There was no lightning in the area when the accident happened. The witness has explained that, when he observed it, the helicopter appeared to be flying in a controlled manner.

[6] The commander may have been referring to the NPRA's inspection site, approximately 2.5 km northwest of Langangen.

The NSIA has also been given access to videos, a photo and a sound recording that was handed over to the police in connection with the accident. With the exception of a recording from a video camera belonging to the Norwegian Public Roads Administration (NPRA), this information was of limited value to the investigation. The video recording, on the other hand, shows the helicopter for approximately the last 50 metres of the flight before it hit the power line.

In the video, the helicopter appears as it is flying steadily along the E18 at about the same height as the top of the rockface on the left side of the road (see figure 3). It is going at approximately the same speed as a car that is driving along the road. The image shows that it is raining heavily. After approximately 2.5 seconds, the helicopter hits the high-voltage power line. A flash of light starts to appear before the recording is interrupted when the camera's power supply is cut (see figure 4). The crash to the ground is therefore not recorded.

Some witnesses stated that they saw a helicopter flying at low altitude in the Tønsberg/Larvik area at around the time in question. Two witnesses had seen a helicopter at low altitude at Langangen and just east of Langangen.

Figure 2: Places referred to in the report. Map: @ the Norwegian Mapping Authority. Illustration: NSIA

Figure 3: Still image from video. The helicopter appears at the top of the image. The image may give the impression that there was more daylight than what there actually was. Video: NPRA/NSIA

Figure 4: Still image from video. A flash of light can be seen next to the white navigation light on the helicopter's tail. The video recording was cut off after that. The image may give the impression that there was more daylight than what there actually was. Video: NPRA/NSIA

1.2 Injuries to person

Table 2: Injuries to person

Injuries	Crew	Passengers	Others
Fatal	1		
Serious			
Minor/none			

1.3 Damage to aircraft

The helicopter was destroyed (see details in section 1.12.2).

1.4 Other damage

In addition to the damage to the power line, 369 subscribers remained without electricity for 3 hours and 42 minutes.

1.5 Personnel information

The commander, a 46-year-old man, started training for a private helicopter pilot licence (PPL(H)) on 15 January 2017. A PPL(H) entitling him to fly Robinson R44 helicopters was first issued on 22 May 2018. The right was renewed on 30 May 2021 and was valid until 31 May 2022. The commander had also obtained night qualification (NQ) and the right to fly Airbus Helicopters SE 3130 Alouette II. The pilot had a valid class 2 medical certificate without restrictions.

The NSIA has talked to some of the commander's instructors. He was characterised as systematic, thorough and cautious. They expressed surprise that he appeared to have pushed the limits that far in poor weather conditions. The commander was described as having a keen interest in aircraft and being eager to fly.

The commander was undergoing training to obtain a private pilot licence for aeroplanes (PPL(A)). As recently as the day before the accident, he had undergone the last check before the skill test with an instructor from Oslo Flyveklubb. The plan was to perform the skill test the following Saturday. The commander was also the co-owner of an Airbus Helicopters SE 3130 Alouette II, together with the owner of LN-OGT. He had flown to Western Norway on a weekend trip in late May using this helicopter. After that flight, the commander had mentioned that he had flown in some rain. According to the owner of the helicopter, most of his other flights had been short flights from Kjeller. Many of these flights had been instruction flights.

The commander was self-employed. According to his cohabitant, the commander had had a normal night and workday before he started planning the flight. He had his dinner at around 1700 hrs, just before he drove to Kjeller. It is likely that he purchased some food to go and ate it while on the ground in Kvinesdal.

Table 3: Flying experiance, commander

Flying hours	All types	On type
Last 24 hours	03:00	03:00
Last 3 days	06:05	03:00
Last 30 days	21:40	05:20
Last 90 days	46:00	05:20
Total	200:10	126:50

1.6 Aircraft information

1.6.1 GENERAL INFORMATION

The Robinson R44 is a light piston engine helicopter with four seats; two in the front and two in the back. The minimum crew is one pilot, seated in the right-hand front seat. The prototype first flew in 1990. The helicopter has a two-bladed main rotor rotating anti-clockwise when seen from above, and hydraulically assisted flight controls. In recent years, R44 has been the most-produced helicopter in the world. The helicopter has a fuel consumption of approximately 50 litres an hour. In practice, this means that, with a full tank and the required reserve fuel, it can be used for flights scheduled to last three hours.

1.6.2 DATA RELATING TO LN-OGT

Manufacturer and model: Robinson Helicopter Company R44 Raven I

Serial number: 1846

Year of manufacture: 2008

Total engine time: 2,115.5 hours

Engine: Lycoming O-540-F1B5

Maximum take-off mass: 2,400 lb (1,089 kg)

The helicopter was equipped to fly during the day and at night under visual flight rules (VFR), but not for instrument flying.

1.6.3 MASS AND BALANCE

The NSIA assumes that approximately 90 litres of fuel was left in the helicopter's fuel tanks when it crashed. The assumption is based on the fuel tanks being full before departure and the helicopter being refuelled using the three fuel cans.[7] An estimate of the helicopter's mass and balance at the time it crashed shows that the mass was 1,844 lb (836 kg) and the centre of gravity position were within the limits.

1.6.4 MAINTENANCE

LN-OGT had an Airworthiness Review Certificate (ARC) issued on 25 February 2021, valid until 25 February 2022. The last maintenance work performed was a 100-hour inspection carried out on 15

[7] *Three empty fuel cans were found at the accident site.*

June 2021 when the engine time was 2,107 hours. There were no remaining remarks in the helicopter's journey log book.

