Norwegian Safety Investigation Authority

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REPORT Aviation 2021/09

REPORT ON AIR ACCIDENT NEAR SKJELBREITJØRNA IN SANDNES MUNICIPALITY, ROGALAND COUNTY, NORWAY ON 6 APRIL 2020 INVOLVING AIRBUS HELICOPTERS AS350 B3, LN-OFQ, OPERATED BY HELITRANS AS

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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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REPORT ON AIR ACCIDENT

Type of aircraft:	Airbus Helicopters AS350 B3
Nationality and registration:	Norwegian, LN-OFQ
Owner:	Skjolden Invest AS, Hønefoss, Norway
Operator:	Helitrans AS, Stjørdal, Norway
Crew:	1, the commander
Passengers:	None
Accident site:	Northwest of Skjelbreitjørna in Sandnes, Rogaland, Norway (N 58° 49.951´ E 5° 51.434´)
Time of accident:	At 0857 hours on Monday 6 April 2020

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

NOTIFICATION

At 0920 hours on Monday 6 April 2020, the Norwegian Safety Investigation Authority's (NSIA) duty officer was notified by the company's Accountable Manager that one of the company's helicopters had been involved in an accident. LN-OFQ had crashed in connection with a sling load operation. The commander, who was alone on board, sustained only minor injuries. Due to mandatory restrictions in connection with the Covid-19 pandemic, the NSIA did not deploy personnel to the scene of the accident.

In accordance with ICAO Annex 13 Aircraft Accident and Incident Investigation, the NSIA notified Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation civile (BEA) in France (State of Manufacture). The European Union Aviation Safety Agency (EASA) and the Civil Aviation Authority (CAA) Norway were also notified.

SUMMARY

The commander was moving a container in connection with the construction of a power transmission line. Windy conditions with strong gusts made it difficult to keep the helicopter steady. While the container was being lifted, the helicopter was exposed to a wind gust at the worst possible time, as the longline was being pulled taut. The helicopter entered a dynamic rollover situation and crashed. The commander was just lightly injured and the NSIA believes that his use of a helmet prevented any further injury. The helicopter was destroyed.

The forecast wind for the area was basically above the limit of 30 kt for sling load operations set by the helicopter operator Helitrans. There are often large local wind variations. Consequently, the decision to fly or not to fly can be difficult to regulate with absolute regulatory values based on an area forecast. The final decision is therefore left to the commander. There is no information on what the wind conditions was exactly where the accident happened. The NSIA believes that the commander may have underestimated the difficulties of flying in the prevailing winds.

1. FACTUAL INFORMATION

1.1 History of flight

1.1.1 In connection with the construction of a 420 kV power transmission line from Forsand to Fagrafjell on the border between Time and Sandnes municipalities in Rogaland county, Statnett SF had signed a contract with Dalekovod as the contractor. Dalekovod, for its part, had signed a contract with Helitrans AS regarding helicopter services. At the time of the accident, two helicopters from Helitrans were on contract in the project.

1.1.2 The previous day, LN-OFQ had undergone a 100-hour inspection at Stavanger Airport Sola (ENZV) and been flown to rig area C42 near pylon 161 by another Helitrans pilot (see Figure 1). The commander has explained that he had been briefed about the assigned tasks on Friday, three days before the accident occurred. In addition, a representative of Dalekovod briefed him about the tasks on the morning of the accident. The first task was to move a container weighing just under 1,100 kg from the rig area to pylon 151.

1.1.3 A 15-metre longline was attached to the cargo hook under the helicopter. A 6-metre-long line extension was attached to the longline, which in turn was attached to a lifting yoke for the 2-metre high container. This meant the helicopter had to climb to a height above ground level of approximately 24 metres to be able to lift the container off the ground.

1.1.4 The commander started up the helicopter in rig area C42 at 0835 hours. The helicopter contained 35% fuel (approx. 190 litres, approx. 150 kg) and was carrying approximately 20 kg of equipment. The departure was at 0839 hours. En route to pylon 151, the commander noticed that there was a strong southeasterly wind with gusts. Once he had landed the helicopter by pylon 151, he realised that he had landed at the wrong place. It became clear that there was also a pylon 151 on an older 132 kV line, a line that had to be relocated to accommodate the 420 kV line. The container was therefore supposed to have been delivered to pylon 151 on the 132 kV line and not the 420 kV line. The correct pylon was approximately 10 NM further to the northeast, on the eastern side of the Høgsfjord.

1.1.5 The commander had landed the helicopter next to the container and kept the engine running. He first called the client Dalekovod using his mobile phone to clear up the misunderstanding. The commander said he was in doubt as to whether he could fly the helicopter across the Høgsfjord in the prevailing winds. He then called a colleague in rig area C32, approximately 2 NM east of the helicopter. They discussed the wind conditions. Following an assessment, the commander decided to fly the helicopter over to his colleague in rig area C32 and see how the conditions developed. The commander has explained to the NSIA that he felt no pressure from the client when he made the decision to move the container. For him, it was only natural to bring it to an easily accessible place and not leave it by pylon 151.

