Norwegian Safety Investigation Authority

Published December 2023

REPORT AVIATION 2023/09

Air accident in Verdal in Trøndelag County on 1 November 2022 involving an Airbus Helicopters AS 350 B3, LN-OBP operated by Midtnorsk Helikopterservice AS

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

The purpose 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 make possible safety recommendations. It is not the NSIA's task to apportion blame or liability.

Use of this report for any other purpose than for flight safety should be avoided.

Photo: Midtnorsk Helikopterservice AS

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 of reference.

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Air accident report

Table 1: Data

Type of aircraft:	Airbus Helicopters AS 350 B3
Nationality and registration:	Norwegian, LN-OBP
Owner:	Midtnorsk Helikopterservice AS
Operator:	Same as owner
Crew:	1, sustained serious injuries
Passengers:	2, sustained fatal injuries
Accident site:	Forbregdsmyra, Verdal, Trøndelag, 63.798601N 11.542992E
Accident time:	Tuesday 1 November 2022 at 1036 hrs

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

Notification

At 1137 hrs on Tuesday 1 November 2022, the Norwegian Safety Investigation Authority (NSIA) was alerted by the Joint Rescue Coordination Centre of Southern Norway about a helicopter accident in Verdal, Trøndelag County. There were three persons on board, two of whom were confirmed to have died. The police secured the accident site until the NSIA arrived. Three accident investigators went to the site and started investigations on Wednesday 2 November 2022 at 0830 hrs.

The following were notified of the accident in accordance with ICAO Annex 13 and the Norwegian Aviation Act Section 12-6 cf. EU Regulation 996/2010 article 9 no. 2:

- The French national investigation agency – Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile (BEA) – as the state of manufacture
- The European Union Aviation Safety Agency (EASA)
- The Civil Aviation Authority Norway (CAA Norway)

The BEA appointed an accredited representative who was accompanied by technical advisors from the helicopter manufacturer, Airbus Helicopters, and the engine manufacturer, Safran Helicopter Engines.

Since some of the seatbelts in the helicopter were made by an American manufacturer, the American national investigation Agency NTSB (National Transportation Safety Board) was notified during the investigation.

Summary

A helicopter operated by Midtnorsk Helikopterservice AS (MNHS) with the registration LN-OBP crashed at 1036 hrs on Tuesday 1 November 2022. The accident happened after the commander lost visual references in fog. The accident occurred 450 m from the take-off helipad and only about 10–20 seconds after take-off.

The commander survived, but both passengers died. A failure of the rotary buckle in combination with incorrect seat belt use, as well as a large amount of unsecured luggage next to the rear passenger contributed to both passengers ending up on the outside the helicopter and sustaining fatal injuries.

The commander was to transport two passengers, a dog and luggage from the operating base of Midtnorsk Helikopterservice AS in Verdal to Gaundalen mountain farm in Skjækerfjella, Snåsa municipality, Trøndelag county. Two days before the accident, the commander had tried to fly the passengers to the farm, but had to abort due to fog in the mountains. They had not attempted to fly the day before the accident due to fog in Verdal.

Two other pilots from the helicopter operator had lifted off about 2 hrs before LN-OBP crashed. The morning fog varied in density and extent and the two pilots had to wait a bit before they had an opening and could take off.

The commander of LN-OBP also had to wait before he perceived an opening in the fog that permitted take-off. The commander was alone in evaluating and understanding the situation. This is normal for the inland helicopter segment, and the quality assurance of own operations is therefore important.

The helicopter operator had been issued an Air Operators Certificate from CAA Norway. To be issued an AOC it is required that certain positions are filled. These requirements are regulated by EASA. Together, the various roles must contribute to ensuring that the intention of the regulations, and thus the expected safety, is achieved, among other things, by collectively contributing to a good safety net and safety management. The commander held several of these positions in addition to being an active pilot and the main shareholder of the company. The investigation has also found that the company’s operational control was deficient, and this is seen among others in relation to the organisation of the company which was approved by the CAA Norway.

When the CAA Norway approve organisations where individuals are granted several roles, the NSIA expects that it is aware that the safety margins might be reduced. Given that the Norwegian Civil Aviation Authority's oversight activities are risk-based, such an organisation will require the Norwegian Civil Aviation Authority to adapt the oversight activities of these helicopter operators to ensure that safety is safeguarded. The NSIA has not found information that indicates that this has been the case. This investigation has revealed that the CAA Norway is aware of this challenge, but has not necessarily positioned itself to be able to handle it.

The investigation has revealed that the CAA Norway has challenges in performing risk based oversight activities of the inland helicopter segment in general. The NSIA issues one safety recommendation concerning this.

About the investigation

Purpose and method

The purpose of this investigation has been to clarify what caused LN-OBP to impact the terrain shortly after take-off and why it happened. The NSIA has also considered what can be done to improve safety and prevent the recurrence of similar accidents and consequences in future.

The investigation was conducted in line with the NSIA's framework and analysis process for systematic safety investigations (the NSIA method[1]).

Sources of information

- Investigation at the accident site
- The commander
- The helicopter operator
- Informants
- Aircraft documents
- Electronic units such as mobile phone and iPad
- Technical examinations of the helicopter
- Videos & photos
- The Civil Aviation Authority Norway – CAA Norway
- The helicopter manufacturer
- The engine manufacturer
- The manufacturer of some of the seatbelts
- Police documents

The investigation report

The first section of the report, Factual information, describes the sequence of events, associated data and information collected in connection with the accident, and describes the NSIA's examinations and related findings.

The second section, Analysis, describes the NSIA's assessments and analyses of the sequence of events and contributing factors, on the basis of factual information and examinations carried out. Details and factors that are found to be less relevant to explaining and understanding the accident are not discussed in depth.

The report ends with the NSIA's conclusions and safety recommendation.

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

1. Factual information

1. Factual information

1.1 History of the flight

On Tuesday 1 November 2022, the commander was transporting two passengers, a dog and luggage from the operating base of Midtnorsk Helikopterservice AS (MNHS) in Verdal to Gaundalen mountain farm in Skjækerfjella, Snåsa municipality, Trøndelag county. Two days before the accident, the commander had tried to fly the passengers to the farm, but had to abort due to fog in the mountains. They had not attempted to fly the day before the accident due to fog in Verdal. Later in the day the commander also had a sling load mission for a construction company planned.

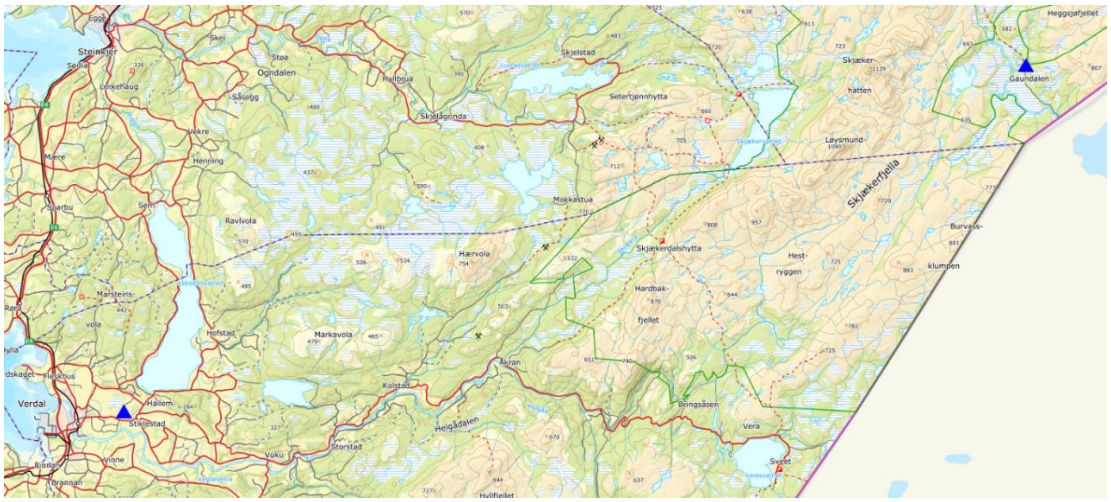

Figure 1: Map over the planned flight. The departure location is marked with a blue triangle in the lower left corner, while the planned arrival location is marked with a blue triangle in the upper right corner. Map: © The Norwegian Mapping Authority / NSIA

On the day of the accident the morning fog lay low in the terrain in Verdal, and followed the valley and river. Three pilots from MNHS had missions that day. Two of them have explained to the NSIA that they had to wait for the fog to clear before they could take off. The commander of LN-OBP had some other errands before his flight. He drove up to Forbregd Lein, which is located at a higher elevation, to get an overview of the weather situation, see Figure 2. At around 0815 hrs, the two other pilots took off in two different helicopters.

Figure 2: Photo taken by the commander at 0758 hrs about 2.5 hrs before the accident. The helicopter base is located 1.3 km behind the birch to the left in the photo. It is about 500 m to the trees in the background marked with the black arrow. Photo: The commander / NSIA

The passengers arrived at the helicopter base at around 0900 hrs. The commander loaded the luggage onto the helicopter and waited for the visibility to improve so they could take off. The commander has stated that there was a calm atmosphere and that he did not feel any stress. One of the passengers took a photo of the helicopter at 1003 hrs and sent it to family members, see Figure 3. At 1019 hrs, the other passenger sent a photo of the helicopter hangar to some friends, see Figure 4. The photos are taken in opposite directions.

Figure 3: Photo taken by one of the passengers at 1003 hrs. Photo: Private / NSIA

Figure 4: Photo taken by the other passenger at 1019 hrs. Photo: Private / NSIA

The commander has explained that he perceived an opening in the fog and prepared for take-off. He has both explained and drawn on a map how the fog lifted north-east of the helicopter base, which was where he wanted to fly. Right before take-off, at 1030 hrs, he took a photo and sent it to

an acquaintance, see Figure 6. He completed some final preparations and sent a departure message (flight following[2]) at 1031 hrs.

The commander has explained that, due to the improvement in the weather, he intended to perform a normal departure towards the north-east. To do this, he had to fly around a cluster of trees close to the helipad, see Figure 3 and Figure 5.

Figure 5: Map drawn based on a sketch by the commander of where he perceived an improvement in the weather (shaded area). The direction the helicopter was facing before take-off (red arrow), a cluster of trees close to the helipad (green circle) and the accident site (red triangle) are indicated. Picture: © The Norwegian Mapping Authority. Illustration: The Commander / NSIA

[2] *Flight following is the monitoring of a flight to increase flight safety.*

Figure 6: Photo taken by the commander towards the north-east right before take-off. Photo: The commander / NSIA

A private surveillance camera in Forbregd Lein has captured the sound of the helicopter starting up, which indicates that the helicopter began the starting sequence at 10:32:40 hrs. A change in the sound, which is commensurate with an increase in the throttle level, can be heard at 10:34:52 hrs. The recording indicates that the helicopter lifted off between 10:35:39 and 10:35:49 hrs. The recording has also captured the sound of the helicopter impacting the ground at 10:35:59 hrs. The helicopter was in the air between 10 and 20 seconds before it crashed.

The commander has explained to the NSIA that he cannot remember what happened after he lifted off, until he suddenly saw he was moving towards the ground at high speed.

Right after the crash, he stated to several of the rescue workers that he was surprised by the fog. To one rescue worker he said *"it was like flying into a wall of fog"*. To another he said *"everything was just white"* and to a third *"the fog just closed around me"*.

About 450 m after take-off and 10 m lower than the take-off altitude, LN-OBP impacted the terrain for the first time. After several jumps, the helicopter came to rest on its left side, about 90 m from the first impact.

When the commander regained consciousness after the accident, he was hanging in his safety harness and had difficulty breathing. He opened the buckle and crawled away from the helicopter. He then called the company's Manager of Flight Operations who initiated the rescue operation.

There was initially some confusion as to where the helicopter had crashed, since there was no helicopter tracking[3] and the emergency locator transmitter antenna had snapped during the crash. The Manager of Flight Operations therefore instructed the commander to call emergency services with the Hjelp 113-app to notify them of the accident. Dense fog contributed to the problem of locating the aircraft. After 10–15 minutes, a doctor and rescue personnel arrived at the accident site. Both a rescue helicopter and an air ambulance helicopter were unable to land near the accident site due to fog. After a little while, the air ambulance helicopter was able to land in a field slightly higher up in the terrain about 2 km from the accident site.

It was quickly established that one of the passengers had been thrown from the helicopter and killed. The other passenger was partially outside their seat and was stuck underneath the helicopter. The police had to use a tractor to lift the helicopter to free the passenger. It was established that both passengers had been killed. The dog, which had sat on the floor between the legs of the passenger in the front seat, was thrown from the helicopter, but survived. The commander sustained serious injuries and was flown to St. Olavs Hospital in Trondheim.

1.2 Injuries

Table 2: Injuries

Injuries	Crew	Passengers	Other
Fatal		2	
Serious	1		
Minor/none			

1.3 Damage to aircraft

The helicopter was completely destroyed, see chapter 1.12.2 for details.

1.4 Other damage

Some fuel and oil leakage in a ploughed field.

1.5 Personnel information

The commander trained for his pilot's license in Stockholm and graduated in 1998. Since then he has worked as a helicopter pilot, primarily for his own company, and must be regarded as an experienced pilot.

The commander held a valid commercial pilot licence for helicopters, CPL(H) and held a class 1 medical certificate valid until 20 April 2023 with a **VML** "Valid only with correction for defective distant, intermediate and near vision" limitation. This means that the commander had to use glasses or contact lenses when he was flying.

He completed a *Proficiency Check* (PC)[4] on 18 February 2022, which was valid until 28 February 2023. He completed an *Operators Proficiency Check* (OPC) on 11 July 2022, which was valid until January 2023.