1.7 Meteorological information

1.7.1 REPORT FROM THE NORWEGIAN METEOROLOGICAL INSTITUTE

The NSIA has obtained a report[8] from the Norwegian Meteorological Institute concerning the weather situation in the area in question in the evening of 17 June 2021. The following is quoted from the report:[9]

> ***The weather situation in general***
>
> *At 20:00, there is a low-pressure system with fronts southeast of Jan Mayen (ground analysis 20:00). A cold front extending from Bodø to Stad and further south in the North Sea is moving in a north-easterly direction. Hot air masses east of the cold front cover Eastern Norway, and these masses are becoming increasingly unstable as the cold front approaches. At 20:00, a line of heavy rain and thunder showers has been established west of the Oslofjord, moving in a north-easterly direction at a speed of approximately 30 kt.*

[8] *See https://www.ippc.no/ippc/index.jsp for an explanation of meteorological abbreviations.*
[9] *For considerations of readability, all the times mentioned in the report have been converted into local time.*

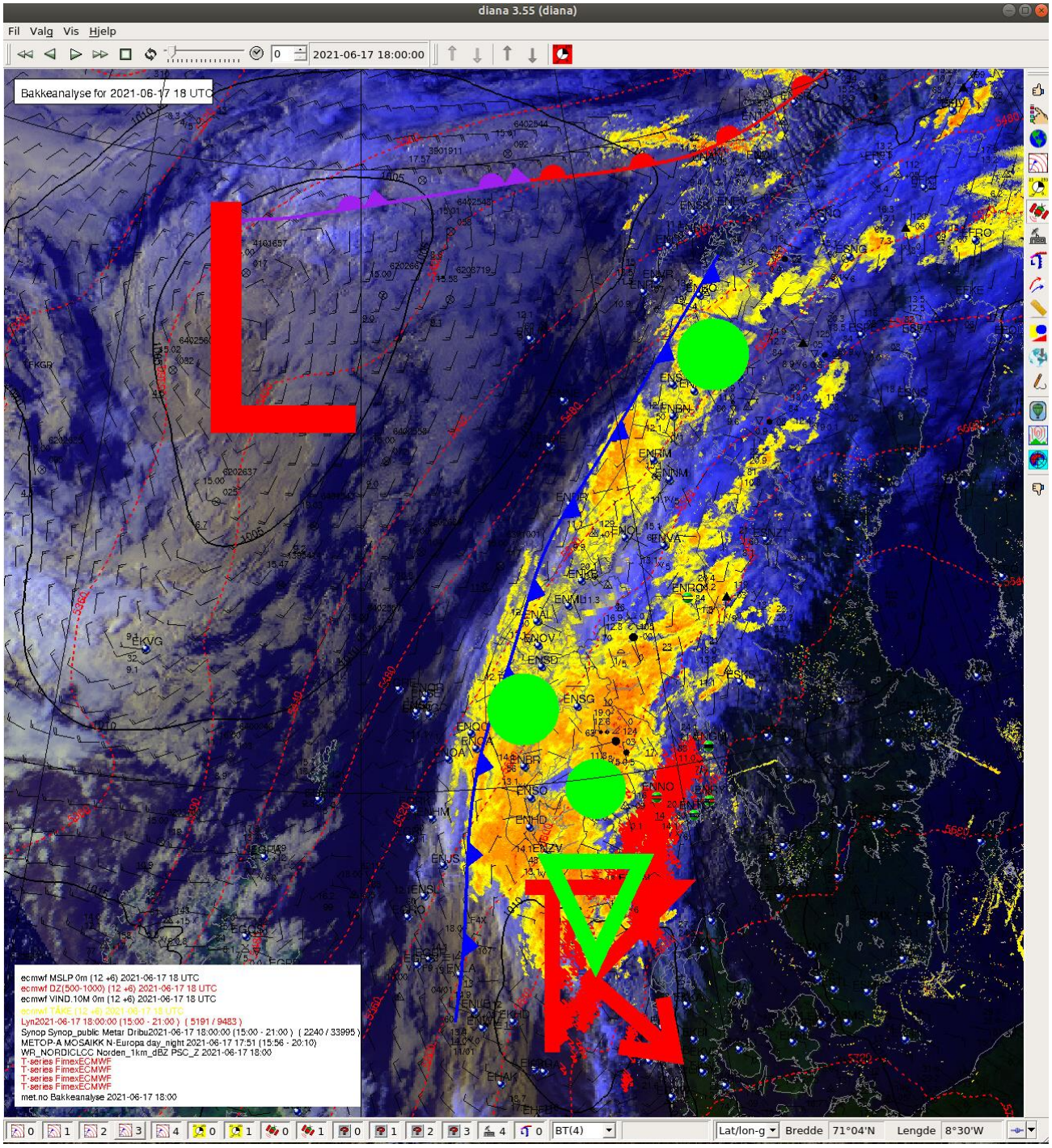

Figure 5: Ground analysis at 2000 hrs on 17 June 2021. Source: Norwegian Meteorological Institute/NSIA

Description of visibility, cloud cover, weather and ground winds in the area in question

East of this line of showers, the weather is cloudy or partially cloudy with some light rain showers, a cloud base of at least 4,000 ft and visibility of more than 10 km (METAR Torp (ENTO) and Gardermoen (ENGM)). The aircraft in question started the flight under these conditions.

Observations made after 2150 hrs at Torp are automatic. They do not register thunder, and there are weaknesses associated with visibility and cloud base observations. We have no manual observations of visibility or cloud base over the Grenland area.

Late in the evening, the showers start to appear over Torp and Gardermoen (after 2100 hrs), with the heaviest precipitation and thunder between 2400 hrs and 0200 hrs on 18 June. At Torp, the visibility and cloud base / vertical visibility in these showers are as low as 1.1 km visibility and 600 ft, respectively. At Gardermoen, the showers are less intense, with down to 3 km visibility and a cloud base of 2,000 ft or more.

Thunder was forecast in the TAF at both Gardermoen and Torp, but the TAF for Torp was amended at 2100 hrs when thunder was observed from a distance a little earlier than forecast. Lower visibility and a lower cloud base / vertical visibility were also observed during the most intense showers, but these were, as mentioned, automatic observations (after 2150 hrs). The reduced visibility and cloud base / vertical visibility up until 2400 hrs was largely due to the rain showers rather than fog or stratus clouds.