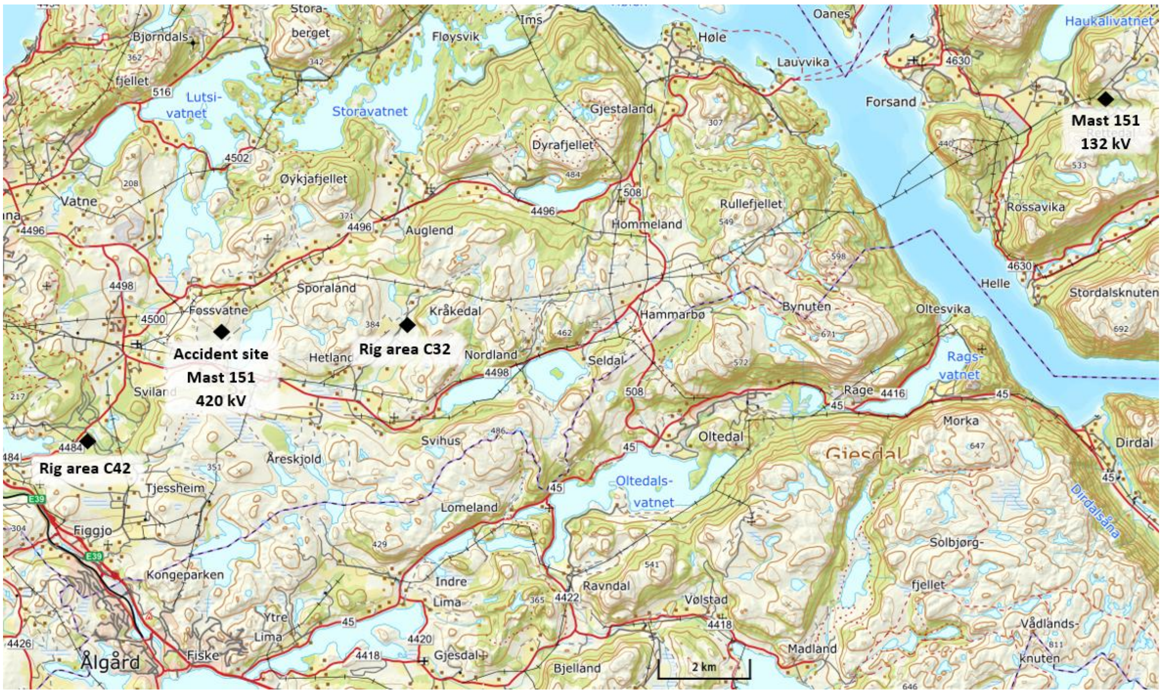

Figure 1: Outline of the area. Map: @Norwegian Mapping Authority/NSIA

1.1.6 The helicopter had been on the ground with the engine running for a little less than seven minutes when the commander lifted the helicopter off the ground with the container positioned in front and to the right of the helicopter. He then turned the helicopter leftwards to a heading of approximately 140 degrees, ensuring that the line was getting taut in view down below on his right-hand side. The helicopter was equipped with a lightweight flight recorder of the type Appareo Vision 1000. This records technical data and video with sound. The video recorder's field of view covered most of the instrument panel. A review show that also the cargo hook load indicator sometimes comes partially into view on the far right in the image (see Chapter 1.6.4 and Figure 2). The details in the description below were obtained from the recordings.

1.1.7 The recordings show that the helicopter started rolling to the left, at the same time as the nose started to pitch up. The commander moved the cyclic stick forward and to the right to counteract this movement, but the movement continued. When the helicopter had rolled 11.6 degrees to the left and with an upward nose angle of 6 degrees, moving the cyclic stick all the way to the right caused the commander's right foot to slip off the right pedal. At the same time, a green diode on the cargo hook load indicator came into sight on the far right in the image, indicating that the load on the hook was less than 100 kg at the time. The helicopter then started turning to the left.

1.1.8 Seven seconds after being in a normal position, the helicopter heading passed 59 degrees during the leftward turn, at the same time as the left roll to reached 31 degrees. It had a nose high angle of 5.1 degrees. Two green lights on the cargo hook load indicator indicated that the load on the hook was at least 100 kg.[1]

1.1.9 Eight seconds after the helicopter was in a normal position, the commander activated the trigger switch on the cyclic stick to open the cargo hook. The helicopter was still turning

[1] Two green lights can be seen on the indicator on the far right in the image. Any additional lights are outside the field of view. It is therefore not possible to determine the exact load on the cargo hook, but it was at least 100 kg, as indicated by the two lights.

to the left and had reached a heading of 24 degrees. The roll was 18.6 degrees to the left, and the nose had dropped to -4 degrees (see Figure 3). As the helicopter continued to turn, it started to roll to the right.

1.1.10 Nine seconds after being in a normal position, the helicopter had continued its leftward turn to a heading of 301 degrees and the angle of roll was 32 degrees to the right.

1.1.11 The rotation continued and the helicopter was getting close to the ground. Twelve seconds after being in a normal position, the helicopter’s main rotor hit the ground and the helicopter ended up lying on its right side with its nose pointing south. The helicopter had thus almost completed a full rotation to the left before it came to rest (see Figure 4).

1.1.12 When the helicopter hit the ground, various objects, including a tablet computer and a bottle of oil, were thrown around in the cockpit. The commander banged his helmet into the door, damaging the helmet and causing the chin strap to come loose. The red light indicating that the emergency locator transmitter had been triggered started flashing.

1.1.13 The commander’s right hand got trapped, but he quickly managed to free it. He then released his seatbelt and climbed out of the helicopter’s left side door. The engine continued to run for 19 seconds after the helicopter hit the ground.

1.1.14 There were several people present by pylon 151, and the emergency services were immediately notified of the accident. Shortly after, the commander returned to the helicopter and switched off the electrical power and the emergency locator transmitter. He sustained no physical injuries, apart from an abrasion on his right hand and bruises on his right arm and shoulder.

1.1.15 In connection with the crash, the container was pulled slightly to the north, causing it to overturn. After the crash the container came to rest 47 metres south of the helicopter.

Figure 2: The helicopter has rolled left to an angle of 11.6 degrees and has a nose high angle of 6 degrees. The commander has moved the cyclic stick all the way to the right, and his right foot has just slipped off the pedal. A single green light can be seen on the far right in the image, indicating a load of less than 100 kg (green arrow). Source: Appareo Vision 1000/NSIA

Figure 3: Two green lights (green arrow) can be seen on the far right in the image, indicating that the cargo hook load has exceeded 100 kg. The commander pressed the switch on the cyclic stick to release the cargo (red arrow). At this point in time, after spinning out of control, the helicopter had turned 116 degrees to the left. The nose angle had dropped to -4 degrees. Source: Appareo Vision 1000/NSIA

Figure 4: Southeasterly view of LN-OFQ. Photo: The police

1.2 Personal injuries

Table 1: Personal injuries

Injuries	Crew	Passengers	Others
Dead			
Serious			
Minor/none	1		

1.3 Damage to aircraft

The helicopter was destroyed. See section 1.12.2 for a more detailed description.

1.4 Other damage

None

1.5 Personnel information

1.5.1 The commander (38 years of age) trained as a helicopter pilot in the USA during the period 2008 to 2010. In the USA, he flew Robinson R22 and R44 and worked as an instructor for a period. He returned to Norway and completed his conversion training to obtain a Norwegian commercial helicopter pilot licence (CPL(H)) in 2011. He started working at Helitrans the same year and was permanently employed from 2013.

1.5.2 The commander had a commercial helicopter pilot licence (CPL(H)) valid until 28 February 2021. The right to fly AS350 helicopters was most recently renewed on 17 February 2020 and was valid until 28 February 2021. The commander had a Class 1 medical certificate valid until 18 January 2021. The medical certificate has no limitations. The commander is approved for special helicopter tasks at level HESLO 4.[2]

Table 2: Flying hours, commander

Flying hours	All types	Actual type
Last 24 hours	00:18	00:18
Last 3 days	04:12	04:12
Last 30 days	31:06	31:06
Last 90 days	64	64
Total	3,228	1,758

1.6 Aircraft information

1.6.1 <u>General information</u>

AS350 B3 is a light, single-turbine helicopter with three main rotor blades and a conventional tail rotor. It is frequently used for sling load operations in Norway.

[2] Level 4 is the highest level of approval for helicopter external sling load operations.