[3] The flight following had not been able to record on the short flight.
[4] Skill test done with an examiner from CAA Norway.

The commander has stated to the NSIA that he had slept well the night before the flight and was well rested.

Table 3: Flying experience commander

Flight time	All types	On type
Last 24 hours	1:10	1:10
Last 3 days	1:10	1:10
Last 30 days	22:25	22:25
Last 90 days	70:20	62:40
Total	6 115	3 800

1.6 Aircraft information

1.6.1 GENERAL

Airbus Helicopters AS 350 B3 is a FAR – 27 Normal Category Rotorcraft[5] certified helicopter. The prototype, AS 350 C, was first flown in 1974. The AS 350 B3 was issued a type certificate in 1997, and customer deliveries started in 1998. The helicopter is a multipurpose helicopter and is used for e.g. sling load missions and passenger transport.

Figure 7: A previous photo of LN-OBP. Photo: Midtnorsk Helikopterservice AS / NSIA

Airbus Helicopters AS 350 B3 has three main rotor blades and a conventional tail rotor. Substantial parts of the helicopter are made out of composite materials, including most of the main rotor. The engine is a Safran Helicopter Engines Arriel 2B turboshaft engine.

AS 350 B3 has room for six people, two in the cockpit and four in the cabin. The minimum crew is one pilot in the right-hand seat. Since LN-OBP was configured to transport passengers, the flight controls on the left-hand side of the cockpit had been removed. The helicopter was also equipped with a cargo basket such as the one in Figure 7.

[5] *American certification regulation for helicopters.*

1.6.2 DATA FOR LN-OBP

Table 4: Data for LN-OBP

Manufacturer:	Airbus Helicopters
Type designation:	AS 350 B3
Serial number:	3575
Nationality and registration:	Norwegian, LN-OBP
Year of manufacture:	2002
ARC date:	23 June 2023
Total flight hours:	7,362.3 flight hours
Number of landings:	24,300
Flight hours since last maintenance:	422.3
Engine:	Safran Helicopter Engines Arriel 2B
Serial number:	22498
Fuel:	Jet A1

All maintenance and inspections were documented to have been performed and at the correct time interval. The NSIA has found nothing in the helicopters' technical documentation that may have had a bearing on the accident.

The NSIA has observed some irregularities about proper usage of equipment on board and with respect to the helicopters' airworthiness:

- The artificial horizon (Attitude indicator – AI) was removed from the helicopter without proper documentation. The formal airworthiness of the helicopter were therefore not properly taken care of. The regulation require an AI if operations are conducted in less than 1,500 m visibility. The NSIA believes that a lack of artificial horizon did not contribute to the accident and this is therefore not analysed further.
- A fibreboard plank was found on the floor in the rear cabin. The plank was cut such that it fit with the seat fixtures. It did not fulfil fire requirements and interfered with the structure of the rear seats and the energy absorption mechanism of the front seats during the accident. The plank was just laid on the floor and not fastened.
- A homemade centre console of corrugated aluminium was found in the helicopter. A bottle holder on this console broke during the accident. This meant that an aluminium cylinder was thrown about the helicopter. Airbus Helicopters produce certified consoles for installation. The console was fastened to the helicopter by latches and three cargo rings. One of the latches broke during the accident and another was loose since the bolt had slid open.
- Both the seats in the cockpit were equipped with five point safety harnesses. The crotch strap of the front passenger was found stowed underneath the seat and was unavailable for use.

All of the irregularities had been present a while based on witness accounts and their condition. The helicopter was inspected before renewal of the Airworthiness Review Certificate[6] in June 2022[7]. The artificial horizon was at this time removed and the centre console was present. Before the ARC is renewed, the helicopter is inspected by an approved organisation, which forward its

[6] *"Airworthiness Review Certificate", proof of continuing airworthiness issued by CAA Norway.*
[7] *The NSIA knows that the artificial horizon was removed before the ARC review in 2019.*

recommendation about renewal to the CAA Norway. None of the irregularities were reported in the “Airworthiness Review Report” dated 20 June 2022. The CAA Norway also has the ability to inspect the helicopter if it is present during compliance monitoring audits. This has not been the case for LN-OBP.

Figure 8:The artificial horizon should have been installed under the sign “Radiocall LN-OBP”. The hole after the instrument was covered with electrical tape. Photo: NSIA

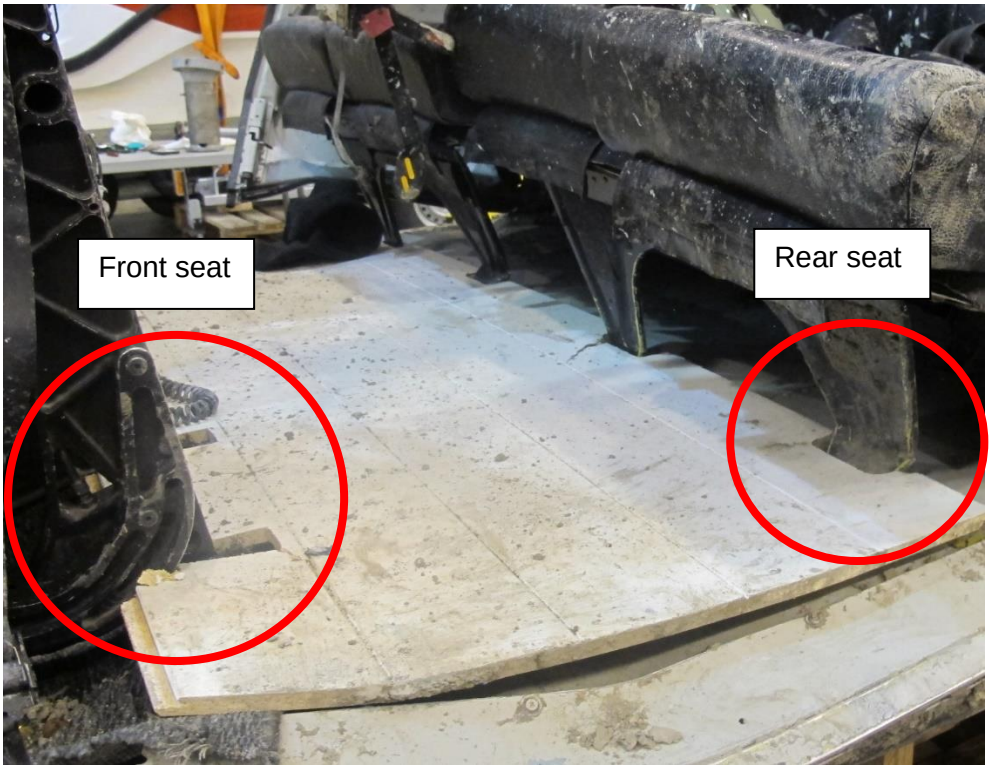

Figure 9: The fibreboard plank on the floor of the rear cabin. This came in conflict with the energy absorption mechanism of the front seat and the structure of the rear seats, marked with red rings. After the accidents it was no longer possible to remove the plank without destroying it. Photo: Airbus Helicopters / NSIA

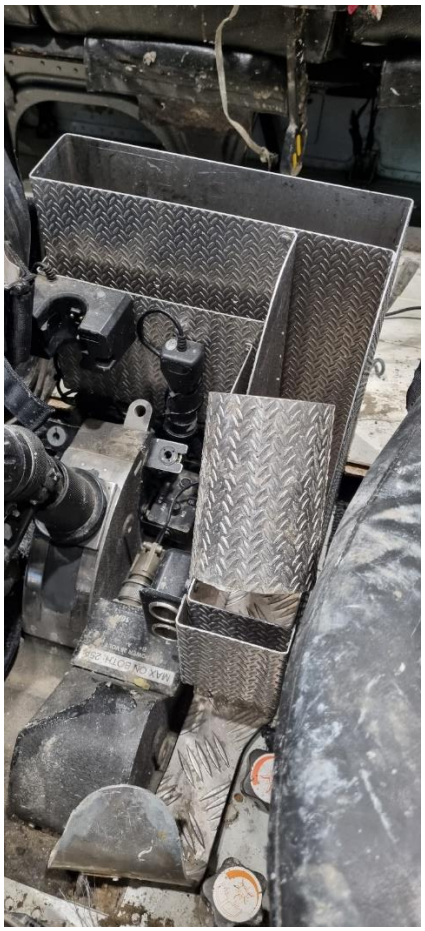

Figure 10: The homemade centre console. The bottle holder is placed in the console for the photo. It was fastened on the front of the console where it can be seen that the plate is bent upwards. The console used latches to attach to three of the helicopters cargo rings. One of the latches broke while for one of the others the bolt had slid open. A green bottle can be seen in the bottle holder in Figure 6. Photo: NSIA

Figure 11: One of five straps for the front passenger seat was stowed underneath he seat. Photo: SHK

1.6.3 WEIGHT AND BALANCE

The NSIA has estimated the following weight for the helicopter:

Table 5: Estimation of take-off weight

Item	Weight
Helicopter with cargo basket:	1,341 kg
Long line equipment:	121 kg
Fuel:[8]	386–408 kg
Commander and passengers:	235 kg inc. clothes
Luggage and dog:	227 kg
Total	2,310–2,329 kg

The NSIA has estimated the weight of the luggage based on findings at the accident site. Even the most conservative estimate is higher than the maximum take-off weight of 2,250 kg. The NSIA has calculated that the centre of gravity was within the limits provided in the flight manual.

1.7 Meteorological information[9]

1.7.1 WEATHER REPORT FROM THE NORWEGIAN METEOROLOGICAL INSTITUTE

The Norwegian Meteorological institute has prepared a weather report on behalf of the NSIA. The NSIA cites the following:

> *Local Weather conditions*
> *The weather conditions in the area were calm but with local fog. Satellite images show that there was fog in the inner/northern parts of the Trondheimsfjord from Leksvik and further north, as well as inland towards Levanger and Verdal town centres. The fog appears to have spread eastwards to areas of lower terrain in Verdalen, some way east of Stikklestad and up towards Leksdalsvatnet lake. The foggy conditions seem to have changed little during the morning. Satellite images show roughly the same coverage at 0900 hrs and 1100 hrs local time.*
>
> *There were no clouds in other areas around the Trondheimsfjord […]*
>
> *It is difficult to estimate exactly how poor the visibility was at the accident site. Synoptic weather stations in the area are automatic and do not report visibility. The closest observations that include visibility are Namsos Airport and Trondheim Airport. Neither of these places had fog around the time of the accident, but Namsos did have fog a couple of hours earlier. Fog was observed there with a visibility of 600 m at 0750 hrs local time (0650 UTC):*
>
> *2022-11-01T06:50:00 ENNM 010650Z 06004KT 360V100 0600 R07/0800 FG SCT001 04/04 Q1011=*

[8] *The fuel tanks of 540 L were estimated to be 85–90% full and Jet A1 has a density of 0.84 kg/L.*
[9] *For standard weather abbreviations see www.ippc.no*

The report also excludes icing as a factor due to the temperature. The prevailing weather conditions meant a low probability of turbulence.

Around the accident the air and dew point temperature were near identical. Namsos reported 04/04 °C and Værnes 04/03 °C around 1000 hrs. The closest synoptic stations showed 2.6/2.4 °C and 2.6/2.6 °C.

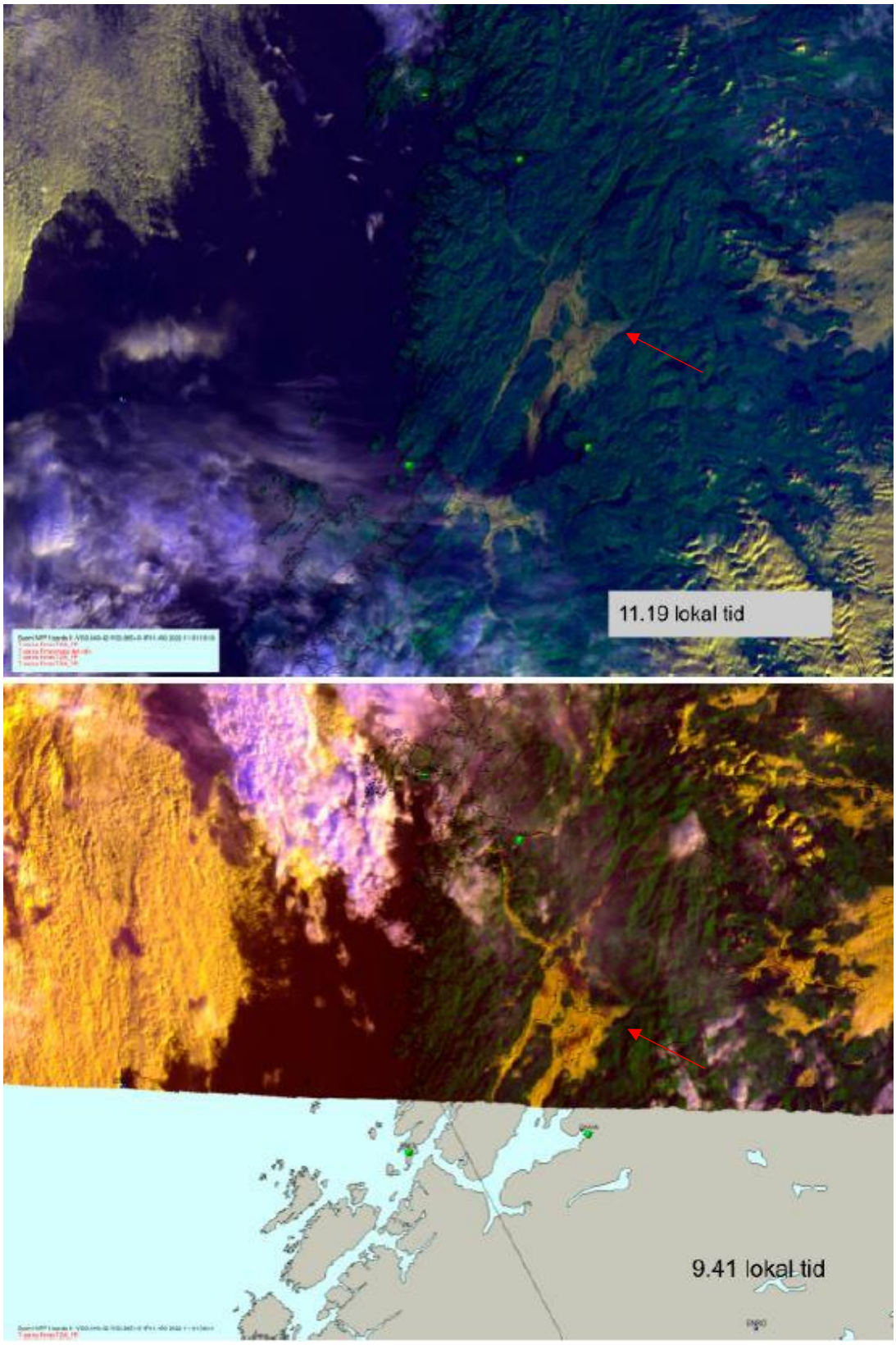

Figure 12: Satellite images of Trøndelag. Low clouds are a yellow colour, higher clouds are purple/blue or white. The red arrow indicates Verdalen. Source: The Norwegian Meteorological Institute / NSIA

Figure 13: Photos from the HemsWX weather service taken in Namdalseid. Photo: Norwegian Air Ambulance AS / NSIA

Figure 13 shows the fog variation in Trøndelag. The photos are taken in Namdalseid, about 50 km from the accident site. The photos serve to illustrate how varied fog can be, as it can change density and coverage quickly. Visibility can also vary a lot both vertically and horizontally.