Little wind was observed on the ground during this situation, but strong gusts locally cannot be ruled out. Ahead of the line of showers, there was a southern or variable wind of up to 11 kt.

Radar and lightning

It can be assumed (but not verified) that the weather observed at Torp is also representative of the weather in the Grenland area with regard to visibility and the cloud base / vertical visibility during the showers. Based on radar and lightning data, it appears as if the first rain shower arrived between 2000 hrs and 2100 hrs, but it had weakened in intensity by the time it reached Porsgrunn. There was no lightning in the immediate vicinity of Porsgrunn during this hour. There was no precipitation between 2100 hrs and 2200 hrs, and the heaviest shower passed over the Grenland area between 2200 hrs and 2400 hrs. Some lightning was also registered around Porsgrunn during this period. This was also the period when the accident occurred.

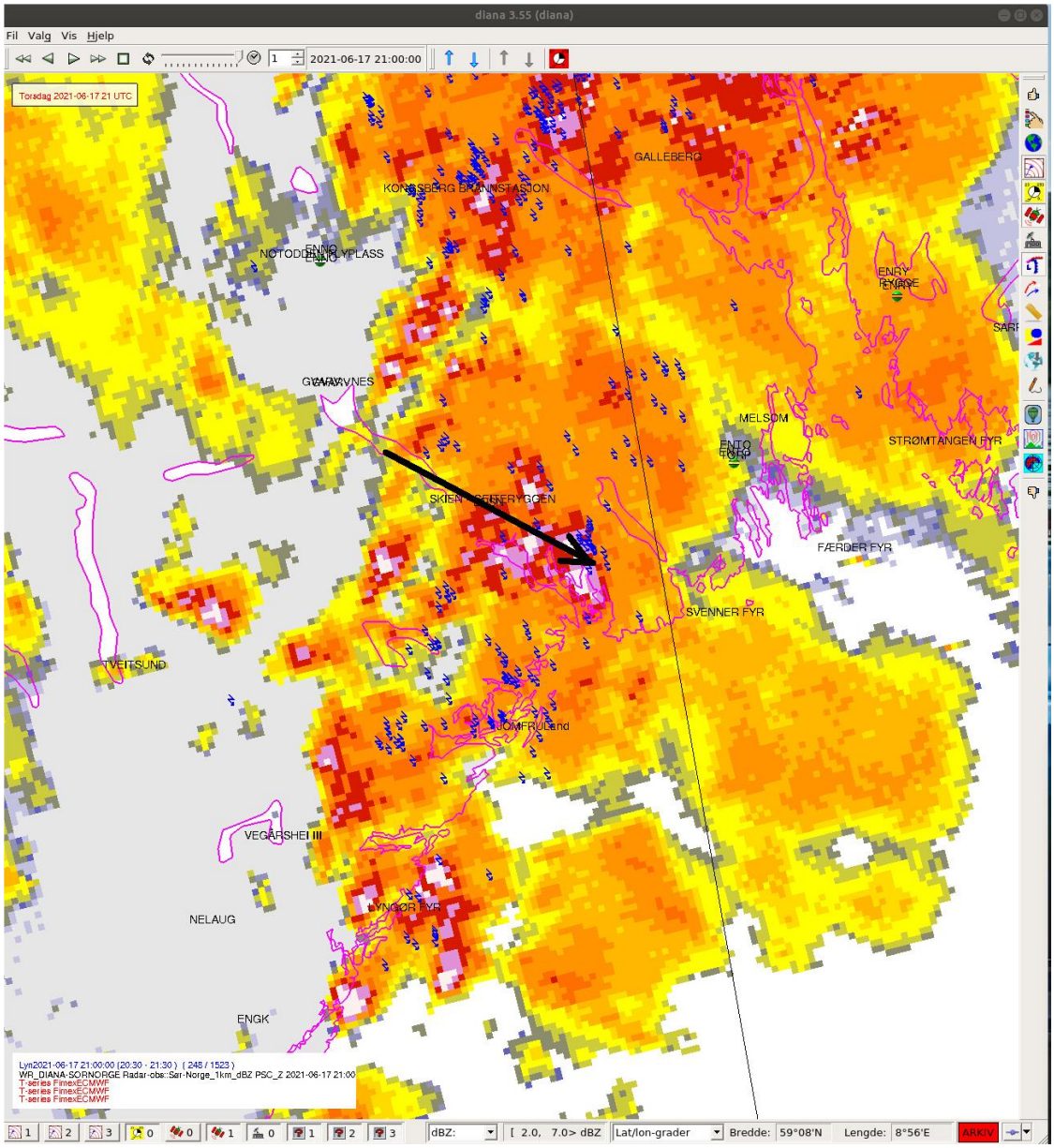

Figure 6: Radar and lightning data at 2300 hrs. The intensity of precipitation goes from yellow (weak) via orange and red to white (heaviest). Lightning data (blue) from 2230 hrs to 2330 hrs. The accident site is marked with a black arrow. Source: Norwegian Meteorological Institute/NSIA

Wind conditions and turbulence

Although the wind on the ground was mainly a light breeze, the wind speed at 2,000 ft was between 35 and 45 kt from a southerly direction in the area in question (model data). Earlier in the afternoon, the wind speed was between 25 and 35 kt. We have no observations of wind at altitude. This may have caused a fair bit of turbulence / wind shears between the ground and an altitude of 2,000 ft, estimated to moderate in the IGA forecast. Strong vertical air currents may arise in connection with cumulonimbus clouds. Downdrafts are particularly dangerous in connection with these clouds, which may have occurred in connection with the showers around Porsgrunn at the time in question. For that reason, the IGA forecast mentions severe turbulence in connection with cumulonimbus clouds.

Icing

The altitude of the 0-isotherm was 10,000 ft in the situation in question, with a temperature near the ground of around 20 degrees, which means that icing can be ruled out.