1.6.2 Data for LN-OFQ

Manufactured:	2019
Serial number:	8699
Engine:	Safran Arriel 2D
MTOM including underslung load:	2,800 kg
Helicopter's mass at the time of the accident (container excluded):	1,609 kg
Fuel:	Jet A-1

The helicopter was not equipped with Crash Resistant Fuel System (CRFS).

1.6.3 Technical information

1.6.3.1 Two licenced technicians performed a 100-hour inspection of LN-OFQ at Sola on 5 April 2020. At that time, the helicopter's total flight time was 517:07 hours. There were no entries in the Deferred Defect List (DDL) in the helicopter's technical log following the inspection.

1.6.3.2 The helicopter's Airworthiness Review Certificate (ARC) was issued on 17 March 2020 and was valid until 11 April 2021.

1.6.3.3 The commander has explained that there were no technical problems with the helicopter at the time of the accident. This is verified by data and the video from Appareo Vision 1000. No other information has emerged to suggest that technical failure of the helicopter or any of its systems had an impact on the accident. The NSIA has therefore not investigated the helicopter's maintenance in any further detail.

1.6.4 Cargo hook load indicator

The helicopter was equipped with a cargo hook weight. A cargo hook load indicator connected to the weight was installed on the right-hand side of the cockpit. The instrument indicates the mass of the load suspended from the hook in kilos or pounds. The instrument also displays a series of green diodes indicating the load (FAST LOAD WT). One diode emits light even if there is no load on the cargo hook. The next diode is lit when the weight reaches 100 kg or more. Two diodes are lit when the weight exceeds 180 kg, as shown in Figure 5. If the load is increased to 350 kg, six diodes are lit.

Figure 5: Two green diodes are lit to indicate a load of 180 kg. Reflections in the glass can give the impression that four diodes are lit. Photo: Helitrans AS

1.7 Weather[3]

1.7.1 In general

The NSIA has obtained information from the Norwegian Meteorological Institute about the wind situation in the area. Some of the material received is reproduced below.

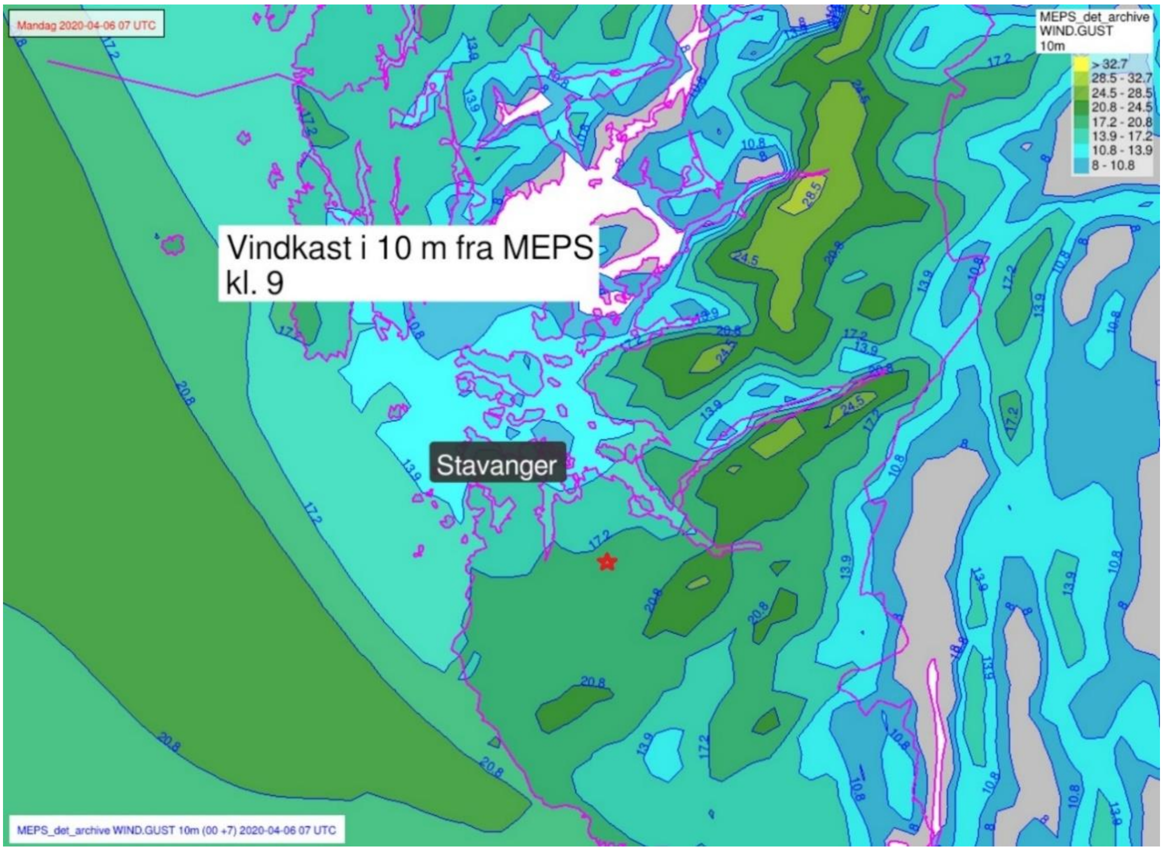

Figure 6: Map showing gusts at 10 metres above ground level at 0900 hours. The accident site is marked with a red star. According to the table, there were gusts of 17.2–20.8 m/s (33.4–40.5 kt) in the area. Source: Norwegian Meteorological Institute

[3] See https://www.ippc.no/ippc/index.jsp for an explanation of meteorological abbreviations.

