Havarikommissionen

Accident Investigation Board Denmark

Report 2020-372

Serious incident to LN-OOZ (Airbus Helicopter EC135 P3) on short final for runway 23 at Ringsted (EKRS) on 6-11-2020.

INTRODUCTION

This report reflects the opinion of the Danish Accident Investigation Board regarding the circumstances of the occurrence and its causes and consequences.

In accordance with the provisions of EU Regulation 996/2010, the Danish Air Navigation Act and pursuant to Annex 13 of the International Civil Aviation Convention, the safety investigation is of an exclusively technical and operational nature, and its objective is not the assignment of blame or liability.

The safety investigation was carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents and serious incidents.

Consequently, any use of this report for purposes other than preventing future accidents and serious incidents may lead to erroneous or misleading interpretations.

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GENERAL

State file number:	2020-372
UTC date:	6-11-2020
UTC time:	19:38
Occurrence class:	Serious incident
Location:	Short final for runway 23 at Ringsted (EKRS)
Injury level:	None
Aircraft registration:	LN-OOZ
Aircraft make/model:	Airbus Helicopters Deutschland GmbH EC135 P3
Current flight rules:	Visual Flight Rules (VFR)
Operation type:	Helicopter Emergency Medical Service (HEMS)
Flight phase:	Approach
Aircraft category:	Helicopter
Last departure point:	Industrial site in the outskirts of Slagelse
Planned destination:	EKRS
Aircraft damage:	Minor
Engine make/model:	2 x Pratt & Whitney Canada PW 206B

SYNOPSIS

Notification

All date and time references in this report are Coordinated Universal Time (UTC).

On 6-11-2020 at 21:26 hours (hrs), the operator notified the Aviation Unit of the Danish Accident Investigation Board (AIB) of the serious incident.

The AIB notified the Norwegian Safety Investigation Authority (NSIA), the German Federal Bureau of Aircraft Accident Investigation (BFU), the Canadian Transportation Safety Board (TSB), the Danish Transport and Construction Agency (DTCA), the European Aviation Safety Agency (EASA), the Directorate-General for Mobility and Transport (DG MOVE) and the International Civil Aviation Organization (ICAO) on 8-11-2020 at 10:30 hrs.

The NSIA, the BFU, and the TSB accredited non-travelling representatives to the AIB safety investigation.

On 9-11-2020, the Aviation Safety Department of Air Command Denmark, upon request from the AIB, accredited an operational advisor to the AIB safety investigation.

Summary

On short final during a night visual approach to runway 23 (helipad), the helicopter inadvertently entered Instrument Meteorological Conditions (IMC) and impacted a field northeast of the aerodrome.

Adhering to go-around procedures, the helicopter became airborne again and diverted to Slagelse Hospital (EKSE) without any further occurrences.

The following causal factors led to a Controlled Flight into Terrain (CFIT):

- A less than optimum pre-flight weather briefing.
- An action plan on flying a shallow approach under Visual Flight Rules (VFR) conditions with low fog and fog patches.
- Difficulties in assessing height and depth while using Night Vision Goggles (NVG).
- Loss of situational awareness due to visual illusions.
- NVG whiteout at low altitude.

The serious incident occurred in moonlight under IMC.

1 FACTUAL INFORMATION

1.1 History of flight

The serious incident occurred during a VFR Helicopter Emergency Medical Service (HEMS) flight from the outskirts of Slagelse to the HEMS home base in Ringsted (EKRS).

The crew consisted of the commander (CDR) sitting in the right hand pilot seat, the HEMS technical crew member (HCM)/paramedic sitting in the left hand pilot seat and the medical doctor (MD) sitting in the right hand cabin seat. The crew were the only occupants on board.

Prior to the serious incident flight

Earlier that day, the crew had conducted several flights, encompassing a night mission around midnight, a morning mission and several missions in conjunction starting approximately at noon.

At around 18:00 hrs, the crew had finished a mission at Odense Hospital (EKOH) and was ready to return to EKRS.

The flight crew (the CDR and the HCM) checked, using their tablets, the actual and forecasted weather for the Zealand area (EKRS, Roskilde (EKRK) and Copenhagen (EKCH)). The CDR noted that the weather would deteriorate later during the evening, but it would not affect their flight to EKRS.

As their active duty time would exceed 14 hours upon “check-out” in EKRS, they called in for a stand-by crew to take over the duty watch in EKRS.

While en route between EKOH and Slagelse, the medical emergency services contacted the crew and asked if they could respond to a medical emergency in the outskirts of Slagelse.

The crew accepted the mission, landed at 18:27 hrs at an industrial site in Slagelse, and attended the medical emergency.

After approximately 30 minutes, the medical emergency ended, and the crew started planning their return flight to EKRS.

The pre-flight planning

The flight crew checked the latest weather observations for EKRS, EKRK and EKCH on the NorthAviMet Observations page “Visibility/Ceiling”. The symbol representing EKRS showed a grey square, which the flight crew interpreted as no weather observation information was available for EKRS.