1.7.2 METAR

The following METAR report (METeorological Aerodrome Report) was issued for Sandefjord Airport Torp (ENTO) (times in UTC):

2021-06-17T15:50:00 ENTO 171550Z 17011KT CAVOK 21/12 Q1014 NOSIG=

2021-06-17T16:20:00 ENTO 171620Z 17011KT 9999 FEW050TCU SCT055 20/12 Q1013 NOSIG=

2021-06-17T16:50:00 ENTO 171650Z 18008KT 9999 FEW045TCU SCT055 20/13 Q1013 NOSIG=

2021-06-17T17:20:00 ENTO 171720Z 19006KT 9999 FEW045TCU SCT050 20/13 Q1013 NOSIG=

2021-06-17T17:50:00 ENTO 171750Z 18008KT 150V220 9999 FEW045TCU SCT050 20/14 Q1012 NOSIG=

2021-06-17T18:20:00 ENTO 171820Z 16007KT 110V200 CAVOK 19/14 Q1012 NOSIG=

2021-06-17T18:50:00 ENTO 171850Z 13006KT 9999 VCSH FEW030TCU SCT070 19/14 Q1012 NOSIG=

2021-06-17T19:20:00 ENTO 171920Z 14006KT 9999 VCTS SCT068CB 18/14 Q1011 TEMPO SHRA=

2021-06-17T19:20:00 ENTO 171920Z 14006KT 9999 VCTS SCT068CB 18/14 Q1011 NOSIG=

2021-06-17T19:50:00 ENTO 171950Z VRB03KT 9999 -SHRA FEW041CB SCT076 18/14 Q1011 NOSIG=

2021-06-17T20:20:00 ENTO 172020Z 15003KT 130V190 9999 -DZ FEW049/// SCT074/// 18/15 Q1011 RERA=

2021-06-17T20:50:00 ENTO 172050Z VRB02KT 9000 RA VV007 18/15 Q1012=

2021-06-17T21:20:00 ENTO 172120Z VRB02KT 9999 -RA FEW009/// 18/16 Q1012=

The following METAR report was issued for Oslo Airport Gardermoen (ENGM) (times in UTC):

2021-06-17T15:50:00 ENGM 171550Z 19009KT 9999 BKN048 22/11 Q1014 NOSIG=

2021-06-17T16:20:00 ENGM 171620Z 19009KT 9999 -SHRA BKN048 21/11 Q1014 NOSIG=

2021-06-17T16:50:00 ENGM 171650Z 20008KT CAVOK 22/11 Q1013 NOSIG=

2021-06-17T17:20:00 ENGM 171720Z 17011KT CAVOK 22/11 Q1013 NOSIG=

2021-06-17T17:50:00 ENGM 171750Z 17010KT CAVOK 22/11 Q1013 NOSIG=

2021-06-17T18:20:00 ENGM 171820Z 16009KT 9999 OVC046 22/11 Q1013 NOSIG=

2021-06-17T18:50:00 ENGM 171850Z 15007KT 9999 -SHRA OVC046 21/13 Q1013 NOSIG=

2021-06-17T18:50:00 ENGM 171850Z 15007KT 9999 OVC046 21/13 Q1013 NOSIG=

2021-06-17T19:20:00 ENGM 171920Z 20003KT 170V240 9999 -SHRA OVC044 19/14 Q1012 NOSIG=

2021-06-17T19:50:00 ENGM 171950Z 32003KT 270V060 9000 -SHRA OVC044 19/16 Q1012 TEMPO 4000 TSRA=

2021-06-17T19:50:00 ENGM 171950Z 32003KT 270V060 9000 -SHRA OVC044 19/16 Q1012 TEMPO 4000 TSRA=

2021-06-17T20:20:00 ENGM 172020Z 23008KT 5000 SHRA SCT014 OVC040 17/15 Q1013 TEMPO 4000 TSRA=

2021-06-17T20:50:00 ENGM 172050Z 17009KT 4000 SHRA FEW017 SCT044 OVC054 17/15 Q1012 TEMPO 6000 TSRA=

2021-06-17T21:20:00 ENGM 172120Z 19006KT 9000 4000N SHRA FEW035 OVC045 17/16 Q1012=

1.7.3 TAF

The following TAF report (Terminal Aerodrome Forecast) was issued for Sandefjord Airport Torp (ENTO) (times in UTC):

2021-06-17T11:00:00 ENTO 171100Z 1712/1812 18008KT 9999 FEW040 SCT070 TEMPO 1720/1801 TSRA BKN012 SCT020CB PROB30 1801/1808 BKN008=

2021-06-17T17:00:00 ENTO 171700Z 1718/1818 18008KT 9999 SCT040TCU TEMPO 1721/1802 SHRA BKN012 SCT020CB PROB40 1721/1802 4000 TSRA PROB40 1802/1808 BKN004=

2021-06-17T19:17:00 ENTO 171917Z 1719/1818 18008KT 9999 SCT040TCU TEMPO 1719/1802 SHRA BKN012 SCT020CB PROB40 1719/1802 4000 TSRA PROB40 1802/1808 BKN004=

The following TAF report was issued for Oslo Airport Gardermoen (ENGM) (times in UTC):

2021-06-17T11:00:00 ENGM 171100Z 1712/1812 19012KT 9999 FEW040 SCT070 TEMPO 1712/1718 20015G25KT TEMPO 1718/1802 SHRA SCT025CB BKN030 BECMG 1719/1721 VRB07KT PROB30 TEMPO 1721/1802 4000 TSRA BECMG 1802/1804 4000 BR BKN004 BECMG 1807/1810 19010KT SCT020=

2021-06-17T17:00:00 ENGM 171700Z 1718/1818 18008KT 9999 FEW040 SCT070 TEMPO 1720/1803 SHRA SCT025CB BKN030 PROB30 TEMPO 1720/1803 4000 TSRA BECMG 1802/1804 BKN008 TEMPO 1804/1808 2000 BR BKN003 BECMG 1807/1810 SCT020=