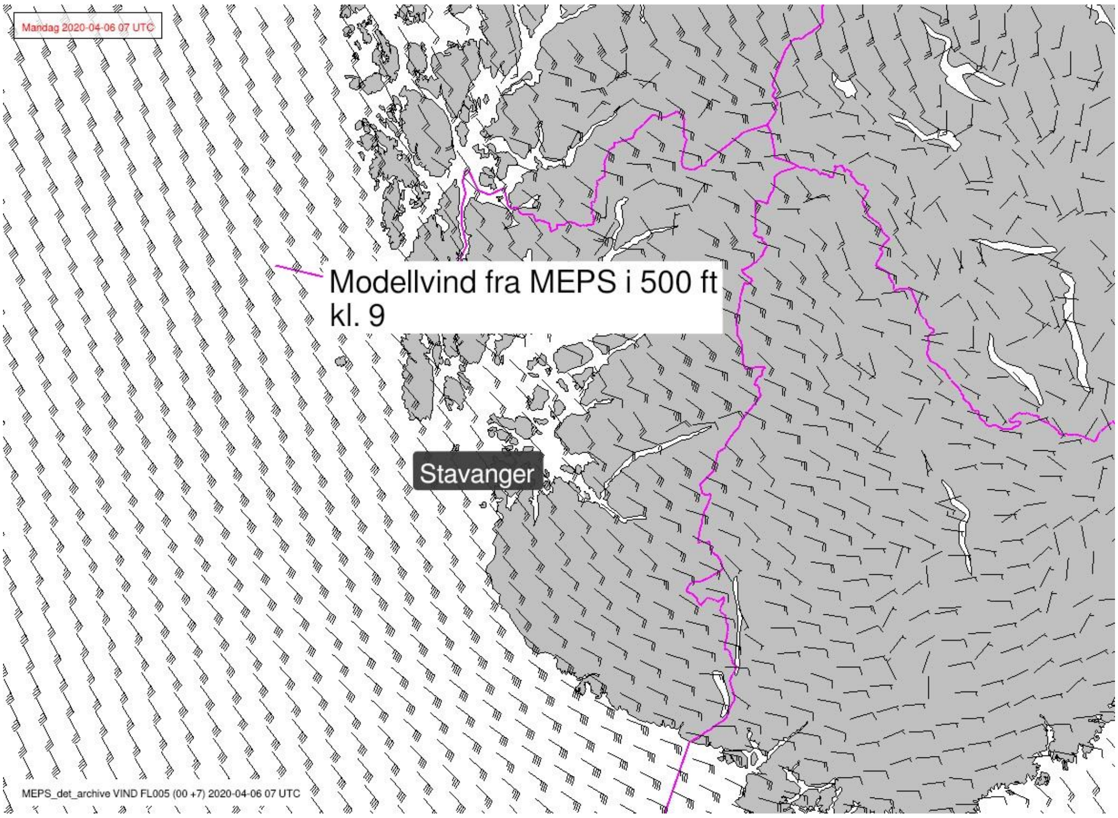

Figure 7: According to the map, at 0900 hours the wind was southeasterly with a mean wind speed of 20 kt at a level of 500 ft above the accident site. Source: Norwegian Meteorological Institute

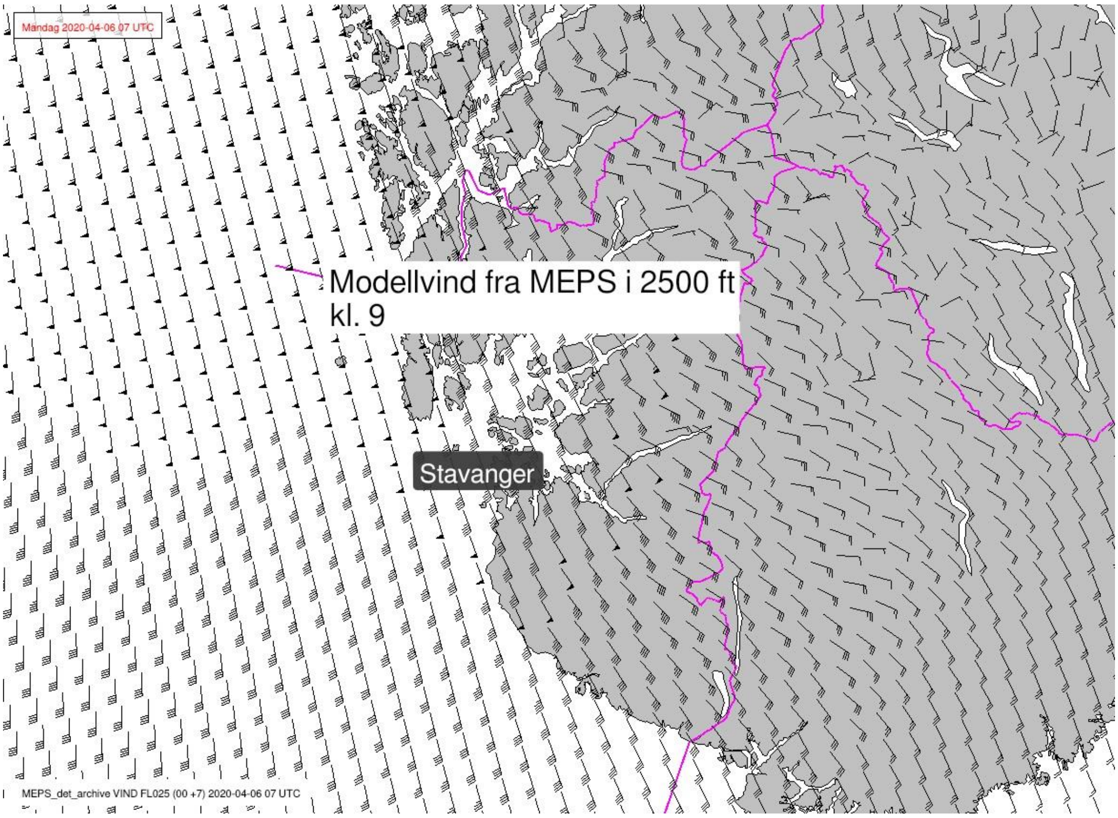

Figure 8: According to the map, at 0900 hours the wind was southeasterly with a mean wind speed of 45 kt at a level of 2,500 ft above the accident site. Source: Norwegian Meteorological Institute