The NSIA is aware that pilots from the air ambulance service experience that people on the ground look up and see the helicopter and say that is possible to land, while at the same time the pilot cannot see the ground due to fog.

1.7.2 IGA – WEATHER PROGNOSIS

ZCZC
FBNO44 ENMI 010500
IGA PROG 010500 - 011500 UTC Nov 2022 NORWAY FIR COASTAL AND FJORD AREAS N6200
TO N6500

COR WX AND VIS/CLD DUE TO FG
WIND SFC.....: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WIND 2000FT....: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WIND/TEMP FL050: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WIND/TEMP FL100: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WX.....: NIL, LCA FG FIRST HR
VIS.....: +10KM, 0,1-1KM IN WX
CLD.....: MAINLY NSC, LCA BKN/VV 0100-0500FT ASSW FG
0-ISOTHERM.....: PLS CHECK Aviation Forecast Map Overlay at ippc.no
ICE.....: NIL
TURB.....: MAINLY FBL, LATER FBL/MOD. FJORDS: OCNL MOD, LATER MOD, OCNL MOD/SEV

ZCZC
FBNO44 ENMI 010900
IGA PROG 010900 - 011800 UTC Nov 2022 NORWAY FIR COASTAL AND FJORD AREAS N6200
TO N6500

WIND SFC.....: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WIND 2000FT....: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WIND/TEMP FL050: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WIND/TEMP FL100: PLS CHECK Aviation Forecast Map Overlay at ippc.no
WX.....: NIL, N-PART RISK LCA FG FIRST HR, LATE SCT RA S-MOST PART
VIS.....: +10KM, 0,1-1KM IN FG
CLD.....: MAINLY NSC, LCA BKN/VV 0100-0500FT ASSW FG

0-ISOTHERM.....: PLS CHECK Aviation Forecast Map Overlay at ippc.no
ICE.....: NIL, LATE FBL S-MOST PART
TURB.....: FBL, BECMG OCNL MOD, LATER OCNL MOD/SEV

1.7.3 THE COMMANDER'S OBSERVATIONS

The commander has stated that the fog varied in density and coverage throughout the morning. When he took off, it was sunny and the sky was blue right above the helipad. He has explained that there was still some fog around the helipad, but that it was clear towards the north / north-east where there was good enough visibility.

1.7.4 WITNESS OBSERVATIONS

1.7.4.1 Driver of a car

A person was driving their car from Stiklestad towards Verdal along Stiklestad Allé right after the accident. This is about 650 m south-east of the helipad. They explained that the fog suddenly became very dense right beside the accident site, and that they had to reduce their speed as visibility was only 30 m. Immediately after reducing speed, this person observed blue lights from a fire engine approaching from the opposite direction.

1.7.4.2 Roofer

A person was laying roof tiles on a house in Forbregd Lein and took a video of the weather conditions at 1022 hrs, see Figure 14. The altitude of the houses and the fog are about 130 m above mean sea level (MSL). The helicopter company base is located behind the hill, just left of the centre of the image, and about 100 m lower. Fog can be seen on both sides of the hill.

Figure 14: Mosaic of still images from a video taken in Forbregd Lein at 1022 hrs. Photo: Private/NSIA

1.8 Aids to navigation

The commander had an iPad on which Air Navigation Pro[10] was installed. The tracking functionality of this application was not active, and it was not possible to retrieve data from the flight.

[10] Air Navigation Pro is an uncertified application for tablets and mobile phones used for navigation. It displays maps, weather etc.

1.9 Communications

The take-off was in uncontrolled airspace and the commander was not in contact with anyone over the radio during the short flight.

1.10 Aerodrome information

The helicopter took off from an asphalt helipad located at the main operating base of Midtnorsk Helikopterservice AS. The helipad, named Slottelid (ENVS), is situated in Verdal (63.80021N 11.53358E) at an altitude of 33 m MSL.

1.11 Flight recorders

LN-OBP was not equipped with either a flight data recorder or cockpit voice recorder and nor is this a requirement.

Appareo Vision 1000 is a simple recording unit that records the instrument panel and out of the cockpit windows. It is installed in all Airbus Helicopters AS 350 helicopters delivered after 2013. LN-OBP was built in 2002 and was not retrofitted with an Appareo Vision 1000. The topic of light weight recorders was thoroughly discussed in in the NSIA report after the Alta-accident[11]. After the investigation three safety recommendations about the topic were issued (NO. 2022/10T, NO. 2022/11T, NO. 2022/12T). These are still open in the European database of safety recommendations (SRIS). An EASA regulatory change was made effective from 5 September 2022. This mandates that all turbine powered helicopters with a MTOW of 2,250 kg or greater, built after this date, and which is used for commercial passenger transport must have a lightweight flight recorder[12] installed.

The NSIA has downloaded information from the helicopter's Vehicle and Engine Multifunction Display (VEMD). The VEMD stores some information such as whether any parameters are over given limits (over-limits), error codes (failures) and a flight report with information about the total number of cycles and flight time.

When the VEMD was powered up for inspection, the flight report from the accident flight was still open. There were no failures or over-limits recorded for the accident flight. The engine running time was recorded as 4 minutes, which due to the recording interval means between 3 minutes 30 seconds and 4 minutes 30 seconds.

1.12 The accident site and wreckage information

1.12.1 THE ACCIDENT SITE

The accident site, which is located 450 m from the departure site at an altitude of 20 m MSL was a ploughed field with some large rocks in the ground. The field is located about 3 km north-east of Verdal town centre. The terrain has a slight incline towards the east-south-east.

[11] The accident with LN-OFU (SL report 2022/02).
[12] Appareo Vision 1000 does not fulfil the requirements in EUROCAE Document ED-155 'Minimum Operational Performance Specification for Lightweight Flight Recording Systems' for a lightweight recorder.

Figure 15: Detailed map of the accident site. The departure site is marked with a red diamond in the top left corner. The accident site is marked with a red diamond in the lower right corner. Map: © The Norwegian Mapping Authority. Illustration: NSIA

The first contact marks on the ground, see Figure 16, were from the left skid and had a length of about 5 m (1). After that, there was a contact mark from the right skid for about 13 m (2). There were then no marks for about 6 m before further marks from the right skid for about 6 m (3) and then marks from the left skid again. There were also marks indicating that the left skid had hit a rock and a large hole in the ground (4).

There were two almost parallel marks transverse to the direction of travel 5 m after the hole, with a distance of about 3.2 m between them (5).

There was then a gap of about 25 m before there were further marks from the helicopter (6). This was followed by a gap of 6 m before further marks (7) and a final gap of about 10 m between the last marks and the helicopter wreckage.

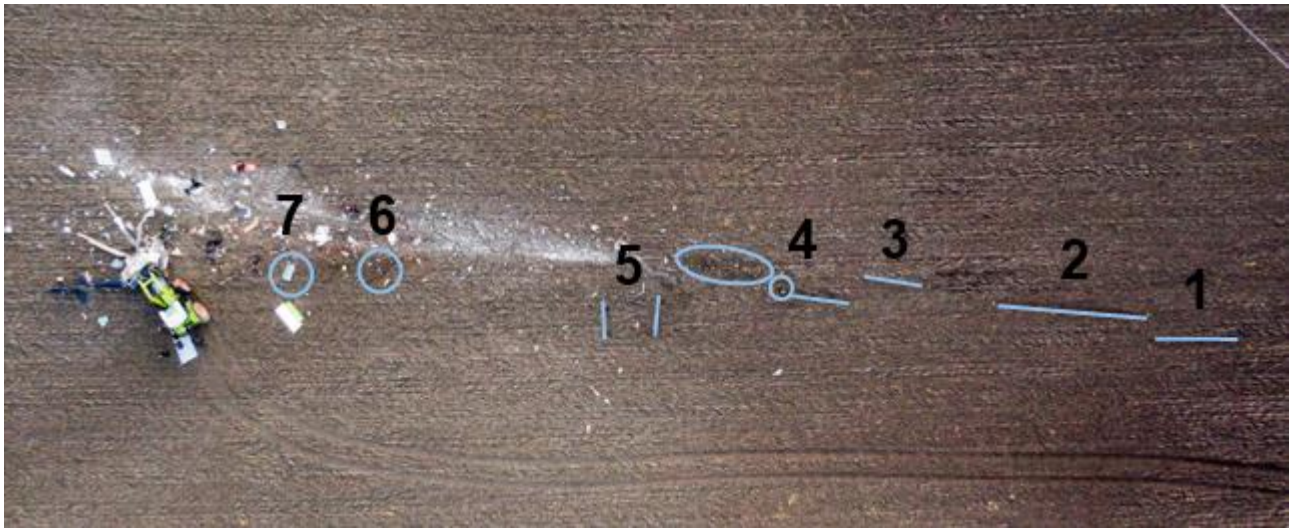

Figure 16: The accident site with contact marks highlighted. The numbers reference the text description above. The tractor that was used to free one of the passengers is seen in the picture. A bucket of paint, which was part of the luggage, was destroyed and the paint has left white stains from point 5. Photo: Trøndelag Police District. Illustration: NSIA

1.12.2 THE HELICOPTER WRECKAGE

The helicopter wreckage was mostly contained in a small area, but a lot of the luggage had been spread out in front of the helicopter in a fan shape. All rotor blades were attached to the main and tail rotor. The cockpit of the helicopter was destroyed and the instrument panel had been knocked loose. The tail boom was not attached to the helicopter and was broken in two places. The fuel

tank had moved and all the fuel had leaked out through the fuel fill tube on the left-hand side. The helicopter was not fitted with a crash resistant fuel system, and this is not a requirement. If this had been the case it is likely that there would not be a fuel leak. There was generally more damage on the left-hand side of the helicopter than the right-hand side. The rotor head cover was dented and deformed with remnants of soil. The front section of the cabin floor was pressed upwards. All the seats were still attached and only sustained minor damage. Both cockpit doors and the sliding door on the left-hand side had detached. The front part of the right skid had broken off while the entire left skid had broken off.

Figure 17: The helicopter wreckage seen towards the west. Photo: NSIA

Figure 18: The helicopter wreckage seen from above. The floor of the cockpit is pressed upwards at about 30 degrees. Photo: NSIA

1.13 Medical and pathological information

1.13.1 THE COMMANDER

A routine blood sample was taken after the accident, which showed no traces of alcohol or narcotic substances.

There are no indications of medical factors contributing to the accident.

The commander sustained several fractures in his back and was bruised.

1.13.2 THE PASSENGER IN THE FRONT SEAT

The passenger was killed due to major injures to the head, chest and abdomen.

1.13.3 THE PASSENGER IN THE REAR SEAT

The passenger was killed due to fractured neck vertebrae and major internal crush injuries.

1.14 Fire

There was no fire during the accident.

1.15 Survival aspects

The seat of the commander had a five-point safety harness. The commander used the harness correctly. He also sat on the right-hand side of the helicopter that sustained less damage than the

left hand side. The commander's seat sustained insignificant damage. The energy absorbing mounts were not deformed.

The seat of the front passenger had a five-point safety harness. Figure 6 shows that the safety harness was not fastened correctly for maximum protection. The harness was placed too high up on the stomach and not down towards the hips. The crotch strap was found stowed underneath the seat and was therefore not in use, see Figure 11. Most AS 350 helicopters are fitted with a four point safety harness from the factory.

The rotary buckle failed so that the right-hand shoulder and lap strap become undone during the accident and the passenger was thrown from the helicopter. See 1.16.2 for examination of the belt buckle. The seat sustained insignificant damage.

The passenger in the rear seat had a three-point safety harness. Findings in the helicopter indicate that the diagonal shoulder strap was not in use, see Figure 19. The NSIA cannot determine how the lap strap was fastened. The passenger ended up partly outside the helicopter and was stuck under the wreckage. Rescue workers had to lift the helicopter and cut the safety belt to free the passenger. The seat sustained insignificant damage. The passenger also sat next to significant amounts of unsecured cargo, see Figure 6. The cargo was found in a fan shape in front of the helicopter, see Figure 16. The unsecured cargo which was placed on the right-hand side of the helicopter must have moved to the left during the crash.