1.7.4 IGA FORECAST

The following IGA forecast (International General Aviation) was issued for the area in question (times in UTC):

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 ZCZC
 FBNO41 ENMI 171500
 IGA PROG 171500-172400 UTC Jun 2021 NORWAY FIR SE PART COAST AND
LOWLAND AREAS E OF E00730 AND S OF N6100


WIND SFC.......: NE-PART: LAN SE-S OR VRB/05-10KT. COT SE-S/10-20KT,
LATE SW/10-20KT. SW-PART: NE-E/05-15KT, BECMG VRB/05-10KT
WIND 2000FT....: NE-PART: S/25-35KT, BECMG S-SW/35-45KT. SW-PART: SE-S/
10-20KT BECMG S-SW/30-40KT, LATE SW/20KT SW-MOST PART
WIND/TEMP FL050: 180-210/25-35KT BECMG 35-50KT, STRONGEST LATE / PS10-
PS16, LOWEST NE-PART LATE
WIND/TEMP FL100: 200-230/35-45KT BECMG 45-55KT / PS02-PS05
WX.............: NIL, BECMG RA/SHRA/LCA TS, FST W-PART
VIS............: +10KM, LCA 4-8KM IN WX
CLD............: E-PART EARLY: SCT/BKN 4000-6000FT. ELSE BKN
2000-4000FT, LCA BKN/OVC 1000-1500FT IN WX, LCA EMBD TCU/CB 2000FT
0-ISOTHERM.....: ABV FL100
ICE............: NIL, RISK MOD/SEV IN CB
TURB...........: LCA MOD. LCA MOD/SEV ASSW TCU/CB
OUTLOOK FOR TOMORROW: VRB OR SW/05-15KT. SCT SHRA E-MOST PART EARLY. LCA
BR/FG EARLY. ELSE WX NIL
```

1.7.5 SIGMET

The following SIGMET (Significant Meteorological Information) report was issued for the area in question (times in UTC):

ZCZC
WSNO31 ENMI 171934
ENOS SIGMET A02 VALID 171940/172200 ENMI-
ENOR NORWAY FIR EMBD TS FCST WI N5830 E01030 - N5700 E00730 - N5900 E00730 - N6120 E01120 - N6030 E01220 - N5830 E01030 TOP FL350 MOV NE 30KT NC

1.7.6 OTHER PUBLISHED WEATHER INFORMATION

At 0839 hrs on 17 June, the Meteorological Institute published a warning on the website http://www.varsom.no about the risk of frequent lightning at yellow level. The warning was valid from 1700 hrs on 17 June to 0400 hrs on 18 June. The following is quoted:

> *Frequent lightning due to rain showers is expected Thursday evening and early Friday morning. First in Agder and Telemark, and later moving north-east towards the southern parts of Innlandet county. There will be considerable local differences in intensity, and some places will not see any thunder.*
>
> ***Consequence***
>
> *Thunderstorms can lead to locally strong wind gusts. Locally heavy rain showers. Danger of damage to object(s) as a result of lightning strikes. The power supply and TV / internet may be affected.*

Advice

Stay up to date on the development of the weather and the weather forecast. Monitor the weather radar or lyn.met.no. Disconnect electrical equipment. Seek shelter. Avoid open plains and large trees. Do not swim or bathe.

On Wednesday, the day before the accident, the website www.yr.no announced that it had launched a dedicated weather warning for lightning. The first weather warning was issued already the following day (Thursday), for the area in question. The news was reported by several media, and the forecast extreme weather conditions received widespread publicity.

1.7.7 WITNESSES

The NSIA has read through the witness statements taken by the police. A great number of witnesses in the Grenland area mention the heavy rain and lightning during the period when the accident happened. Several were surprised to see a helicopter flying in such bad weather.

1.8 Aids to navigation

The helicopter was not equipped for instrument flying. The commander used an iPad with the navigation software Air Navigation Pro. The iPad was attached to the commander's thigh.

1.9 Communications

No air traffic service units have any records of radio contact with LN-OGT. The passenger has informed the NSIA that the commander sometimes transmitted messages via the radio, but he cannot remember whether they were responded to.

The commander used a headset that was connected to his mobile phone via Bluetooth. This meant that he was able to receive phone calls directly to his headset without having to operate his phone.

1.10 Aerodrome information

Not relevant

1.11 Flight recorders

Flight recorders were not mandatory for this type of aircraft, nor were any installed.

1.12 Wreckage and impact information

1.12.1 THE ACCIDENT SITE

The helicopter fell down onto the grassy shoulder on the right-hand side of the E18 road, seen in the direction towards Oslo (see figure 7). It fell down between E18 and Landgangsveien (old E18 road) approximately 100 metres north of the bridge where the roads cross. The accident site is approximately 2.5 km north-west of the NPRA's inspection site at Lannerheia.

On the eastern side of the road, there is a more or less vertical 25-metre-high road cutting. On the western side the terrain is woody and 5–10 metres higher than the roadway. The roadway at the accident site is approximately 98 metres above sea level.

When looking towards Oslo, the E18 road runs in a direction of approximately 150°. The power line the helicopter hit runs approximately 13 metres above the roadway in a direction of 100°–280°. The 22-kV power line belonged to the power distribution company Lede and consisted of three 12-mm-thick steel-cored aluminium conductors. In addition, an earth conductor was installed approximately two metres below the conductors. The three conductors were installed horizontally in relation to each other and spaced approximately 1.5 metres apart. The two northernmost conductors were severed by the helicopter approximately 40 metres from the western pylon. The overhead line was not marked, nor was it required to be.

Figure 7: South-easterly view of the accident site. The E18 is the road on the left. The helicopter wreckage can be seen in the centre of the photo. The one remaining conductor and the earth conductor are visible in the photo. Photo: Porsgrunn fire and chimney sweep service/NSIA

1.12.2 THE HELICOPTER WRECKAGE

The helicopter ended up on its right side with its nose pointing in an easterly direction, approximately 15 metres south of the power line (see Figure 8). The rear end of the tail boom and the tail rotor ended up approximately 25 metres south of the main part of the wreckage. Some smaller parts, including a piece of the tail rotor drive shaft and parts of the tail boom, were scattered around in the area between the power line and the main wreckage.

The helicopter primarily sustained damage to the tail boom and the right side. The windshield and all the windows on the right side were broken. The skid on the right side was knocked off, and both main rotor blades were broken off about one metre from the rotor head.

The helicopter showed signs of contact with power lines in several places, most notably on the forward right landing gear leg, parts of the right side of the cabin, the right side of the rotor mast

and the area were the tail boom was severed. There were traces of ‘welding’ (melted aluminium) on the right side of the rotor mast and at the tip of one of the rotor blades (see figure 9).

There was approximately 90 litres of fuel left in the helicopter when it crashed. Some of the fuel started to leak out when the helicopter was raised in connection with the salvage operation.