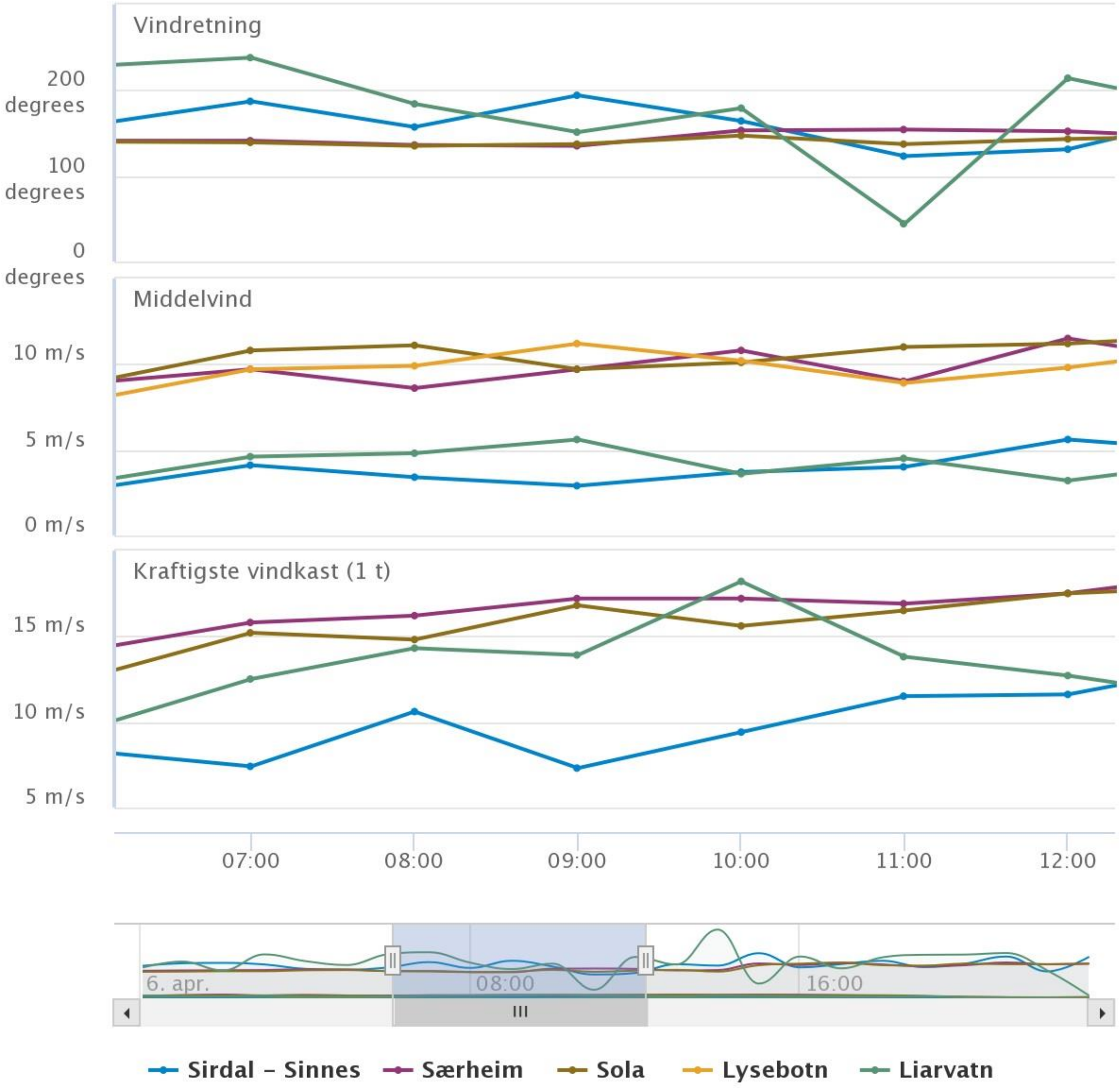

Figure 9: Wind during the period 0700–1200 hours at the most relevant locations for which data are available. Sola and Særheim (13 km south of Sola) are closest to the accident site. (Vindretning – Wind direction, Middelvind – Mean wind speed, Kraftigste vindkast (1 t) – Highest wind gust (1 hour)). Source: Norwegian Meteorological Institute

Table 3: Wind at 0900 hours for the most relevant sites for which data are available. Source: Norwegian Meteorological Institute

Stations	Direction, degrees	Mean wind speed, m/s	Gusts, m/s
Sirdal – Sinnes 560 masl	194	2.9	7.3
Særheim 87 masl	135	9.7	17.2
Sola 7 masl	137	9.7	16.8
Lysebotn 5 masl	not observed	11.2	not observed
Liarvatn – Strand 300 masl	151	5.6	13.9

1.7.2 Routine weather observations (METAR) for Stavanger Airport Sola (ENZV)

All times are stated as standard times (Z), i.e. universal time coordinated (UTC).

060520Z 14021KT CAVOK 10/01 Q1013 TEMPO 15025G38KT=

060550Z 13018KT CAVOK 10/01 Q1013 TEMPO 15025G38KT=

060620Z 13022KT CAVOK 11/01 Q1012 TEMPO 15025G38KT=

060650Z 13022G33KT CAVOK 11/02 Q1013 NOSIG=

060720Z 13019KT CAVOK 12/02 Q1013 TEMPO 15025G38KT=

060750Z 13021KT CAVOK 12/02 Q1012 TEMPO 15025G38KT=

060820Z 15019G31KT CAVOK 13/02 Q1013 TEMPO 15025G38KT=

060850Z 14024KT CAVOK 13/02 Q1012 TEMPO 15025G38KT=

1.7.3 Weather forecast (TAF) for Stavanger Airport Sola (ENZV)

All times are stated as standard times (Z), i.e. universal time coordinated (UTC).

060500Z 0606/0706 14020KT 9999 FEW030 TEMPO 0606/0614 15025G38KT TEMPO 0615/0618 RA BKN014 BECMG 0615/0617 17008KT PROB30 0703/0706 0500 FG VV002=

1.8 Aids to navigation

Not relevant.

1.9 Communications

The commander had selected the frequency at the Sola control tower at (118.350 MHz), but operated just outside the control zone (CTR) and did not communicate with the tower.

1.10 Aerodrome information

Not relevant.

1.11 Flight recorders

The helicopter was equipped with a flight recorder of the type Appareo Vision 1000, installed on the ceiling of the cabin. The unit records and stores images and sound from the cockpit and several key technical data on an internal memory unit and on a SD-card. The SD-card was downloaded by the NSIA. The video recording shows large parts of the instrument panel, the commander and parts of the surroundings in front of the helicopter. Key information that could be retrieved from the unit are engine parameters, helicopter heading and attitude information, and the commander’s operation of the flight controls. The information has been useful in order to describe and understand the sequence of events.

1.12 Accident site and wreckage information

1.12.1 The accident site

1.12.1.1 The accident took place in a relatively flat, open and rocky grazing area 460 metres northwest of Skjelbreitjørna lake (see Figure 10). The helicopter came to rest partly on a big rock protruding from the ground. The accident site is approximately 170 metres (558 ft) above sea level. South of the accident site, the terrain slopes down towards Skjelbreitjørna. In the whole sector south of the accident site (from 80 to 270 degrees), the terrain was partly mountainous, with peaks of from 200 to 384 metres above sea level.

1.12.1.2 The accident took place shortly after Norway was shut down as a result of the Covid-19 pandemic. The NSIA did not travel to the accident site and decided to order drone documentation from Nordic Unmanned. The work consisted of, among other things, 3D documentation as shown in Figure 11 and Figure 12.