Figure 19: Foto of the safety harness of the passenger in the rear seat. There are no signs of paint on the shoulder strap, while a lot of paint can be seen on the lap strap. Both shoulder straps which are mounted in the same fixture was investigated to see if the passenger had used the wrong shoulder strap. Photo: NSIA

The commander has informed the NSIA that he only told the passengers to remember to use the safety belts, as they had flown on numerous occasions previously. How they used them was not checked.

The NSIA has asked Airbus Helicopters why the fastening for the shoulder straps are towards the centre of the helicopter for the outermost seats. This means that the shoulder strap has a limited effect on preventing a person ending up outside the helicopter. Their answer was that this was done to attach the shoulder straps to the helicopter's main frame. Airbus has informed the NSIA that it is working on a different design. The certification requirements for safety harnesses are mainly so to prevent head injuries and to restrain against forward and downward directed forces – not sideways.

The antenna of the ELT broke during the accident and no emergency signal was therefore transmitted. The ELT was found in working order after the accident.

1.16 Tests and research

1.16.1 TECHNICAL EXAMINATION OF THE HELICOPTER

The NSIA has together with BEA, Airbus Helicopters and Safran Helicopter Engines thoroughly examined the helicopter. The structure, main rotor, main gear box, tail rotor, flight controls, hydraulic system, fuel system and engine were inspected. All observed damage is commensurate with the impact with the ground. The inspection revealed that the engine was delivering power when the helicopter impacted the ground, and that both the main and tail rotor were rotating and that the flight controls were in working order.

There are no indications of technical failure contributing to the accident.

1.16.2 EXAMINATIONS OF THE ROTARY BUCKLE OF THE FRONT PASSENGER

The rotary buckle of the front passenger failed during the accident. The NSIA contacted the manufacturer, Parker-Meggit, who contributed during the examinations.

The rotary buckle was brought to the Norwegian Defence Laboratories (FOLAT) for closer examination. Parker-Meggit was present during the examinations, which found that at least 3 out of 4 screws were subject to hydrogen embrittlement, see Figure 23. Both screws on the right-hand side (in the direction of travel) had fractured. One of the screws had lost its screw head before the accident, while the other probably had a pre-existing crack and fractured during the accident. When these screws fractured, the belt could displace the thrust plate that held the belts in place, which meant they could become undone.

Parker-Meggit informed the NSIA that they had received a series of lots with defective screws from a subcontractor in March 2012. Parker-Meggit became aware of the problem in June 2012 when a customer returned a rotary buckle with fractured screws. Parker-Meggit and the subcontractor then investigated the problem.

The screws that keep the rotary buckle together are zinc-plated steel screws, see Figure 20 and Figure 21. As part of the production process, the screws have to be baked at a high temperature after the plating to prevent hydrogen embrittlement[13]. The way the subcontractor performed this process meant that not all the screws were heated enough to diffuse out the hydrogen. This led to some of the screws undergoing hydrogen embrittlement and therefore fracturing when torqued. The production of rotary buckles was stopped, and all buckles already manufactured were inspected. Due to the incident in 2012, Parker-Meggit chose to change the screw material to stainless steel in 2013, which eliminated the problem of hydrogen embrittlement.

Until the accident involving LN-OBP, Parker-Meggit had identified the earliest production date of defect rotary buckles as 27 March 2012, and was certain that no defect rotary buckles had ended up in an aircraft. The rotary buckle in LN-OBP was produced on 5 March 2012.

After the examinations at FOLAT, the NSIA informed EASA, FAA and CAA Norway about the findings and the safety problem at the first possible opportunity. 1 September 2023 Parker-Meggit

[13] *Hydrogen embrittlement is a characteristic change in the mechanical properties of certain metals, especially steel, in the presence of free atomic hydrogen within the metal. Hydrogen embrittlement lowers the metals' ductility under slow loading when the temperature is around room temperature. Source: Otto Lohne, SNL.*

issued two safety bulletins (SB 1111548-25-001-2023 and SB 1111475-25-001-2023) informing customers about the issue and how to correct it. The FAA and EASA has informed the NSIA that they will issue Airworthiness Directives, which make the correction mandatory. The NSIA therefore does not issue any safety recommendation about this.

Figure 20: The commander's intact rotary buckle to illustrate what an intact rotary buckle looks like. The ring is twisted to release the straps. One of the straps is permanently attached. Photo: NSIA

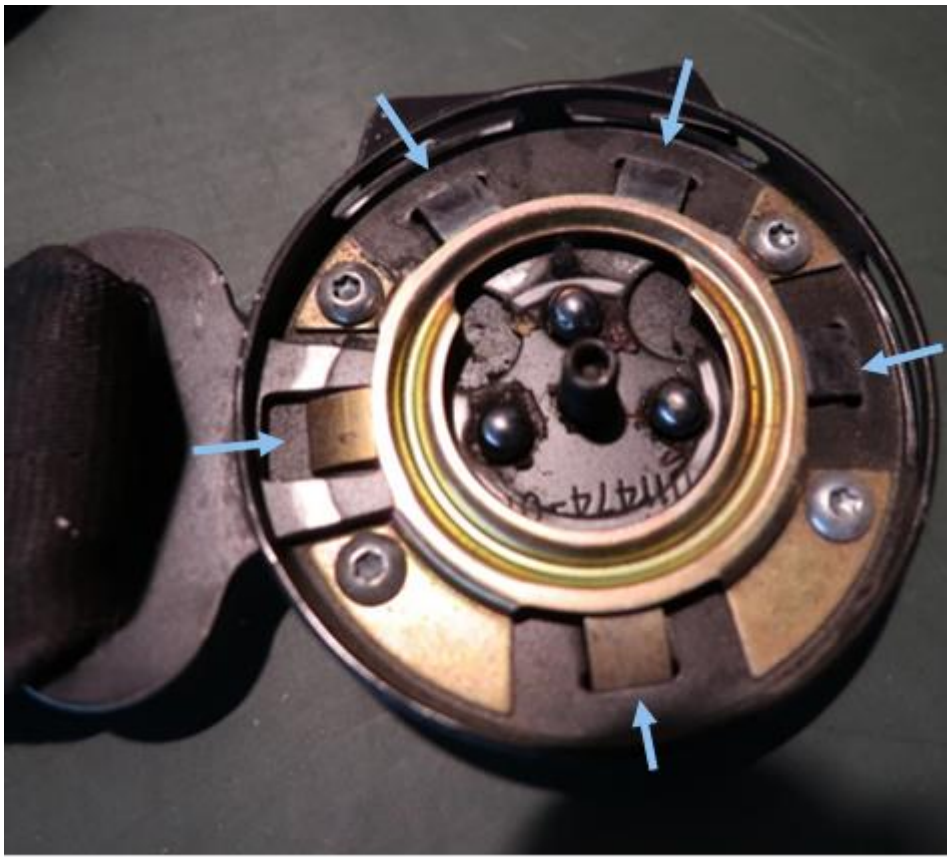

Figure 21: The commander's intact rotary buckle to illustrate what it looks like with the twist grip removed. The four intact screws are clearly visible. The five blue arrows point to the retainers that keep the straps fastened horizontally. The gold coloured part that the screws are fastened through is the thrust plate that keeps the straps fastened vertically. Photo: NSIA

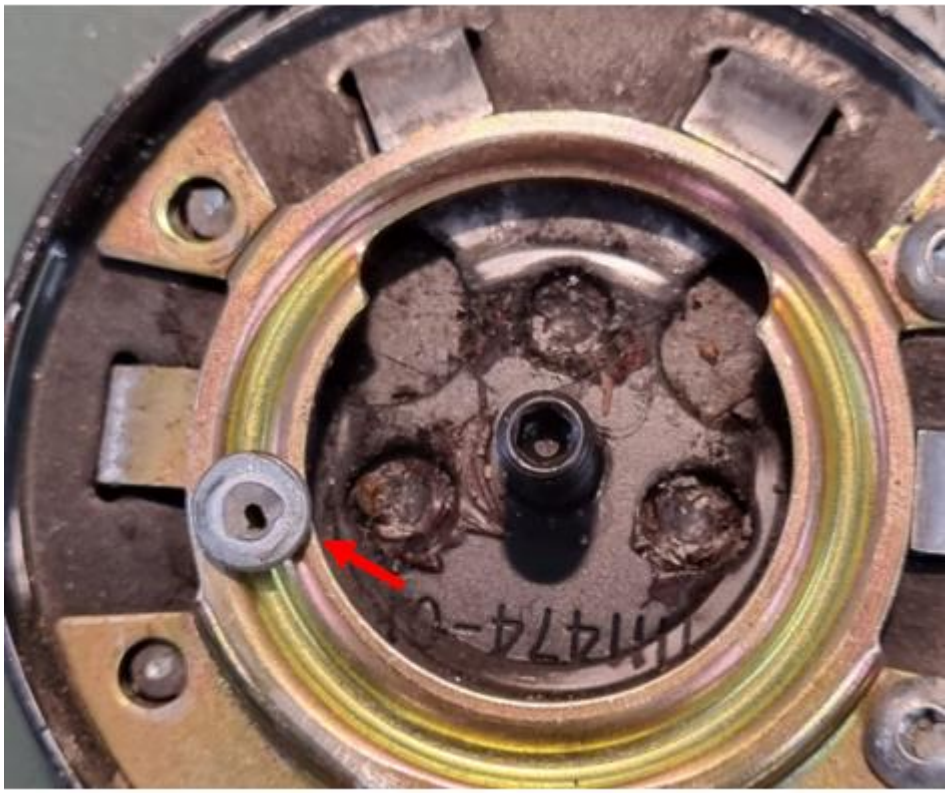

Figure 22: The passenger's rotary buckle. The two screws on the right-hand side (in the direction of travel) had fractured at the root of the screw heads. The screw head of the top screw was found inside the rotary buckle (marked with red arrow). The lower screw was missing its screw head. Photo: NSIA

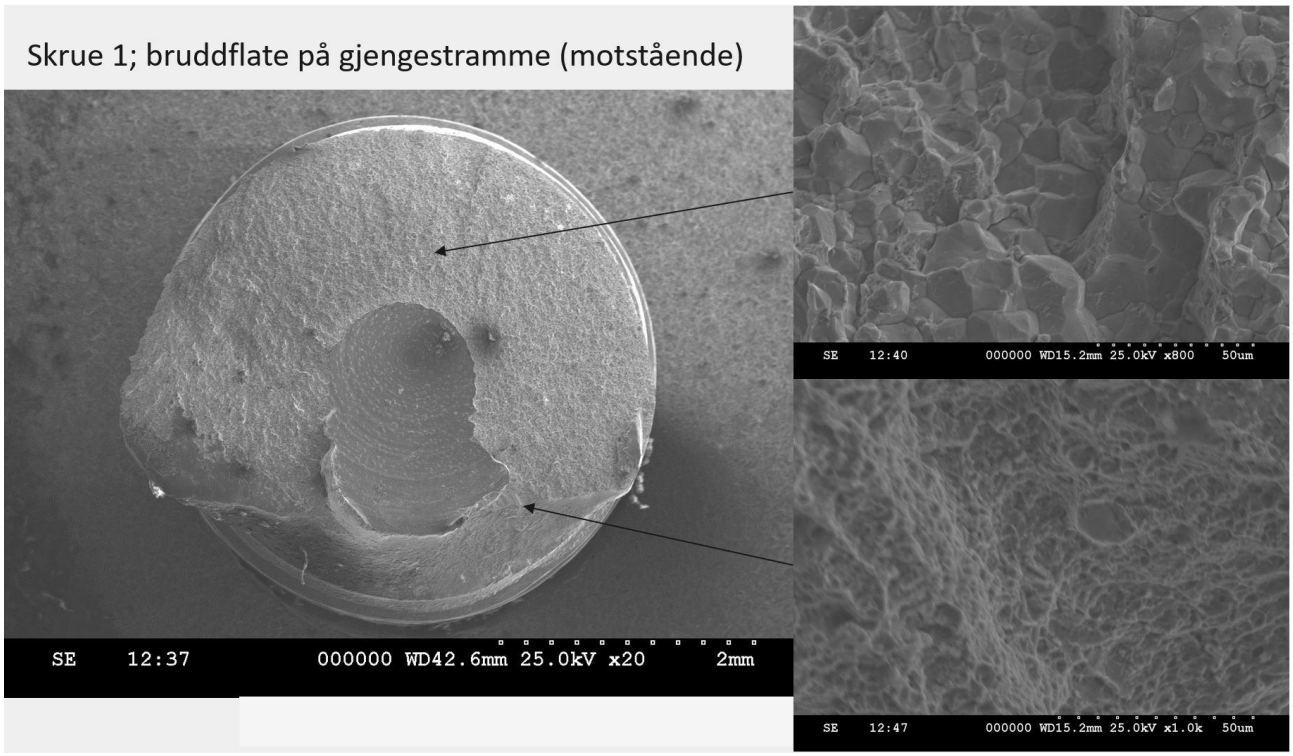

Figure 23: Microscope image of the threaded rod of the top screw. The two smaller images show different fracture mechanisms. The top shows hydrogen embrittlement where the different grains are visible. The lower is a ductile overload fracture with dimples. Image: FOLAT / NSIA

1.17 Organisational and management information

1.17.1 MIDTNORSK HELIKOPTERSERVICE AS

1.17.1.1 Introduction

Midtnorsk Helikopterservice AS (MNHS) was established in 2002. At the time of the accident, they operated three helicopters from Airbus Helicopters: an AS 350 BA, an AS 350 B3 and an EC 120. The company employed eight people, several on a part time basis. Out of the five pilots two were employed in part-time positions and were hired for missions. When the CAA Norway first approved the company in 2002 it only operated one helicopter and employed fewer people.