The helicopter wreckage was taken to the NSIA’s premises in Lillestrøm. A closer inspection found no faults or defects that might have had an impact on the sequence of events.

Figure 8: South-easterly view of the helicopter. The red arrow points to the tail rotor. Photo: NSIA

Figure 9: The damage to the right side of the helicopter photographed in the NSIA's hangar. The red arrows point to areas with melted aluminium. The yellow arrow points to scratch marks on the right forward landing gear leg. Photo: NSIA

1.13 Medical and pathological information

The commander underwent a post-mortem examination at the Department of Forensic Medicine at Oslo University Hospital. The report concludes that the commander died almost instantly from extensive injuries, including head injuries. No traces of ethanol (alcohol), medication or narcotic substances were found in the forensic toxicology tests of blood and urine samples.

1.14 Fire

No fire occurred in connection with the crash.

1.15 Survival aspects

The commander was secured by four-point seatbelts. He was not wearing a helmet.

The helicopter was equipped with an emergency location transmitter (ELT) of the type Kannad 406 AF. It was triggered during the crash, and the signals were detected by the Joint Rescue Coordination Centre at 2256 hrs.

The police were notified of the accident at 2256 hrs. The first of the emergency services to arrive at the scene of the accident was the fire service, arriving at 2307 hrs.

1.16 Tests and research

The commander's iPad was found at the accident site. It was damaged and was therefore sent to Ibas Ontrack AS in Kongsvinger for data recovery. However, it proved impossible to find a log of the flight in the Air Navigation Pro software.

1.17 Organisational and management information

The helicopter was owned by the company Helikopterdrift AS, but was regularly leased by several people. The commander was one of them, and he had leased the helicopter for the flight in question at an agreed hourly rate. The flight was defined as non-commercial.

The passenger has informed the NSIA that any payment in connection with the flight was not discussed.

1.18 Other information

1.18.1 VISUAL FLIGHT RULES

The visual flight rules for visibility and distance to clouds are set out in Regulations on Rules of the Air (BSL F 1-1), which implement the common European rules established in Regulation (EU) 923/2012 (SERA) in section SERA.5001, with Norwegian adaptations set out in BSL F 1-1 Section 13. The rules state as follows:

> *When flying at an altitude of less than 300 m above the ground or water in ATS airspace class G, visibility shall be 5 km, clear of clouds and with the surface in sight. At speeds of 140 kt IAS or less, flying is permitted with flight visibility equal to or greater than 3 km, alternatively equal to or greater than 1.5 km for one traffic pattern and with the airport in sight. Helicopters can operate with flight visibility equal to or greater than 800 m, if manoeuvred at a speed that will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.*

The visual flight rules for minimum altitudes are set out in the common European rules SERA.5005(f). The rules state as follows:

> *Except when necessary for take-off or landing, a VFR flight shall not be flown over the congested areas of cities, towns or settlements or over an open-air assembly of persons at a height less than 300 m above the highest obstacle within a radius of 600 m from the aircraft. Elsewhere at a height less than 150 m above the ground or water, or 150 m above the highest obstacle within a radius of 150 m from the aircraft.*

1.18.2 WEATHER REQUIREMENTS

The rules for non-commercial operations with aeroplanes and helicopters, adopted through BSL D 1-1, are set out in Regulation (EU) No 965/2014 (EASA OPS) Annex VII (Part NCO). No weather restrictions are specified, however, over and above referring to the Rules of the Air (SERA). NCO.OP.160 Meteorological conditions, which state:

> *(a) The pilot-in-command shall only commence or continue a VFR flight if the latest available meteorological information indicates that the weather conditions along the route and at the intended destination at the estimated time of use will be at or above the applicable VFR operating minima.*

1.18.3 THE ACCIDENT AT RØLDALSFJELLET ON 17 FEBRUARY 2019

The NSIA has previously investigated an accident in which a non-commercial pilot flew an R44 (LN-ORH) into an area with low clouds and poor visibility in the Røldalsfjellet mountain area. The commander continued until he lost control of the helicopter and crashed into the mountainside. Both persons on board died. The pilot was inexperienced and had only accumulated a total of 77 flying hours. The accident had several common features with the accident involving LN-OGT (see SL report 2020/11).

1.19 Useful and efficient investigation methods

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

2. Analysis

2. Analysis

2.1 Introduction

At first glance, this accident may seem easy to explain because the sequence of events is well documented by radar, video and witnesses. Before the accident, the helicopter flew for a long period at low altitude in rain and poor visibility. The commander continued until the helicopter hit the power line crossing the E18 road. The difficult question to answer is why, despite the weather forecast, he agreed to fly to Kvinesdal that afternoon and why he did not discontinue the flight in time when the conditions became unsuited for flying.

The sequence of events is first analysed below, followed by an analysis of factors that may have influenced the commander's decision. Finally, the survival aspects are analysed.

The NSIA's investigations has not found any faults or irregularities relating to the helicopter that may have had an impact on the sequence of events. The condition of the helicopter is therefore not described in further detail in the analysis.

2.2 Sequence of events

Based on available information, there were no notable problems on the flight to Kvinesdal. At an early stage during the return flight, however, it seems as if the weather created challenges. For example, the flight took place for a short period in controlled airspace without clearance having been obtained. This may indicate that the commander for a period had too high a workload and he later decided to land on a cabin development area north of Tveitevatnet. There was no conflict with other air traffic during the airspace infringement.

According to the helicopter owner's statement, the landing was made because the weather was problematic. After the helicopter took off again, available information indicates that the flight southward to Risør was uneventful. At Risør, the helicopter was registered at an altitude of approximately 600 ft, which suggests that the weather had become so challenging that the commander had decided to fly low to maintain visual contact with the ground. The fact that the helicopter was only occasionally visible on the radar suggests that the flight continued below radar coverage at low altitude.