Figure 10: The accident site, looking east with Skjelbreitjørna in the background. The overturned container can be seen to the very right in the photo. The distance between the helicopter wreckage and the container is 47 metres. Photo: The police

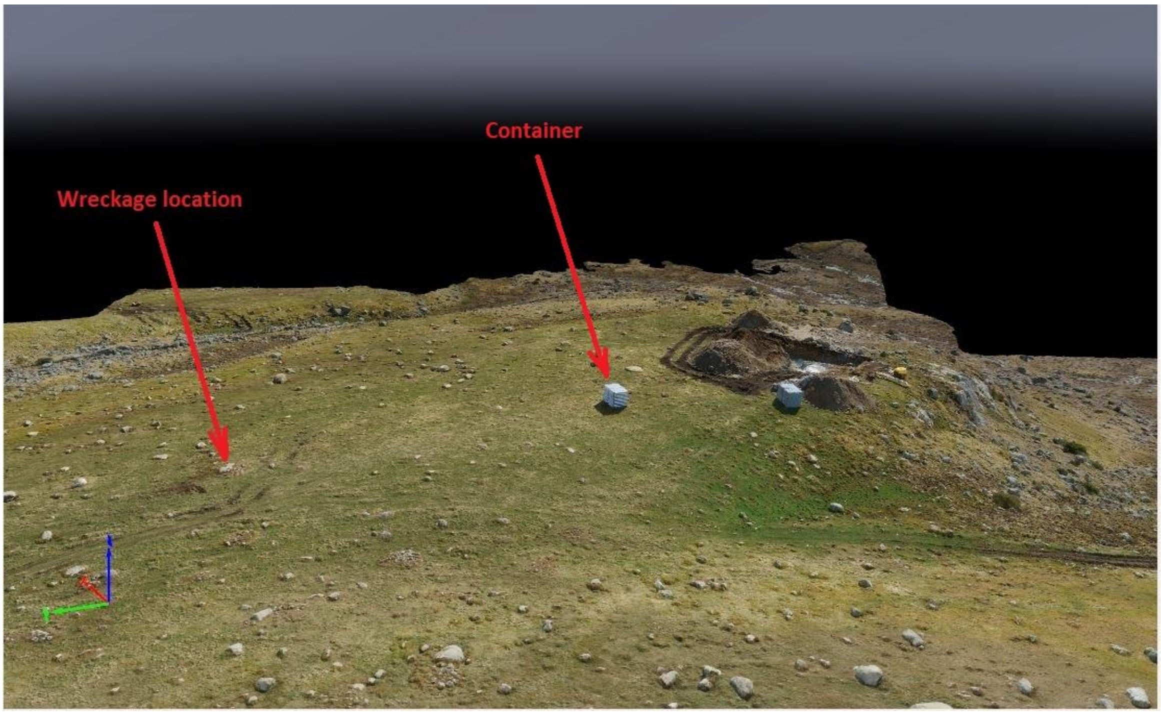

Figure 11: 3D illustration of the accident site, looking southeast, the day after the wreckage was removed. The arrow on the left points to the rock on which the helicopter was lying. The hole in the ground is for pylon 155. A rocky outcrop and steeply sloping terrain can be seen on the far right. Source: Nordic Unmanned/NSIA

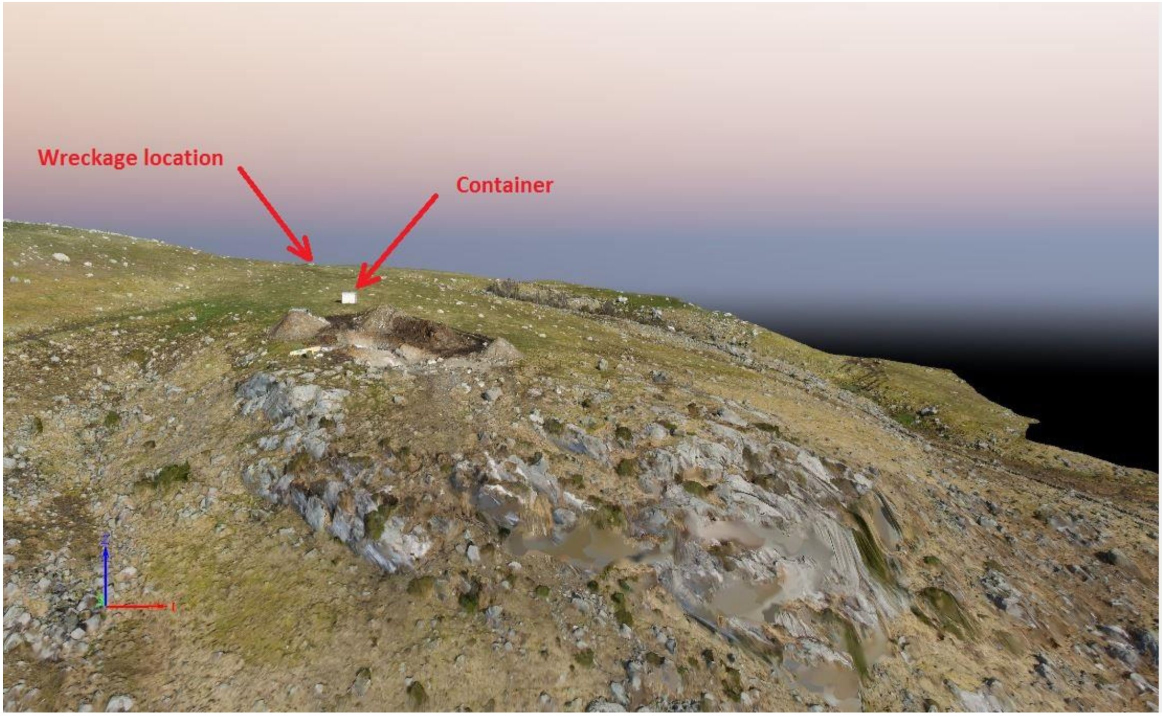

Figure 12: 3D illustration of the accident site, looking northeast, the day after the helicopter was removed. The hole in the ground is for pylon 155. Source: Nordic Unmanned/NSIA

1.12.2 Wreckage information

1.12.2.1 The helicopter was transported to the NSIA's premises in Lillestrøm for the purpose of documenting the damage sustained in the accident.

- The cockpit and cabin were relatively undamaged. Seats and seatbelts were intact and undamaged. The most obvious damage was that the right front door had been smashed in and both windows in the door were broken.

- The right-side skid and steps were knocked off and both cross tubes were broken on the right-hand side.

- Extensive damage to all three main rotor blades. All three star arms were broken, with a fracture surface of 45 degrees.

- All four suspension bars for the main gearbox were broken.

- The main gearbox had been pushed down into and ruptured the fuel tank.

- The engine was virtually without exterior damage.

- The tail boom was split in two places, and the tail rotor gearbox had come loose.

1.12.2.2 The NSIA has no information indicating that a technical failure of the helicopter or any of its systems had an impact on the incident (see section 1.6.3.3). The NSIA has therefore not looked into the helicopter's condition in any further detail.

1.13 Medical and pathological information

In accordance with procedure, blood samples were taken from the commander. No traces of intoxicating or narcotic substances were found.

1.14 Fire

No fire occurred in connection with the crash. The hole in the fuel tank could have led to a major fuel leakage, but because of the position of the helicopter and the fact that the tank was less than half full, only a small amount of fuel ran out.

1.15 Survival aspects

1.15.1 The helicopter was equipped with an emergency location transmitter (ELT) of the type Kannad AP-H INTEGRA (ER). It activated automatically and alerted the Joint Rescue Coordination Centre (JRCC). The commander switched off the transmitter, and Helitrans called the JRCC and gave additional information about the accident.