The company has an AOC[14] issued by CAA Norway and provided a self-declaration about SPO operations[15]. It performs a wide range of commercial operations from taxi flights to power mast installation. Commission Regulation (EU) No 965/2012 of 5 October 2012[16] sets requirements for the operation of helicopters. The company's handbook system OM-A, B, C, D and E details the company's operational procedures. CAA Norway performs audits of companies and issues permits and certificates, see 1.17.2.

1.17.1.2 Distribution of roles in the company

It is a regulatory requirement that an AOC holder must fill some given positions with competent personnel. These positions are responsible for ensuring that operations are managed and

[14] Air Operators Certificate – proof issued by CAA Norway that the company fulfils regulatory requirements and can perform commercial transportation of passengers and goods.
[15] Specialised operations.
[16] Implemented into Norwegian law through Section 1 of the Regulation of 7 August 2013 No. 956 concerning aviation operations.

supervised so they are conducted in a safe manner, that the company is sufficiently staffed with correct personnel and that the company's procedures and operations fulfil regulatory requirements.

Four persons occupied the eight statutory positions in the company. The commander occupied four of these, Accountable Manager, Compliance Monitoring Manager, Safety Manager and Deputy Manager of Flight Operations. The commander was also the main shareholder of the company and therefore held several other roles in the running of the company. Both the Manager of Flight Operations and Technical Manager had other employment outside the company.

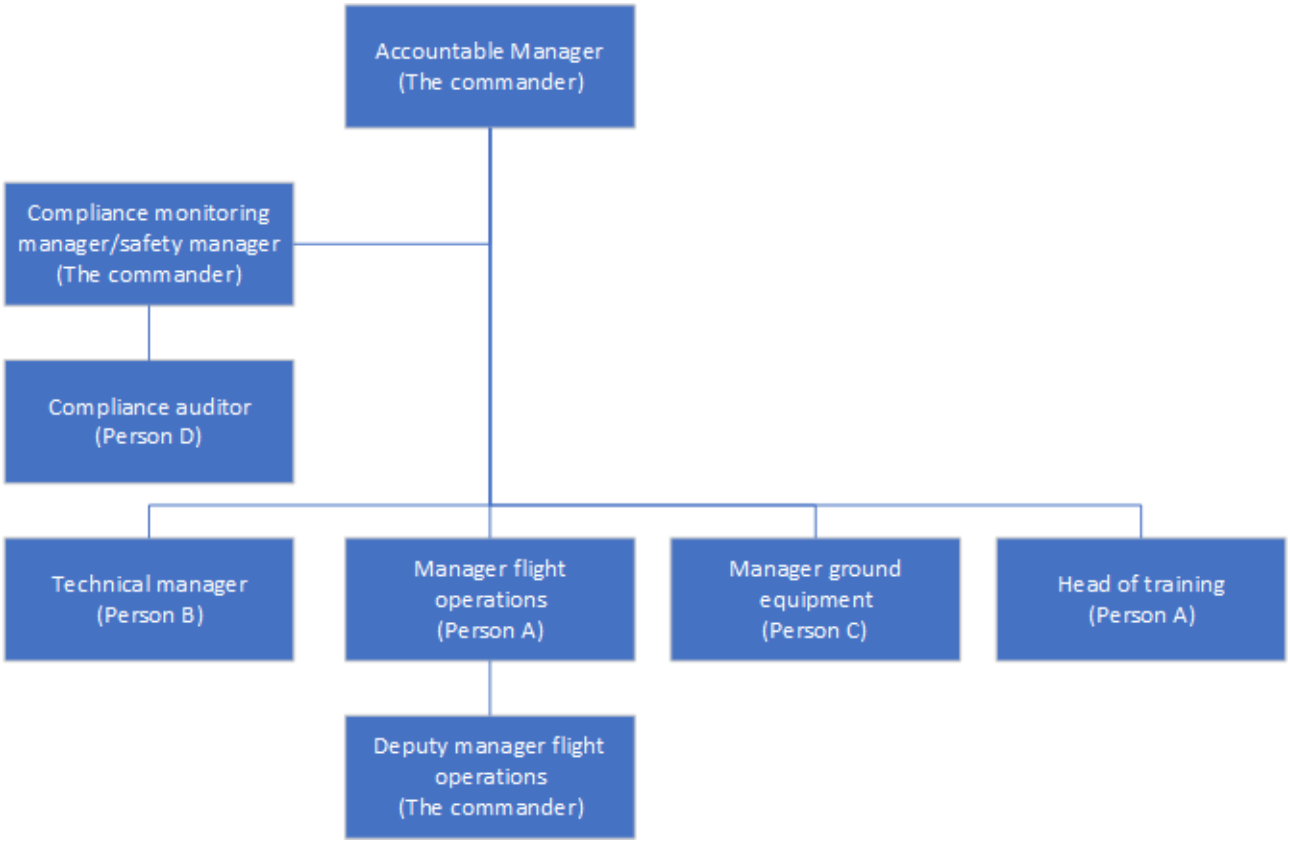

Figure 24: Organisational chart for MNHS. Illustration: MNHS/NSIA

1.17.1.3 Daily operations and safety management

The NSIA has interviewed operational management and pilots in the company. In addition the NSIA has received information from previous pilots in the company and reviewed the company's operational manuals. In the paragraphs below the commander will be referred to as the Accountable Manager.

The Manager of Flight Operations was a retired fixed wing pilot, with no flight experience on rotorcraft. In combination with being Manager of Flight Operations he also ran a company that provided courses in human factors and CRM[17]. Due to his lack of helicopter experience the CAA Norway required a Deputy Manager of Flight Operations with helicopter experience. This role was given to the Accountable Manager by the CAA Norway.

The Manager of Flight Operations has explained that, due to limited helicopter experience, he mainly served as administrative Manager of Flight Operations. He has explained that several good resources have been available to him with respect to helicopter operations, among others the

[17] *Crew Resource Management – CRM, effective use of available personnel to ensure safe and effective flight operations that reduce errors and stress.*

Accountable Manger, Technical Manager and one of the pilots in the company who has a lot of experience.

The commander has told the NSIA that he is concerned about the amount of bureaucracy in aviation and all the regulatory requirements. He has explained that the administrative part of running the company took up so much time that he no longer felt he got enough flight time. The financial situation of the inland helicopter segment has also deteriorated over time. The Manager of Flight Operations has stated that there has been strong competition in the inland helicopter segment for as long as he can remember, and that finances have always been a factor. Several people in the company state that MNHS has been in a good financial situation all the time, and the Accountable Manager has had a strong focus on finances. The Manager of Flight Operations has emphasised that there should never be any pressure to perform a flight, that it should always be possible to say no, and everyone in the company agreed that safety was important.

The NSIA has been informed by current and previous pilots in the company that there was a low threshold for cancelling missions due to safety concerns. Nevertheless, some pilots have stated that the Accountable Manager could have a very operation-driven focus. Although there was never any explicit pressure, some of the pilots felt that this focus could be problematic.

The Manager of Flight Operations has explained that the other pilots in the company mainly called him when they had questions about rules and regulations. With respect to questions about helicopter operations, however, they mainly called the Accountable Manager. Some of the pilots have stated that they now and then chose to call the Manager of Flight Operations with operational helicopter questions, to get more support for their view and bypass the financial focus of the Accountable Manager. The Manager of Flight operations has partly supported this.

In response to questions about how day-to-day operations were conducted, both pilots and the Manager of Flight Operations has stated that this was mainly handled by the Accountable Manager and that much was done informally. The Accountable Manager scheduled which pilot was to fly which mission and had an overview of how each mission was to be conducted. The Accountable Manager supported the pilots with respect to planning and performing missions. The Accountable Manager was also the one who was the most present at the base and involved in the flight operational questions.

When asked how he manged to oversee operations, the Manager of Flight Operations stated that he often talked to people on the phone and that he tried to be at the base at least once a week. He felt that he had a good overview of operations, for example by using the company’s IT-systems.

In principle, everyone has stated that the standard of safety has been good. Several of the pilots have stated that there was a lot of freedom with responsibility. The pilots have also stated that a lot of informal safety work was done around the coffee table and this was confirmed by the Manager of Flight Operations. In relation to questions about feedback and learning in the company, the Accountable Manager confirmed that there is a lot of freedom with responsibility. He also felt that there was a low threshold to provide feedback to each other with respect to flight safety. The company held pilot meetings about four times a year. Other than that, there was informal interaction between the pilots when they often talked together before and after missions.

With respect to the dialogue with CAA Norway, the Manager of Flight Operations has stated that he felt that it was good. The dialogue focused on the fact that MNHS was a small company where a lot of good work was done informally. CAA Norway performed annual audits of flight operations, but a continuous dialogue was also maintained. The Manager of Flight Operations pointed out that MNHS was open with CAA Norway about their operations.

1.17.2 CAA NORWAY

1.17.2.1 Introduction

CAA Norway has several core tasks, two of which are to issue licenses and permits, and perform oversight. The following is cited from CAA Norway's website:

> ***Licences and permits:*** *CAA Norway performs different kinds of control before a licence or permit is granted. The most common control mechanisms are document review, testing and inspection. Licences and permits are granted to organisations, aircraft, materials and persons who are either employed or applying for a job in the aviation industry. Licences and permits are initiated by application from different actors in the aviation industry or due to renewal requirements.*
>
> ***Oversight:*** *This mainly concerns different kinds of planned compliance monitoring audits. The basis for the compliance monitoring audits are national and international aviation safety requirements. CAA Norway has defined a policy for how often different types of objects under oversight are subject to an compliance monitoring audit.*

1.17.2.2 Approval of organisation

EU Regulation (EU) 965/2012[18] "ORO.GEN.210 Personnel requirements" and "ORO.AOC.135 Personnel requirements" state which roles must be filled by a competent person to receive an AOC and which qualifications are required, see Appendix A. In addition to one person having overall responsibility for operations, finances and the safety management system, an operator is required to have positions in charge of the following areas:

- Flight operations
- Training
- Ground operations
- Continuing airworthiness

The regulation allows one person to have several roles. Whether several roles can be combined depends on a number of considerations. It is CAA Norway that approves the organisation of an operator when it issues an AOC and decides whether it is appropriate to combine roles. The following is cited from "AIC-N 02/17 – The acceptance of nominated persons in the aviation industry":

> *The combination of roles*
>
> *The regulation does, to some extent, permit one person to have several roles. The requirements for this are set out in the respective regulations. In all cases, the combination of several roles requires the approval of CAA Norway. If a person is to hold several positions, the person must, as a minimum, have the qualifications for all the positions. In addition, an evaluation will be done to determine whether it is deemed feasible and appropriate for the person to attend to all the tasks associated with the roles.*

1.17.2.3 The supervision of Midtnorsk Helikopterservice AS

The NSIA has reviewed MNHS's audit reports for the last five years and obtained information about CAA Norway's oversight activities in general. For each holder of an AOC, CAA Norway

[18] *Section 1 of the Regulations concerning aviation operations states that Commission Regulation (EU) 965/2012 applies.*

creates an compliance monitoring audit programme. CAA Norway employs risk-based oversight[19] such that the audit programme takes into account and bases activities on the minimum requirements of the regulations, a risk profile[20], the results of previous audits and any other known information. CAA Norway has told the NSIA that it can be challenging to translate the risk profile into an appropriate compliance monitoring audit.

CAA Norway has also informed the NSIA that at the time of the accident it had five inspectors, where four were authorised, in the section for helicopter flight operations who cover the inland helicopter segment. In the Autumn of 2023 the CAA Norway has four inspectors where three are authorised. The inland helicopter segment is more highly represented in the Norwegian accident statistics than other commercial aviation.

CAA Norway has audited MNHS's operations once a year. The NSIA has studied the audit reports and observe that the findings mainly address a lack of reporting seen in conjunction with the amounts of flight hours produced, lack of training of personnel, inadequate job instructions, outdated manuals with respect to the regulations, inadequate training plans for standard operating procedures, unclear procedures, inadequate emergency kit and similar findings. There are also several recurring findings, as well as inadequate documentation about the implementation of safety management. The NSIA is not aware that the CAA Norway have had any findings that require an immediate limitation of the company's operations.

The organisation and distribution of roles in MNHS has been an oral topic during audits, and this is not documented. CAA Norway has informed the NSIA that this has been a topic of discussion during every audit and that CAA Norway is not happy with the organisation. They have also stated that they have deemed that the organisation is within the regulatory framework and that CAA Norway therefore has had limited options.

The audits for technical operations and flight operations have taken place at separate times.

1.18 Additional information

1.18.1 PRACTICAL DRIFT

"Practical Drift"[21] is a theory that has mainly been developed for larger organisations, but the logical foundations are also relevant in this accident. In simple terms, the theory explores a drift over time from an idealised, designed organisation to a pragmatic operation-based organisation. Such a gradual drift over time can be difficult to detect. If this drift leads to reduced safety margins, coincidences will, over time, lead to normal actions having abnormal outcomes.

The EASA regulation has operational control as a requirement. It is the Manager of Flight Operations who is in charge of this and operational control will be their main tool when it comes manage, direct, supervise and control operations. This will be essential to prevent a reduction of safety margins over time.