Witness statements from the final part of the flight up until the accident site all point out that the helicopter was flying at low altitude partly in heavy rain. A witness believes that the helicopter flew under a power line that crossed the E18 west of Sannidal. This indicates that the commander at that point may have flown 60 meters or lower above the ground. The witness statements also indicate that the helicopter, during the final part of the flight, flew along the shoreline and that it climbed a little as it was approaching the E18. That may suggest that the commander intended to follow the lights along the road to the NPRA's inspection site at Lannerheia.

The NSIA sees no direct connection between the accident and witness observations made at Langangen, Tønsberg and Larvik, as described in section 1.1. These observations may have been of other helicopters, for example from the emergency services.

Available information suggests that, in some places, the helicopter flew significantly below the minimum altitude of 150 metres (500 ft) above the terrain, and that flight visibility may have been below the minimum requirement of 800 metres in the area between Stathelle and the accident site. Based on the NPRA's video recording, it is difficult to determine whether flight visibility in the area at this time met the 800-metre requirement. It is clear, however, that the helicopter flew approximately 13 metres above the roadway with a heading of approximately 150° when the

accident occurred. The low altitude indicates that the commander's possibilities of keeping an overview of the area was limited.

Poor visibility and light conditions combined with rain on the windshield suggest that it may have been virtually impossible for him to spot the power line in time. The damage to the helicopter indicates that the lower part of the right forward landing gear leg hit the northern conductor of the power line first. The conductor then slid up along the landing gear leg before being severed at the leg's attachment point. It is likely that the impact of the collision caused the helicopter to turn to the left at the same time as it rolled to the right.

During this sequence, the helicopter also came into contact with the middle conductor. This caused a short circuit and a strong flash of light that was observed by several witnesses. As that happened, a strong electric current passed through parts of the helicopter, causing aluminium to melt. One of the conductors, probably the middle one, hit the tail boom and cut it in half. After the two conductors had been severed, the helicopter fell more or less straight to the ground, hitting the road shoulder with its right side first. The loose tail with the tail rotor continued moving for approximately 25 metres before it fell down onto the grass along the road.

The speed of the helicopter when it hit the power line is difficult to ascertain. The helicopter was travelling at approximately the same speed as a car on the road below, which suggests a speed of 70–80 km/h (38–43 kt).

2.3 Planning and implementation

In hindsight, it may seem obvious that the flight should have been discontinued or alternatively never started. To be able to prevent similar accidents from happening in future, it is therefore important to try to understand why the commander made the decisions he did.

The commander was eager to fly, and it is likely that he saw the flight to Kvinesdal as an opportunity to gain experience of slightly longer flights. The NSIA has no information indicating that the commander felt external pressure to fly or that the flight was motivated by financial gain. He was responsible for planning and conducting the flight himself. Available information indicates that he spent time planning the flight, but how he familiarised himself with the weather forecast is not known. What weather information he obtained, and when, therefore remains uncertain.

Information available via TAF reports, the IGA forecast and SIGMET all indicates that rain and thunder were forecast for the evening in the area in question, and that the weather system would move in from the west. Thunder showers and thunder 'baked into clouds' were also forecast. Visibility was stated to be more than 10 km, but the IGA forecast stated that visibility could drop to 4 km. Before the departure from Kjeller, there was no METAR report indicating that it would not be possible to fly along the coast.

The extent to which the commander used weather forecasts aimed at the general public is unknown. Both websites yr.no and varsom.no warned of rain and thunder with the possibility of great local variations in the area in question. The NSIA considers that the weather forecasts should give grounds for concern about the possibility of flying round trip Kjeller–Kvinesdal on the evening in question, especially considering the scarcity of weather forecasts aimed at aviation in the inner parts of Agder and Telemark. The commander also had little experience of flying in bad weather, and adding extra safety margins would be natural. The fact that there was only one aircraft with the general transponder code 7000 flying in the area suggests that no one other than the commander considered the weather suitable for flying in accordance with the visual flight rules (VFR).

In practice, the commander could have terminated the flight and landed at any time. A landing should normally be approved by the land owner, but in the event of unexpected changes in

weather, safety is paramount, and no laws or regulations prevent a pilot from landing under such circumstances. The commander also did carry out such a precautionary landing north of Tveitvatnet lake. While on the ground, he accessed information about the weather situation via weather radar and was urged not to take any chances under the prevailing weather. Why he nonetheless chose to continue is therefore unclear. The most likely answer must be that he saw, or thought he saw an improvement in the weather. A decreasing altitude as the helicopter headed north along the coast from Risør suggests that the weather deteriorated.

The tendency of people to continue with the original plan in spite of problems that arise is often referred to as *Plan Continuation Error* or *Plan Continuation Bias*. The phenomenon can be described as follows:

> *Once you set out on a plan for which you see no obstacles, or only minor ones, you continue with your plan even when evidence piles up that you should change direction or stop entirely.*

When the phenomenon is related to a homeward journey, the term *Get-home-itis* is also used.

> *Get-home-itis is a funny sounding colloquialism, but the danger behind it is very real. It is when the desire to get to a destination overrides logic, sound decision-making, and basic instinct (from the website I Fly America).*