1.15.2 The commander was wearing a helmet and was strapped to his seat with a four-point seatbelt. The helicopter and the right cockpit door were lying over a large rock and the commander may have hit this rock with his helmet. The chin strap came loose on the right-hand side and the helmet fell off during the crash. A detailed examination showed damage to the protective hard shell on the right side of the helmet, and the helmet was subsequently scrapped (see Figure 13). One of the damaged areas was close to the right ear, near the chin strap attachment. It was also found that very little force was required to open the chin strap lock. The attachment mechanism of the chin strap worked correctly, however, in that it was not possible to pull the chin strap loose with the lock engaged.

Figure 13: The commander’s helmet, showing damage to the right side. The arrow points to the chin strap lock that came undone. Photo: NSIA

1.16 Tests and research

None

1.17 Organizational and management information

1.17.1 <u>The company</u>

1.17.1.1 Helitrans AS is a Norwegian helicopter company whose head office is at Trondheim Airport Værnes. The company was formed in 1990. Its core business is to offer services to companies and private individuals, including personnel transport, sling load operations and mast installation.

1.17.1.2 At the time of the accident, Helitrans AS had approximately 65 permanent employees and 25 freelance/seasonal workers. The company had an approved technical organisation that performed inspections and maintenance on the company’s helicopters.

1.17.1.3 At the time of the accident, the company had a total of 22 helicopters, 18 of which were of the type Airbus Helicopters AS350.

1.17.2 Company procedures

The company had standard procedures for sling load operations (SOP 5.5.2 Limitations):

> *Under conditions of turbulent air, the speed is reduced further. Maximum wind is normally 30 kt, in mountain areas the maximum can be considered 15 to 20 kts. Wind conditions must always be considered by the commander on the spot.*

1.18 Additional information

1.18.1 Dynamic rollover

1.18.1.1 A dynamic rollover normally occurs if a helicopter has one skid on the ground at the same time as it is affected by a lateral force or movement. As the helicopter starts to pivot, the main rotor thrust will contribute to further pivot the helicopter around the skid. When the critical rollover angle is exceeded, dynamic rollover cannot be prevented by corrective cyclic control alone, and the main rotor will hit the ground. Dynamic rollover is most likely to occur in sideways sloping terrain, but can also occur on a horizontal surface, for example if a skid gets caught in something in connection with take-off (see Figure 14).

1.18.1.2 A form of dynamic rollover can also occur if a longline or underslung load gets caught in something on the ground while the helicopter is moving horizontally.

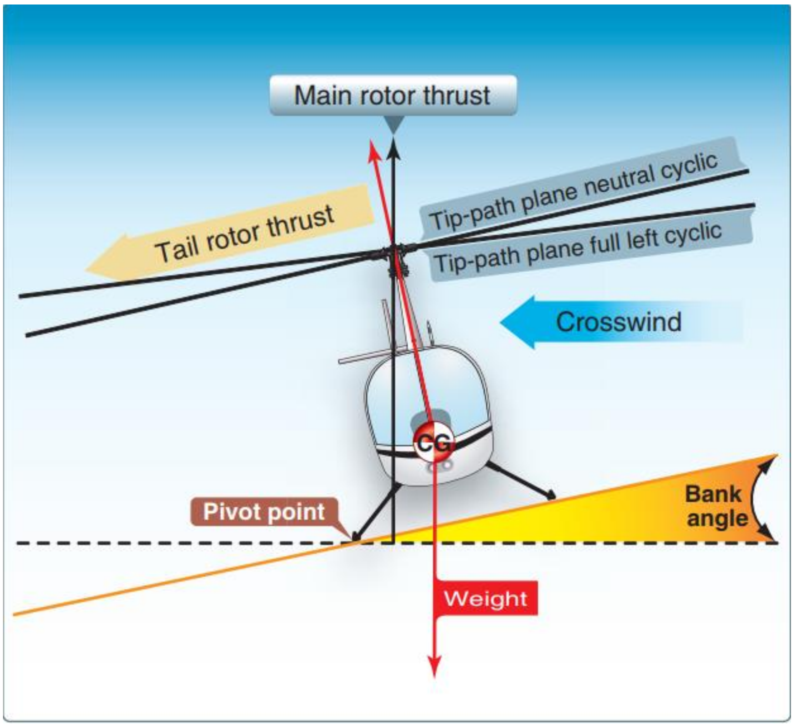

Figure 14: Illustration of factors in a dynamic rollover caused by crosswinds and tail rotor thrust. Source: Flight Literacy

1.19 Useful or efficient investigation methods

No methods warranting special mention have been used in this investigation.

2. ANALYSIS

2.1 Introduction

Based on interviews with the commander and thorough documentation of the incident with the aid of Appareo Vision 1000, it became clear at an early stage that the helicopter was affected by strong winds and that that contributed to the accident. The wind conditions, and the commander's responsibility and operational assessments are therefore key subjects of the analysis. The NSIA has not found that the technical condition of the helicopter, lifting gear or the container itself has contributed to the accident. These factors are therefore not discussed any further in the report. We start the analysis with a review of the sequence of events. The survivability aspect is discussed in section 2.4.

2.2 Sequence of events

2.2.1 The fact that there were two pylons numbered 151 seems to be an obvious explanation of why a misunderstanding arose about where the container was to be transported to. The NSIA has chosen not to look further into why the misunderstanding arose, as it is not deemed to have had any direct bearing on the accident itself.

2.2.2 There are no exact data for the wind conditions that were applicable at the accident site. There were strong winds and gusts at the time the commander was to move the container from pylon 151 to rig area C32. Both the forecast and the reported wind direction was southerly or southwesterly. This means that the wind probably followed upwards the sloping terrain south of the accident site.

2.2.3 Information from Appareo Vision 1000 suggests that there was a wind gust just as the longline between the helicopter and the container was being tautened. The commander had turned the helicopter so it was at 140 degrees heading. The southerly wind could therefore move the helicopter backwards and to the left unless the commander used the cyclic stick to counteract the movement. The image (Figure 2) shows that the cyclic stick had been moved all the way to the right without this stopping the leftward roll.

2.2.4 The NSIA believes that, at that point, the helicopter had come in a dynamic rollover situation. Dynamic rollover normally occurs if the helicopter is connected to the ground at the same time as it is affected by lateral forces (see section 1.18.1). In this case, the container, which was still on the ground, acted as a fixed point via the longline.

2.2.5 The helicopter quickly entered a situation where moving the cyclic stick as far as it would go was not sufficient to stop the roll. The fact that the commander moved the cyclic so far to the right that his right foot slipped off the right pedal further aggravated the situation in that the weight of his left foot may have pushed the left pedal slightly forwards. That may have resulted in the helicopter starting to rotate leftwards around the vertical axis. The movement could have been stopped using the right pedal, but that was not possible because the commander's right foot had slipped off the pedal.