1.18.2 MINIMUM REQUIREMENT FOR VFR OPERATIONS

Section 2 of the Regulations concerning air traffic rules and operative procedures (*Forskrift om lufttrafikkregler og operative prosedyrer* – in Norwegian only) implements Regulation (EU) No 923/2012 into Norwegian law. This is the Standardised European Rules of the Air which among

[19] CAA Norway defines "risk based oversight" as a systematic approach to select which areas or actors where the safety risk is the largest and perform extra oversight with these.
[20] An evaluation of the organisation, operation and safety performance of the object in question.
[21] Snook, S. (2000). Friendly Fire, New Jersey: Princeton University Press

other things sets out minimum visibility requirements for VFR operation, see Figure 25. Section 13 of the Regulations also states that footnote (***) in table S5-1 applies in Norway.

Table S5-1 (*)

Altitude band	Airspace class	Flight visibility	Distance from cloud
At and above 3 050 m (10 000 ft) AMSL	A (**) B C D E F G	8 km	1 500 m horizontally 300 m (1 000 ft) vertically
Below 3 050 m (10 000 ft) AMSL and above 900 m (3 000 ft) AMSL, or above 300 m (1 000 ft) above terrain, whichever is the higher	A (**) B C D E F G	5 km	1500 m horizontally 300 m (1 000 ft) vertically
At and below 900 m (3 000 ft) AMSL, or 300 m (1 000 ft) above terrain, whichever is the higher	A (**) B C D E	5 km	1500 m horizontally 300 m (1 000 ft) vertically
	F G	5 km (***)	Clear of cloud and with the surface in sight

(*) When the height of the transition altitude is lower than 3 050 m (10 000 ft) AMSL, FL 100 shall be used in lieu of 10 000 ft.

(**) The VMC minima in Class A airspace are included for guidance to pilots and do not imply acceptance of VFR flights in Class A airspace.

(***) When so prescribed by the competent authority:

(a) flight visibilities reduced to not less than 1 500 m may be permitted for flights operating:

(1) at speeds of 140 kts IAS or less to give adequate opportunity to observe other traffic or any obstacles in time to avoid collision; or

(2) in circumstances in which the probability of encounters with other traffic would normally be low, e.g. in areas of low volume traffic and for aerial work at low levels;

(b) helicopters may be permitted to operate in less than 1 500 m but not less than 800 m flight visibility, if manoeuvred at a speed that will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.

Figure 25: Applicable regulation for the flight in Verdal. Source: EASA/NSIA

For the flight in Verdal, which took place in G airspace, this means that the horizontal visibility could be down to 1,500 m, but the flight still needed to be conducted clear of clouds and with visibility to the earth. If LN-OBP had been equipped with an attitude indicator, operations could be performed in 800 m visibility. Below is an excerpt from the operator's OM A ch. 8.1.3:

> *The visibility must at the same time not be less than 800 m and the helicopter speed is adjusted to the current visibility such that the commander has sufficient time to detect and avoid collisions.*

MNHS has set the recommended speed in visibility between 1,500 m and 2,000 m as 100 kt and between 800 and 1,500 m to 50 kt.

1.18.3 NEW BASIC REGULATION

Regulation (EC) No 216/2008[22] of the European Parliament and of the Council, is the basic regulation that overall regulates all aviation within Europe. An updated basic regulation, EU regulation (EU) 2018/1139, has been implemented in all EU countries but is not implemented in Norwegian law. The new basic regulation has a clarification in Article 4 "Principles for measures under this Regulation" which states among other things:

[22] *Regulation 7 August 2013 No. 956 concerning aviation operations § 1 states that (EF) nr. 216/2008 is considered Norwegian regulation.*

2. The measures taken under this Regulation shall correspond and be proportionate to the nature and risk of each particular activity to which they relate. In preparing and enacting such measures, the Commission, the Agency and the Member States shall take into account, as appropriate for the activity concerned:

(a) whether persons other than flight crew are carried on board, and in particular whether the operation is open to members of the public;
(b) to what extent third parties or property on the ground could be endangered by the activity;
(c) the complexity, performance and operational characteristics of the aircraft involved;
(d) the purpose of the flight, the type of aircraft and type of airspace used;
(e) the type, scale, and complexity of the operation or activity, including, where relevant, the size and type of the traffic handled by the responsible organisation or person;
(f) the extent to which the persons affected by the risks involved in the operation are able to assess and exercise control over those risks;
(g) the results of past certification and oversight activities.

There is no direct correlation to the "old" basic regulation, which is still valid in Norway. Nevertheless, EU-regulation (EU) 965/2012 ARO.GEN.300 and ARO.GEN.305 states that oversight activities should be risk based. The NSIA considers that when the CAA Norway states that they perform risk based oversight activities the above considerations are relevant. Since the incorporation of (EU) 2018/1139 in Norwegian law is forthcoming and the rest of Europe follow this regulation, it is natural for the NSIA to also look to this regulation.

1.18.4 SAFETY STUDY INLAND HELICOPTER SEGMENT

Safetec conducted the first safety study of the inland helicopter segment in 2011–2012. In 2021, an updated version was published. The summary provides an overview of the situation:

Safetec concludes that safety, in general, is substantially better in 2021 than after the completion of the previous study. However, significant safety issues remain, including:

- *Safetec's evaluation is that the segment to some extent competes at the expense of safety. The segment's margins are still low, there is pressure on cost and little change when it comes to the financial situation and helicopter types.*
- *Erroneous prioritisation with respect to dealing with conflicting goals in the cockpit is a substantial problem. Many pilots experience different kinds of direct/indirect pressure from customers/users/booking agents to fly when safety should be the first priority by stopping/delaying/changing the job.*
- *There is a substantially higher share of material damage compared with other types of damage in 2021. This is seen in conjunction with increased building and construction work. This type of work, and incidents involving objects in the rotor and collisions with power lines, are key risk contributors.*
- *The operational collaboration between external actors, and the multilateral cooperation within the segment, should be strengthened to ensure safety.*

The safety study has included interviews where points have been made that *"… there may be too many roles for one person, for example when it comes to safety management, operational roles and customer relations".* The safety study does not explore this further.

The safety study also states that extensive use of task specialists has had a positive impact on safety and this is confirmed by the industry.

1.18.5 ROTOR INDUCED CONDENSATION

If the air and dew point temperature is very close to each other, the low pressure, and accompanying cooling, of the rotor system may create condensation. The amount of condensation created will be affected by several factors such as the helicopter weight and atmospheric conditions. This is a greater challenge in the mountains, especially when operating over snow or glaciers.

The risk is greater during landing and in hover. If the helicopter has a velocity, any condensation created will disappear behind the helicopter. The NSIA has been in contact with pilots with experience from rescue helicopter, offshore and inland helicopter. The NSIA is only aware of one instance where condensation of significance has been created. This happened in the mountains while the helicopter was in hover over a glacier and the situation was handled without issue.

1.19 Useful or effective investigation techniques

No methods have been used in this investigation that require special mention.

2. Analysis

2. Analysis

2.1 Introduction

The NSIA has identified a probable course of events during its investigations.

No technical faults have been found in the helicopter that may have contributed to the accident.

A key issue for the NSIA has been to evaluate why the commander made the decision to lift off.

The analysis begins with an evaluation of the course of events, before discussing survival aspects. The analysis further explores the issue of chasing windows in the weather. It continues with a discussion of safety management in the company, the organisation of the company, particularly that individuals hold several of the statutory roles that are intended to function as a safety net and the operational control in the company. The analysis concludes with a discussion about oversight activity from the authorities.

2.2 Course of events

On the morning of 1 November 2022, there was a lot of fog in Verdal, but the fog varied in density and extent. The commander therefore drove around to get an overview of the situation. The variation in visibility is confirmed by two other pilots from the company, who, according to them, lifted off without problems about two hours before LN-OBP crashed.

Only the passengers were present when the commander prepared LN-OBP for departure. This means that the commander was alone in evaluating and understanding the situation. This is not uncommon when it comes to inland helicopter operations, and the quality assurance of own operations is therefore important. He perceived a window in the fog that enabled him to perform a normal take-off to the north-east. The fact that it took three minutes from the starting sequence began until lift-off, which is a normal time-span, supports the commander's explanation that the starting sequence and take-off progressed as he expected.

Figure 6 shows the fog situation right before take-off. The NSIA would like to emphasise that conditions could have been slightly different than the photo indicates, but assume that visibility was severely reduced. The commander's explanation that he saw blue skies above is supported by the photo taken by one of the passengers, see Figure 4. Fog is a dynamic phenomenon that can change density and extent in a very short time span. The NSIA does not rule out that the commander may have had a window in the fog that allowed take-off, but that it may have closed in again in the minutes after the decision to take off had been made.

Even though the probability is very low, the NSIA does not exclude the possibility that condensation from the rotor might have made the situation worse. The air and dew point temperature were almost identical, which is required for condensation to form. Under a normal departure the helicopter will have either upward or forward velocity, such that any condensation will be diluted and end up behind the helicopter. The audio recording from the surveillance camera in Forbregd Lein does not indicate that the helicopter operated in hover over an extended period of time, which is required for the condensation that might be created to become so dense that visual references are challenged.

The flight lasted between 10 and 20 seconds from take-off to the accident. Based on all available information the NSIA considers it probable that the commander lost all visual references almost immediately after taking off. It is most likely that the horizontal visibility was not adequate, such that the references were lost when the pilot started flying forwards. The sun was at this time in the

south-east. This means that the pilot could have faced the sun, which would make the situation worse. The sun would light up the fog and make the contours less pronounced.

Based on the commander's explanation, the NSIA believes that he was startled by the situation and therefore acted on pure instinct when he lost his visual references. It is then natural to descend to regain visual references, but the fog was probably so dense that this did not occur until it was too late.

The following description is based on findings at the accident site, and is the NSIA's most probable accident sequence. The helicopter impacted the ground at a relatively shallow angle with the left skid. The left skid hit a large rock right under the surface 35 m after the first contact. The helicopter tilted forward and the nose impacted the ground. The helicopter then began a clockwise rotation about the vertical axis and an anti-clockwise rotation about the longitudinal axis. The helicopter bounced upwards and continued for about 25 m before it again impacted the ground with its left side before again impacting the ground hard after another 8 m ground on its left side. The external fuel pump, located in the left cargo bay ripped off the door and was thrown out. The helicopter then bounced a final 10 m. At the very end of the accident sequence, the helicopter stood upside down on the rotor head before it fell on to its left side and stopped moving.

The course of events could have been much more detailed if the helicopter had been fitted with a recorder with storage such as Appareo Vision 1000. Airbus Helicopters has, as a standard, equipped all helicopters with Appareo Vision 1000 at the factory since 2013. LN-OBP was an older helicopter and did not have an Appareo Vision 1000 installed. The images and sounds that this unit records is a great aid for accident investigation. In addition, video and data from the unit can be used proactively in safety management. The NSIA is of the opinion that it is unfortunate that the regulatory change that concerns lightweight recorders was not made retroactive and that it does not cover all helicopters used for commercial passenger transport. The safety recommendations issued after the investigation of the air accident at Alta with LN-OFU recommended this. Since the recommendations after the Alta-accident are still open in the European database of safety recommendations (SRIS), no safety recommendation is issued. The NSIA still advise all that operate older AS 350s for commercial passenger transport to fit them with recording units with storage capacity.

2.2.1 THE DESCISION TO TAKE OFF

Based on the information available, the NSIA does not exclude that the weather conditions at times allowed visual flight. However, the NSIA believes that the prevalent shifting weather conditions in the area on 1 November were unclear and that they could be expected to be challenging. With the onboard instrumentation, a visibility of 1,500 m would be required.

The safety study by Safetec highlights conflicting goals in the cockpit as a challenge for the segment. There are several factors that might have contributed to the decision to take off.

The commander had thousands of hours of experience as a helicopter pilot. He has been described as a good pilot, but also very mission driven.

The following factors may have contributed to the commander taking off in the prevailing visibility conditions:

- Drift: The investigation has found that the company's operational control was deficient. There is therefore an increased probability that the commander's reference point for safe operation may have shifted such that the safety margins were reduced, see also 2.5.
- A wish to please the customer: The passengers had used MNHS on several occasions. The mission had been cancelled and reschedule twice due to weather.

- The next mission: The commander had another mission waiting, and he may have felt a certain pressure to take off as time went on, without necessarily being aware of this.
- Other pilots who had taken off: This may have supported the understanding that the weather at times allowed take-off. The take-off was from the home base which the commander knew well.
- Changing weather conditions: The changing weather conditions may have created an expectation that the fog was about to clear. Horizontal and vertical visibility conditions might have been different.
- Alone as decision-maker: The commander was alone when evaluating the situation and had nobody to discuss with. This is a known risk for the inland helicopter segment.

2.3 Survival aspects

Based on the marks at the accident site, an expected take-off profile and audio recording, the NSIA has estimated that the helicopter hit the ground at a relatively shallow angle and at a speed of 70–100 kt. Since both the commander and the dog survived, the NSIA considers the accident to be survivable. In the following analysis, the NSIA will assess why the two passengers were still killed.

Both passengers were located at the left-hand side of the helicopter which sustained greater damage than the right-hand side during the accident. However, the NSIA does not rule out that both passengers might had survived if their seat belts had been worn as expected and if one of the rotary buckles had not failed due to a production defect.

The passenger in the front seat was thrown from the helicopter due to the failure of the rotary buckle. The safety harness was also not properly fastened over the pelvis as it should if it is to protect internal organs in an optimal way. When the rotary buckle failed, the possibility to remain fastened was drastically reduced. The NSIA cannot exclude that the use of the crotch strap would have increased the probability of the passenger remaining in the seat. The incorrect use of the safety harness and the failure of the rotary buckle were the important difference between the passenger and the commander who survived in the seat next to them. The NSIA believes that the damage to the seat was inconsequential and that there was survival space after the crash.

There is greater uncertainty with respect to survivability for the passenger in the rear seat.