The NSIA believes that both phenomena are relevant in terms of explaining what happened during the flight. That the commander continued, but at ever lower altitude, suggests that the weather deteriorated gradually, but that his courage and sense of mastering the situation increased as the weather deteriorated. Thus, '*logic, sound decision-making, and basic instinct*' may have been weakened, leading to the decision to discontinue the flight being made too late. The NSIA cannot rule out that the commander had decided to land at the NPRA's inspection site at Lannerheia when he hit the cables. If that was the case, he was only 2.5 km from the landing site.

The commander had limited experience. There is reason to assume that he had little experience with flying in weather with visibility close to minima. The decision to continue flying is thus difficult to understand.

During the flight, the commander was in regular contact with the owner of the helicopter. Based on available information, it has not been possible for the NSIA to say anything about the extent to which this contact influenced the commander's decisions. His mobile phone was directly connected to his headset, and he could thereby operate it without taking his hands off the controls. Phone calls can be distracting, but the NSIA has no indications for claiming that the commander was distracted by the contact with the owner of the helicopter.

A number of investigations have left the NSIA with the impression that many pilots are willing to push the limits far when flying a helicopter in bad weather. The accident involving LN-ORH in Røldalsfjellet is an example of how even inexperienced pilots are willing to push the limits. The fact that many people rely on the helicopter's ability to fly slowly, hover or land if the weather conditions become unacceptable may help to explain why. If provisions on planning, flight visibility, distance to clouds and altitude above ground are complied with, the flexibility of a helicopter can make it safer than an aeroplane.

When flying at low altitude in poor visibility, tablet-based map software will not be very helpful, among other things because it is not possible to fly the helicopter and pay attention to details on the map at the same time. In addition, the maps do not include all low obstacles. The minimum requirements for flight visibility and altitude are not set at random, but based on long-standing experience and lessons learnt from many previous accidents.

In recent years, there have been fewer helicopter accidents in which pushing the weather and loss of visual references have been a factor. This may indicate that Norwegian commercial operators have acquired a more mature attitude to safety in general and the risk of loss of visual references in particular. The commanders of the helicopter involved in this accident and LN-ORH operated on a non-commercial basis and were not influenced to the same extent by the corrective attitudes that seem to have gained a foothold among the commercial operators.

Many people who fly light aircraft are affiliated to flying clubs. These clubs are home to many forms of organised safety work and exchange of experience. Corresponding flying clubs for non-commercial helicopter pilots are rare. The NSIA assumes that similar clubs or joint arenas could have a positive impact on the attitudes and knowledge of private helicopter pilots. Regardless of organisational matters, it is important that everyone who flies takes weather and visibility conditions seriously. The NSIA hopes that these two fatal accidents can help to raise awareness among non-commercial helicopter pilots about the risks of flying in poor visibility. Moreover, helicopter training organizations must emphasise imparting good, fundamental attitudes to the weather and requirements of visibility and visual references.

2.4 Survival aspects

The helicopter probably dropped 13 metres to the ground in more or less a free fall. That type of fall will normally be fatal. In this case, the helicopter landed on its right side, and the commander, who was sitting on the right-hand side of the cabin, suffered the full effect of the crash forces and died instantly.

The commander was secured by four-point seatbelts, but they had no notable effect, as the helicopter fell down on its right side.

The commander was not wearing a helmet. Helmets can offer good head protection in a crash. In the crash in question, the commander suffered fatal head injuries. A helmet would probably have limited these injuries, but the NSIA has no reason to claim that the use of a helmet could have been lifesaving.

There were several witnesses to the accident, and the emergency services were notified immediately. They arrived at the accident site soon after the accident, but the commander died instantly during the impact.

The helicopter’s emergency location transmitter was triggered in connection with the accident, as it is designed to. The emergency services were notified directly by witnesses, which meant that the transmitter did not contribute directly to the swift arrival of rescue personnel.

3. Conclusion

3. Conclusion

3.1 Main conclusion

The commander planned to fly from Kjeller to Kvinesdal and back, despite the fact that rain and thunderstorms were forecast in the area. He continued flying at low altitude after the visibility and light conditions deteriorated. The final part of the flight took place at very low altitude. This is often referred to as ‘pushing the weather’. The NSIA does not have information that can provide an obvious explanation to why the commander continued to fly despite the bad weather.

3.2 Investigation results

A. The commander had the licence required to fly the helicopter.

B. The commander was relatively inexperienced.

C. The NSIA’s investigations has not found any faults or irregularities in the helicopter that may have had an impact on the sequence of events.

D. The NSIA has no information suggesting that the commander was under external pressure to conduct the flight.

E. The weather deteriorated during the flight.

F. The helicopter flew at very low altitude above the terrain both during and immediately before the collision with the power line.

G. The helicopter fell straight to the ground after hitting the power line, and the commander died instantly.

H. If the commander had worn a helmet, that would probably have limited the extent of his head injuries, but the NSIA has no reason to claim that the use of a helmet could have been lifesaving.

4. Safety recommendations

4. Safety recommendations

The NSIA issues no safety recommendations in connection with the investigation.

Norwegian Safety Investigation Authority
Lillestrøm, 7 June 2022

Abbreviations

Abbreviations

ATS	Air Traffic Services
E	east
ft	foot (feet) – (0.305 m)
IAS	Indicated Air Speed
ICAO	International Civil Aviation Organization
kt (KT)	knot(s) – nautical mile(s) (1,852 m) per hour
kV	kilovolt
lb	pound(s) (0.454 kg)
N	North (North latitude)
NM	nautical mile(s) (1,852 m)
NPRA	Norwegian Public Roads Administration – Statens vegvesen
NSIA	Norwegian Safety Investigation Authority – Statens havarikommisjon
PC	Proficiency Check
TMA	Terminal control area; airspace in a defined altitude above/near to a controlled airport
UTC	Coordinated Universal Time
VFR	Visual Flight Rules