2.2.6 The situation rapidly deteriorated. The commander lost control of the helicopter in less than seven seconds. After that, the commander had no possibility of controlling the sequence of events even if he opened the cargo hook and released the longline. When the cargo hook opened, the helicopter had already overturned the container and pulled it some way along the ground. It is not possible to determine how far the helicopter had rotated to the left before the longline was released from the cargo hook. That the helicopter ended up lying on its right side suggests that it had rotated so far to the left that the container had come over on the helicopter's right side before the hook released the longline. Given that the helicopter ended up 47 metres from the container, it is likely that the helicopter moved a further 20 metres or more away from the container after the cargo hook was released.

2.2.7 The NSIA considers that the wind gust came at the worst possible time. Had it come a little earlier, the longline would have been slack, enabling the commander to counteract undesirable movements without the helicopter pivoting into a dynamic rollover situation. Had it come a few seconds later, the container would have been up in the air and there would have been no contact with the ground. That would have prevented any possibility of dynamic rollover and given the commander a better chance of withstanding undesirable wind loads.

2.3 Operational assessment of the weather conditions

2.3.1 Available weather forecasts and reports from Stavanger Airport Sola (TAF and METAR) show that a strong southerly to southwesterly wind with gusts up to 33–38 kt was expected. That exceeded the limit of 30 kt that Helitrans had originally set for sling load operations. The commander could therefore have refused to fly on the day in question, with reference to the limits set by the helicopter operator.

2.3.2 The first flight from rig area C42 to pylon 151 gave the commander a good basis for assessing the prevailing wind conditions in the area. The NSIA therefore considers that the commander had additional information over and above the official weather data when deciding whether the wind conditions permitted further flying.

2.3.3 Mountains, valleys and local terrain can cause wind conditions to vary greatly. Wind data reported by an airport are therefore only reliable locally and will only serve as guidance relating to conditions outside the airport. This leaves the commander with a big responsibility for considering whether the wind conditions are acceptable for the operation in question. The decision to go through with an operation can also be influenced by a number of variables, including:

- Training and experience
- Whether the commander is on top form on the day
- Willingness to take risk
- Pressure from the client
- Self-imposed pressure to complete the task

2.3.4 This means that two different commanders can reach different conclusions in one and the same situation. A commander may also reach different conclusions for two tasks under otherwise similar conditions. The NSIA believes that it mainly makes sense to seek decision support from a colleague, but the feedback does not give a clear answer as to whether an operation is safe to carry out or not.

2.3.5 The NSIA is of the understanding that the commander had doubts about whether the weather conditions were suitable for a sling load operation, and that crossing the Høgsfjord was in any case not an option. It is conceivable that the decision to move the container from pylon 151 to rig area C32 was the result of a self-imposed pressure to 'clear up' the misunderstanding that had occurred, and that the commander, at the very least, wanted to move the container to a rig area. The decision may also have been influenced by an overly optimistic assessment of the difficulties of flying in the prevailing winds.

2.3.6 The operation took place in an open mountain terrain where strong winds and local turbulence were to be expected. Based on the company's procedures, the NSIA believes that information on gusts of up to 38 kt should indicate that sling load operations was not an option during the time period in question.

2.3.7 The NSIA understands that the decision to fly or not in demanding wind conditions can hardly be regulated with absolute numerical values or detailed procedures. The company has therefore also added a line that says, *"Wind conditions must always be considered by the commander on the spot."* Consequently, local knowledge, training, experience, culture, attitudes and risk assessments become factors that will influence the decision. These are factors that must be controlled and strengthened by the helicopter operator. Helitrans should therefore assess whether the pilot corps has the necessary prerequisites to make decisions where wind has generally been forecasted or reported outside the limits set in the company's procedure.

2.4 Survival aspects

2.4.1 Loss of control of a helicopter represents a huge safety risk for both those on board and personnel on the ground. Only chance events prevented serious injury in this incident. The helicopter came to rest lying on its right side on top of a large rock, but the cabin sustained relatively little damage. Although the commander was strapped to the seatbelt, he was thrown against the right door and the rock. The doors and the windows on the right side of the helicopter provide minimum protection, and it is likely that the commander's helmet was the only protection against head injuries. This underlines the importance of wearing a helmet.

2.4.2 The commander's helmet came off in connection with the crash, most likely because the lock came undone, so that the chin strap was pulled out when the protective shell was deformed. It had no consequences, as the helmet came off after the commander banged his head against the cabin/rock. In the NSIA's view, this does not indicate faults in the helmet design. Worn locks should be replaced, however, and the company should have procedures for checking this.

2.4.3 The helicopter was not equipped with a crash resistant fuel system (CRFS), but the relatively low amount of fuel onboard together with the way the accident occurred meant that there was no fire.

3. CONCLUSION

The commander was to move a container in demanding wind conditions that could exceed the limit of 30 kt set by the helicopter operator. When he nonetheless decided to move the container, the helicopter was affected by a wind gust at the worst possible time, causing it to crash as a result of dynamic rollover. It is difficult to define absolute regulatory limits that can be used as the basis for deciding whether or not to fly in demanding wind conditions. In addition, the commander must consider local wind conditions and perform a risk assessment of the operation.

a) The commander was qualified to perform the operation.

b) No faults have been found in the helicopter, lifting gear or load.

c) Possible wind gusts of up to 38 kt were forecast at Stavanger Airport Sola.

d) Wind data reported by an airport are only reliable at the airport and will only serve as guidance relating to conditions outside the airport.

e) The decision to fly may have been influenced by an overly optimistic assessment of the prevailing wind conditions.

f) The commander lost control of the helicopter in less than seven seconds.

g) The helicopter was destroyed.

h) The helicopter cabin sustained relatively little damage.

i) The commander’s helmet protected him against head injuries.

j) The helicopter was not equipped with a Crash Resistant Fuel System (CRFS), but no fire occurred in connection with the crash.

k) No persons on the ground were injured.

4. SAFETY RECOMMENDATIONS

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

The Norwegian Safety Investigation Authority

Lillestrøm, 25 August 2021

APPENDICES

Appendix A: Abbreviations

APPENDIX A: ABBREVIATIONS

ft	foot (feet) – (0.305 m)
MHz	megahertz
kt	knot(s) – nautical mile(s) (1,852 m) per hour
kV	kilovolt
METAR	Meteorological Aerodrome Report – routine weather observation
NM	nautical mile(s) (1,852 m)
NSIA	Norwegian Safety Investigation Authority
SOP	Standard Operating Procedure
TAF	Terminal Aerodrome Forecast