The survival space available after the crash was smaller in the rear due to the floor of the helicopter being pushed upwards. The NSIA nevertheless believes that there was enough space for the passenger to survive. Their survival was conditional on the person remaining in their seat and not end up outside the helicopter. Several findings indicate that the passenger in the rear seat did not use the diagonal shoulder strap and that their torso ended up partly outside the helicopter and was crushed under the helicopter.

The fixture points of the outermost seats in the rear of the helicopter are mirrored. This means that on the left-hand side of the helicopter, the shoulder strap will have a limited effect on stopping the torso ending up outside the helicopter when there is a rotation to the left about the longitudinal axis. The same is true for the outermost rear seat on the right-hand side when the rotation is to the right. Four-point safety harnesses would have provided better opportunity to remain fastened. This would most likely have increased the chance of survival for the passenger. The current design criteria for small rotorcraft focus on preventing head injury, and contain no details about four-point harnesses. The NSIA has been in contact with Airbus Helicopters which said that they are working on a new fixture that might contribute to reducing the problem of sliding out of the harness. Because of this no safety recommendation is issued about this topic.

The correct use of safety belts is an important means of limiting injuries. In this case, it is probable that neither of the killed passengers used the safety belts correctly. The NSIA would like to remind the sector that it is important that the commander ensures that safety belts are worn correctly and not merely that they are in use.

The NSIA also believes that filling a helicopter with goods that are not properly secured is irresponsible when it comes to safety. This is very significant in an accident where a 1 litre milk carton moving at 70 kt (130 km/h) will have the same amount of kinetic energy as a person weighing 100 kg moving at 13 km/h. Consequently there is great injury potential in a relatively modest weight. In this case the load was large, both in mass and size. The unsecured goods might have pushed the passenger to the left and contributed to them ending up outside the helicopter. Unsecured goods could also cause issues during an evacuation or interfere with flight controls. This was the case with the accident with G-HKCN in the port of Bergen (NSIA report 2019/01). The homemade centre console also occupied three of the cargo rings. The NSIA believes that this would make securing the cargo properly more difficult.

The ELT was activated, but no signal was registered. This is most likely due to the antenna breaking. In this case, a signal from the ELT would most likely not have changed the outcome of the accident, since a lack of emergency signal did not significantly delay the rescue operation. If the commander had been injured more seriously, or not had a mobile phone available, the ELT would have been more critical.

2.4 Chasing windows during VFR operation

Fog is a phenomenon that can vary a lot over a short period of time. Figure 13 illustrates how great this contrast can be. In a span of 30 minutes, the fog goes from being so dense that taking off is impossible to clearing up before again condensing. The NSIA would like to emphasise that the image only shows the variation. It says nothing about how long the time window was when the fog lifted.

It is also very difficult to determine distance in fog, and humans rely on sharp contrast to be able to do so. Fog erodes this contrast, which can make determining distance very difficult.

Visibility in fog can also vary a lot both in a horizontal and vertical direction, which means the sky can be blue above while the aircraft is enclosed in fog. This is also supported by other pilots. The position of the sun will also have a significant influence on this.

Waiting for the weather to clear is not unusual in visual flight. Fog is one of multiple weather phenomena it is important to factor in. There are several dangers when it comes to sitting around waiting for the weather to clear. One of the most important is a self-inflicted unconscious pressure to take off that can build over time. The challenge is that it is often impossible to know how long a window will last, and it is therefore challenging to know whether the necessary safety margins of the operation are still met.

2.5 Organisation and authority supervision

2.5.1 INTRODUCTION

EASA has established minimum requirements about organisation for companies with commercial flight operations. It may be challenging for small companies to fulfil these requirements. The regulatory framework is therefore mainly intention-based, where the intention is statutory but how the requirements are to be met is more open. The national oversight activities are also presumed to be risk-based, so that the authorities can tailor resource requirements, time between compliance

monitoring audits and focus during compliance monitoring audits based on the risk profile of the organisation being subjected to oversight.

2.5.2 SAFETY MANAGEMENT, DISTRIBUTION OF ROLES AND OPERATIONAL CONTROL IN MNHS

The NSIA investigation has found that there was not a lot of formal safety management in MNHS. Proactive safety management from the operational management seem to have been limited or absent. A natural element of safety management is reflection about the challenges a company faces and what can be done to make the operation even safer. Especially seen in conjunction with the wide range of commercial activities the company has a licence to perform in general, and especially commercial transport of passengers.

The regulatory intention to require the different roles is that they combined shall contribute to a well-functioning safety net. In this case the commander was at the same time Accountable Manager, Compliance Monitoring Manager, Safety Manager, Deputy Manager of Flight Operations and an active pilot in the company. He was also the main shareholder of the company. The NSIA believes it could be challenging to balance the intention of all these roles in a good manner. This in conjunction with the fact that the Manager of Flight Operations, another of the statutory roles, also had other employment and did not possess helicopter experience is unfortunate. These factors could create situations where the different considerations of the commander's various roles could come into conflict with each other, at the same time as the Manager of Flight Operations had limited possibility and prerequisites for operational control and providing guidance. This conflicts with the overall thinking behind the regulation established by EASA.

The NSIA's investigation gives the impression of a small operational environment largely split in two. In the NSIA's opinion, the Manager of Flight Operation's actual possibility to have operational control of day-to-day operations has been limited. His lack of operational helicopter experience also means that in reality he has had limited possibility to provide advice or give qualified opinions about operational questions. The flying organisation has primarily operated independently and it has been the commander, in his role as Deputy Manager of Flight Operations, who has set the flight operational standards during day-to-day operation.

This organisation can be particularly challenging since the operator performs many different types of missions. It can be difficult to maintain an overview. The operation will thus have greater complexity and require more risk-reducing measures. It will be challenging for individuals on a part time basis to keep an overview of a substantial regulatory framework and all the details in a complex operation. The NSIA acknowledges that few people must occupy many roles in small operators, but it is then important that compensatory measures are implemented so that safety is assured. Several of the compensatory measures, such as the commander being approved by the CAA Norway as Deputy Manager of Flight Operations, seem to have had limited effect.

The distribution of roles is designed to ensure that different roles function as corrections and safety barriers. When one individual, who is also in a position to bypass the Manager of Flight Operations, holds too many of these roles, the credibility of the safety management system in practice can be questioned. The NSIA believes that this is especially unfortunate since there is a considerable risk that the individual can end up outside the company's operational control and only the quality assurance of own operations is left. In such cases there is a considerable risk of practical drift. The NSIA is of the opinion that collectively the fact that the helicopter take-off weight was over maximum, the cargo not being properly secured and interview accounts are indications that the company's operational control has been deficient.

The Technical Manager of MNHS was not involved in the day-to-day operation. It is the Technical Manager and the Manager of Flight Operations who in conjunction shall verify the correct

configuration of the company's helicopters for the missions to be performed. The NSIA has found several irregularities with respect to the helicopter which is further indication that the company's operational control has been lacking. The NSIA considers it possible that under other circumstances the irregularities could have had a negative impact on flight safety.

2.5.3 THE CAA NORWAY'S OVERSIGHT ACTIVITIES

CAA Norway is the governing body responsible for monitoring the safety of Norwegian aviation and ensuring that aviation complies with the applicable regulations. CAA Norway issues permits and licences and perform audits of approved organisations as part of this work.

The NSIA has on numerous occasions highlighted the challenges related to the organisation and distribution of roles in small operators[23]. When several of the critical roles, which are presumed to be mutual control mechanisms are held by a small number of persons, there is a danger that the safety barriers are reduced or disappear completely. The regulatory framework allows this to a certain extent, but it requires compensatory measures. The NSIA believes that the compensatory measures in this case did not have the intended effect. As the CAA Norway is using risk based oversight, such an organisation will require the CAA Norway to intensify the oversight activity of such helicopter operators to ensure that safety is assured. This is especially important when an operator can perform commercial passenger transport. Passengers don't necessarily have the knowledge or understanding to evaluate safety.

The NSIA believes that the organisation of MNHS and CAA Norway's oversight activities have not been able to identify any drift in the organisation, ref. 1.18.1. The organisation is such that there is no one to keep oversight over the commander's actions. Gradual, and perhaps imperceptible drift, in behaviour over time towards higher risk is a well-known phenomenon in many types of organisations. It is therefore important that safety barriers are in place to prevent this.

The NSIA has been informed that the organisation and distribution of roles was a discussion point during compliance monitoring audits. The NSIA is of the opinion that only discussing a problem during an audit without any form of documentation is not an adequate compensatory measure. When this occurs repeatedly, there is a danger of it becoming a mere formality for those involved without it actually increasing awareness of the problem.

CAA Norway has in its oversight activity repeated findings about deficient documentation of safety management. There are no signs that this had led to any significant consequences for MNHS or an adapted oversight activity. The NSIA finds it worrisome that repeated findings are accepted.

A challenge for CAA Norway is getting a realistic picture of the day-to-day operation of the organisation they are auditing. Gradual changes over many years may lead to the prerequisites for approval no longer being present. MNHS is a company that has expanded with more helicopters and several types of operations. The NSIA believes that this on its own should have alerted the CAA Norway about the need for adjusted oversight activities. This is in addition to the findings related to safety management and distribution of roles.

This results of this investigation indicate that CAA Norway has had limited opportunity for corrections other than in company manuals. The NSIA is concerned that CAA Norway has not been able to identify several of the safety issues uncovered in this investigation. Especially that the organisation entails a significant risk of lack of operational control.

[23] See e.g. the NSIA reports involving LN-IDB (2020/03), LN-OVO (2014/06), SE-LGA (2005/11) and LN-TSA (1994/03).

Several irregularities suggest that the helicopter was formally not airworthy when the accident happened. The NSIA knows that several of the irregularities was present when the ARC was renewed. The fact that the helicopter could operate over time without this being revealed, neither by the aviation authority nor by MNHS as the operator of the helicopter, is concerning.

Seen in conjunction with other operational findings, such as the helicopter take-off weight being over the maximum and the cargo not being properly secured, the NSIA believes that MNHS' safety barriers have not worked as intended. This highlights the importance of the intention behind the regulation being met when CAA Norway approve managing personnel and the following oversight activities.

CAA Norway has told the NSIA that they have limited options with respect to the distribution of roles since the regulatory framework allows for one person to hold all the statutory roles. The NSIA disagrees with this. The current regulation contains limitations that have been clarified in the new basic regulation. (EU) 2018/1139 Article 4 second paragraph letter f states "the extent to which the persons affected by the risks involved in the operation are able to assess and exercise control over those risks" shall be considered. Even though (EU) 2018/1139 is not incorporated in Norwegian law by autumn 2023 the NSIA presumes that the principles of article 4 can be used in CAA Norway's considerations, ref. AIC-N 02/17. The NSIA holds the opinion that CAA Norway's practice does not meet the intentions of the regulations and that CAA Norway might have more room than it uses.

The NSIA is of the opinion that when CAA Norway approves organisations where the safety margins are reduced due to combined responsibilities, CAA Norway also takes on a greater responsibility to challenge that organisation and monitor that safety is ensured. This investigation has found that CAA Norway is aware of the challenge, but that it has not positioned itself in such a way as to be able to handle it.

MNHS is an operator in the inland helicopter segment, a segment with overrepresentation in the Norwegian accident statistics. The NSIA questions whether CAA Norway has enough resources to properly handle all its statutory tasks related to the inland helicopter segment. It is important that the Norwegian Ministry of Transport in their agency and enterprise management dialogue ensures that CAA Norway prioritises enough resources to be able to properly supervise the inland helicopter segment.

The NSIA recommends the Ministry of Transport to conduct a study of which resources are required to perform risk based oversight activities of the inland helicopter segment, seen in conjunction with the over representation the segment has in the accident statistics.

3. Conclusion

3. Conclusion

3.1 Main conclusion

The NSIA believes that the accident in Verdal on 1 November 2022 occurred due to the loss of visual references shortly after take-off in the transition from vertical to horizontal flight. Based on the commanders explanation the NSIA believes that he might have been startled by the situation and therefore acted on pure instinct when the visual references were lost. It is then natural to descend to try and regain visual references. Due to the density and extent of the fog, the references were not regained before the accident.

The investigation suggest that the organisation of MNHS was not in line with the intention of the regulations. The CAA Norway had approved the company, but its oversight activities had not caught the challenges posed by the company's organisation. The organisation of the company led to the operational control being deficient. CAA Norway aims to perform risk-based supervision, but has challenges translating the risk profile of a company into a tailored audit.

Based on this investigation the NSIA issue one safety recommendation to the Ministry of Transport.

3.2 Investigation results

3.2.1 THE COURSE OF EVENTS, OPERATIONAL AND TECHNICAL FACTORS

A. No indications of technical faults have been found in the helicopter that may have contributed to the accident.

B. On the morning of 1 November 2022, there was a lot of fog in Verdal, but the fog varied in density and extent.

C. Two other pilots from the same company took off without issue about two hours before LN-OBP crashed.

D. No one with helicopter experience was present when the commander prepared LN-OBP for take-off and made the decision to take off.

E. LN-OBP did not have any recorders, such as Appareo Vision 1000, installed and this is not a requirement.

F. The NSIA believes that several factors, among others the fact that the mission previously had been cancelled twice and a changing weather situation contributed to the commander's situational awareness that led to the decision to take off.

G. Based on marks at the accident site, an expected take-off profile and audio recordings, the NSIA estimates that the helicopter impacted the terrain at a relatively shallow angle at a speed of 70–100 kt.

H. The left-hand side of the helicopter sustained the most damage.

I. Both passengers were situated on the left-hand side of the helicopter.

J. The passenger in the front seat was thrown from the helicopter

K. The rotary buckle of the passenger in the front seat failed during the accident.

L. The rotary buckle of the front passenger had manufacturing defects that led to failure.

M. The safety restraint of the front passenger was not correctly placed for maximum protection.

N. The passenger in the rear seat ended up partly outside the helicopter.

O. The passenger in the rear seat did not use the safety restraint as intended.

P. The helicopter was loaded with heavy luggage that was not properly secured.

3.2.2 ORGANISATIONAL AND SYSTEMIC FACTORS

A. The commander held the roles of Accountable Manager, Compliance Monitoring Manager, Safety Manager, Deputy Manager of Flight Operations and was an active pilot in the company.

B. The commander was the primary shareholder of the company.

C. The Manager of Flight Operations in addition ran a company.

D. The Manager of Flight Operations did not have operational helicopter experience.

E. The NSIA is of the opinion that the Manager of Flight Operations had limited opportunity to oversee the operation.

F. The NSIA investigation has found that there was little proactive safety management in the company.

G. The commander's many roles had different goals, while the Manager of Flight Operations possibility to have operational control has been limited.

H. The company had expanded with more helicopters and operational types after the first time approval. The need for adjusted oversight activities was not detected by the CAA Norway.

I. The NSIA believes that the CAA Norway's oversight activities has not been able to reveal that the organisation of MNHS was not in line with the intention in the regulations.

J. This investigation has found that CAA Norway is aware of the challenge with safety margins being reduced when a few number of people hold several roles.

K. The NSIA believes that the CAA Norway has not assigned enough resources to have oversight with the inland helicopter segment in general.

4. Safety recommendations

4. Safety recommendations

The Norwegian Safety Investigation Authority proposes the following safety recommendation[24]:

Safety Recommendation Aviation No. 2023/06T

The air accident in Verdal on 1 November 2022 happened when the pilot lost visual references due to the fog. The investigation has found that the organisation of the company, which was approved by the CAA Norway, entailed a significant risk of deficient operational control. The investigation has revealed that it is challenging for the CAA Norway to perform risk based oversight activities of the inland helicopter segment. It is presumed that the Norwegian Ministry of Transport in their agency and enterprise management dialogue ensures that CAA Norway show that they have enough resources to be able to properly oversee the inland helicopter segment, seen in conjunction with the over representation the segment has in the accident statistics.

The NSIA recommends the Ministry of Transport to review which resources are required to perform risk based oversight activities of the inland helicopter segment with subsequent actions and follow-up plan.

Norwegian Safety Investigation Authority
Lillestrøm, 4 December 2023

[24] The Ministry of Transport forwards safety recommendations to the Norwegian Civil Aviation Authority and/or other involved ministries for evaluation and monitoring, see Norwegian Regulations regarding public investigations of accidents and incidents in civil aviation Section 8.

Abbreviations

Abbreviations

AI	Attitude Indicator
AOC	Air Operator Certificate
ARC	Airworthiness Review Certificate
BEA	Bureau d'enquêtes et d'analyses pour la sécurité de l'aviation civile
CAA Norway	Civil Aviation Authority Norway
CPL	Commercial Helicopter License
EASA	European Union Aviation Safety Agency
FAR	Federal Aviation Regulations
MNHS	Midtnorsk Helikopterservice AS
MTOW	Maximum Take-off Weight
NSIA	Norwegian Safety Investigation Authority
OPC	Operators Proficiency Check
PC	Proficiency Check
SERA	Standardised European Rules of the Air
SRIS	Safety Recommendation Information System
VEMD	Vehicle and Engine Monitoring Display

Appendices

Appendix A Regulations regarding personnel requirements

The following text is obtained from EASA “Easy Access Rules for Air Operations”. This is the regulation with accompanying “Acceptable Means of Compliance” (AMC) and “Guidance Material” (GM).

ORO.GEN.210 Personnel requirements – Regulation (EU) No 965/2012

(a) The operator shall appoint an accountable manager, who has the authority for ensuring that all activities can be financed and carried out in accordance with the applicable requirements. The accountable manager shall be responsible for establishing and maintaining an effective management system.
(b) A person or group of persons shall be nominated by the operator, with the responsibility of ensuring that the operator remains in compliance with the applicable requirements. Such person(s) shall be ultimately responsible to the accountable manager.
(c) The operator shall have sufficient qualified personnel for the planned tasks and activities to be performed in accordance with the applicable requirements.
(d) The operator shall maintain appropriate experience, qualification and training records to show compliance with point (c).
(e) The operator shall ensure that all personnel are aware of the rules and procedures relevant to the exercise of their duties.

AMC1 ORO.GEN.210(a) Application for an air operator certificate – ED Decision 2017/007/R

INFORMATION ON THE ACCOUNTABLE MANAGER

As part of being granted an air operator certificate (AOC), the operator should provide the competent authority with the following detailed information regarding the accountable manager:

(a) name of the accountable manager;
(b) position within the organisation;
(c) information on means to ensure that all activities can be financed and carried out;
(d) qualification relevant to the position; and
(e) work experience relevant to the position.

GM1 ORO.GEN.210(a) Personnel requirements – ED Decision 2017/007/R

FUNCTION OF THE ACCOUNTABLE MANAGER

(a) The accountable manager should have the overall responsibility for running the organisation.
(b) When the accountable manager is not the chief executive officer, the competent authority should be assured that the accountable manager has direct access to the chief executive officer and has the necessary air operations funding allocation.

ORO.AOC.135 Personnel requirements – Regulation (EU) 2019/1384

(a) In accordance with point ORO.GEN.210(b), the operator shall nominate persons responsible for the management and supervision of the following areas:
    (1) flight operations;
    (2) crew member training;
    (3) ground operations;
    (4) continuing airworthiness or for the continuing airworthiness management contract in accordance with Regulation (EU) No 1321/2014, as the case may be.

(b) Adequacy and competency of personnel
    (1) The operator shall employ sufficient personnel for the planned ground and flight operations.
    (2) All personnel assigned to, or directly involved in, ground and flight operations shall:
        (i) be properly trained;
        (ii) demonstrate their capabilities in the performance of their assigned duties; and
        (iii) be aware of their responsibilities and the relationship of their duties to the operation as a whole.

(c) Supervision of personnel
    (1) The operator shall appoint a sufficient number of personnel supervisors, taking into account the structure of the operator's organisation and the number of personnel employed.
    (2) The duties and responsibilities of these supervisors shall be defined, and any other necessary arrangements shall be made to ensure that they can discharge their supervisory responsibilities.
    (3) The supervision of crew members and personnel involved in the operation shall be exercised by individuals with adequate experience and the skills to ensure the attainment of the standards specified in the operations manual.

AMC1 ORO.AOC.135(a) Personnel requirements – ED Decision 2014/017/R

NOMINATED PERSONS

(a) The person may hold more than one of the nominated posts if such an arrangement is considered suitable and properly matched to the scale and scope of the operation.
(b) A description of the functions and the responsibilities of the nominated persons, including their names, should be contained in the operations manual.
(c) The holder of an AOC should make arrangements to ensure continuity of supervision in the absence of nominated persons.
(d) The person nominated by the holder of an AOC should not be nominated by another holder of an AOC, unless agreed with the competent authorities concerned.
(e) Persons nominated should be contracted to work sufficient hours to fulfil the management functions associated with the scale and scope of the operation.

AMC2 ORO.AOC.135(a) Personnel requirements – ED Decision 2014/017/R

COMBINATION OF NOMINATED PERSONS RESPONSIBILITIES

(a) The acceptability of a single person holding several posts, possibly in combination with being the accountable manager, should depend upon the nature and scale of the operation. The two main areas of concern should be competence and an individual's capacity to meet his/her responsibilities.
(b) As regards competence in different areas of responsibility, there should not be any difference from the requirements applicable to persons holding only one post.
(c) The capacity of an individual to meet his/her responsibilities should primarily be dependent upon the scale of the operation. However, the complexity of the organisation or of the operation may prevent, or limit, combinations of posts which may be acceptable in other circumstances.
(d) In most circumstances, the responsibilities of a nominated person should rest with a single individual. However, in the area of ground operations, it may be acceptable for responsibilities to be split, provided that the responsibilities of each individual concerned are clearly defined.

AMC1 ORO.AOC.135(a)(4) Personnel requirements – ED Decision 2022/017/R

NOMINATED PERSON RESPONSIBLE FOR THE MANAGEMENT AND SUPERVISION OF THE CONTRACT WITH A CAMO PURSUANT TO POINT M.A.201(ea)

If the operator concludes a contract with a CAMO pursuant to point M.A.201(ea) of Annex I (Part-M) to Regulation (EU) No 1321/2014, the person nominated by the operator in accordance with point ORO.AOC.135(a)(4) is responsible for the management and supervision of the continuing airworthiness management contract that is required by Appendix I to Part-M. This person should not be employed by the contracted CAMO to avoid conflict of interest. In addition, this person should have the following:

(a) practical experience and expertise in the application of aviation safety standards and safe operating practices;
(b) comprehensive knowledge of:
    (i) the relevant parts of operational requirements and procedures;
    (ii) the air operator certificate (AOC) holder's operations specifications;
    (iii) the relevant parts of the AOC holder's operations manual; and
    (iv) the relevant parts of the continuing airworthiness management exposition (CAME) of the contracted CAMO;
(c) knowledge of:
    (i) human factors (HF) principles; and
    (ii) safety management system (SMS) based on the EU management system requirements (including compliance monitoring) and International Civil Aviation Organization (ICAO) Annex 19;
(d) 5 years of relevant work experience, of which at least 2 years in an appropriate position in the aeronautical industry;
(e) a relevant engineering or technical degree, or an aircraft maintenance technician qualification with additional education that is acceptable to the competent authority; this condition may be replaced by 3 years of experience in addition to those specified in point (d); those 3 years should include an appropriate combination of experience in tasks related

to aircraft maintenance and/or continuing airworthiness management and/or surveillance of such tasks;

(f) thorough knowledge of:
    (i) the continuing airworthiness management contract;
    (ii) the organisation's management systems' interfaces; and
    (iii) the way of achieving harmonisation of those management systems;

(g) knowledge of a relevant sample of the type(s) of aircraft operated by the organisation, which is gained through a formalised training course; such a course should be at least at a level equivalent to Part-66 (Annex III to Regulation (EU) No 1321/2014), Appendix III, Level 1 'General Familiarisation' and may be provided by a Part-147 (Annex IV to Regulation (EU) No 1321/2014) organisation, by the manufacturer, by the CAMO, or by any other organisation that is accepted by the competent authority; 'relevant sample' means that the related course should cover typical aircraft and aircraft systems that are operated by the organisation; and

(h) knowledge of Regulation (EU) No 1321/2014.

GM1 ORO.AOC.135(a) Personnel requirements – ED Decision 2014/017/R

NOMINATED PERSONS

The smallest organisation that can be considered is the one-man organisation where all of the nominated posts are filled by the accountable manager, and audits are conducted by an independent person.

GM2 ORO.AOC.135(a) Personnel requirements – ED Decision 2022/017/R

COMPETENCE OF NOMINATED PERSONS

(a) Nominated persons in accordance with ORO.AOC.135 should be expected to possess the experience and meet the qualification provisions of (b) to (f) respectively. Exceptionally, in particular cases, where the nominated person does not meet these provisions in full, the nominee should have comparable experience and also the ability to perform effectively the functions associated with the post and with the scale of the operation.

(b) Nominated persons for flight operations, crew training and ground operations should have:
    (1) practical experience and expertise in the application of aviation safety standards and safe operating practices;
    (2) comprehensive knowledge of:
        (i) the applicable EU safety regulations and any associated requirements and procedures;
        (ii) the AOC holder's operations specifications; and
        (iii) the need for, and content of, the relevant parts of the AOC holder's operations manual;
    (3) familiarity with management systems preferably in the area of aviation;
    (4) appropriate management experience, preferably in a comparable organisation; and
    (5) 5 years of relevant work experience of which at least 2 years should be from the aeronautical industry in an appropriate position.

(c) Flight operations. The nominated person should hold or have held a valid flight crew licence and the associated ratings appropriate to a type of operation conducted under the AOC. In case the nominated person's licence and ratings are not current, his/her deputy should hold a valid flight crew licence and the associated ratings.

(d) Crew training. The nominated person or his/her deputy should be a current type rating instructor on a type/class operated under the AOC. The nominated person should have a thorough knowledge of the AOC holder's crew training concept for flight, cabin and when relevant other crew.
(e) Ground operations. The nominated person should have a thorough knowledge of the AOC holder's ground operations concept.
(f) Continuing airworthiness. The nominated person for continuing airworthiness or for the continuing airworthiness management contract, as the case may be, should have the relevant knowledge, background and experience in accordance with Regulation (EU) No 1321/2014. If a continuing airworthiness management organisation (CAMO) is contracted by the operator pursuant to point M.A.201(ea) of Annex I (Part-M) to Regulation (EU) No 1321/2014, please refer to AMC1 ORO.AOC.135(a)(4).

GM1 ORO.AOC.135(a)(4) Personnel requirements – ED Decision 2022/017/R

NOMINATED PERSON RESPONSIBLE FOR THE MANAGEMENT AND SUPERVISION OF THE CONTRACT WITH A CAMO PURSUANT TO POINT M.A.201(ea)

If the operator concludes a contract with a CAMO pursuant to point M.A.201(ea) of Annex I (Part-M) to Regulation (EU) No 1321/2014, the person nominated by the operator in accordance with point ORO.AOC.135(a)(4) is responsible for ensuring that both the operator and CAMO fulfil their obligations as specified in the contract (which is established in accordance with Appendix I to Part-M). In the particular context of a single air carrier business grouping, that person is expected to apply critical thinking, to be impartial, and not complacent about the fact that the CAMO belongs to that business grouping.