Due to fog and reduced visibility, the CDR was aware that the weather conditions at EKRK were below VFR minima.

The latest picture available from HEMS Weather (Wx) (an on-location camera in EKRS), *showed misty conditions, but as it was dark, it was extremely difficult to assess local weather conditions.*

As the flight crew assessed the weather conditions at Slagelse to be *sky clear and with visible stars*, and because the flight time to EKRS was only approximately 10 minutes, the flight crew decided to depart for EKRS in order to assess, if it was possible to land under VMC.

If the weather conditions proved to be below VFR landing minima, they intended to return to the lighted helipad at EKSE under VFR flight conditions or convert to Instrument Flight

Rules (IFR) and proceed to an aerodrome with weather conditions allowing landing according to IFR landing minima.

The serious incident flight

The flight crew used NVG during the departure from Slagelse, and the helicopter climbed to 1200 feet (ft) above mean sea level (amsl) towards EKRS.

The flight crew went "NVG Off" (swung their helmet mounted NVG upwards to allow unaided vision), contacted Copenhagen Information, and requested alerting service for the flight to EKRS.

En route to EKRS, the crew observed sporadic fog and fog patches close to the ground towards the south, while weather conditions *were clear towards the north.*

The HCM went "NVG On" approximately 10 nautical miles (nm) from EKRS.

When the helicopter passed south of Ringsted city, halos and glare started developing around lights from cars and buildings. The flight crew noticed increasing ground fog but were fully capable of seeing through the fog and clearly identifying cars, lights, roads and buildings. They felt *by no means uncomfortable with the weather conditions*.

The flight crew informed Copenhagen Information that they set up for landing in EKRS, and terminated the need for alerting service.

The helicopter approached EKRS from the west, and the flight crew activated the runway and the helipad lights by means of the aerodrome radio frequency.

As a part of the pre-landing check, the CDR performed a landing briefing. The landing briefing did not include any go-around criteria. It was the intention of the CDR to perform a *shallow approach to obtain good references and to be able to see obstacles ahead instead of from above*. This should lead to a vertical take-off and landing (VTOL) final let-down to the helipad with a landing decision point (LDP) at 120 ft radio height (RH).

The radio height bug (audio alert) was set to 180 ft.

The HCM set his moving map display to full screen size and selected the largest scale possible for optimum position reference.

Established on a left hand downwind for runway 23, with a ground speed (GS) of 75 knots (kt) and at an altitude of approximately 600 ft above ground level (agl), the flight crew saw unaided and *below the NVG* the aerodrome buildings, the hangars, the rotating beacon, the runway lights, the helipad lights, and the company base buildings with flashing beacon.

The perceived ground fog did not pose a risk for the flight crew concerning a VFR landing, because flight visibility was good and all runway lights, runway surroundings and the main road (Haslevvej) crossing the final approach track were visible through the ground fog.

The HCM called out *500* (ft RH), *400* and *300* with corresponding airspeeds, while the helicopter crossed Haslevvej, and turned onto a left hand base with a GS of 45 kt.

During this period, the CDR went "NVG On" *and everything was perfectly clear in the NVG*.

The helicopter continued on left base and onto a 35° offset final.

The helicopter flight path – see appendix 5.1.

The ground below consisted of ploughed farm fields with short crops and a small group of trees of a height of no more than 50 ft.

The flight crew still *had fine references* and saw all runway lights, beacons, lights from cars on Haslevvej and the helipad (below the NVG). The visibility started decreasing, but compared to previous experiences, it was not unusual, and the flight crew still felt comfortable with the situation.

In their field of view below the NVG, both flight crew members saw the small group of trees, contours on the ground, and on-ground fog patches below the helicopter.

At 19:38:41 hrs, at a height of 150-200 ft agl and with a GS of 15-20 kt, the CDR aligned the helicopter with the extended centerline. The CDR continued forward, while slowly reducing forward airspeed by lifting the nose of the helicopter.

In succession, starting shortly before or about this time, the callouts *200* (HCM), *Decision height* (auto-generated) and *100* (auto-generated) likely occurred.

Most likely, at or shortly after 19:38:53 hrs, *suddenly and without warning*, the CDR saw only bright light within his NVG.

The CDR was startled, but noticed a RH indication of 50 ft on his Primary Flight Display (PFD) and tried to obtain outside visual references by looking below the NVG, but saw only darkness.

The CDR initiated a go-around and almost simultaneously, approximately 134 meter (m) northeast of Haslevvej, the helicopter in an upright position impacted a farm field.

Twice, both flight crew members heard the aural indication for max power as the helicopter immediately resumed flight, and the HCM started calling out airspeeds and altitudes.

As soon as the airspeed increased, the CDR regained normal visual references through his NVG (*the NVG opened up again*) and the helicopter overflew the runway while climbing to approximately 500 ft agl.

While flying a circuit for runway 23, the flight crew analysed that the helicopter, apart from a small change in vibrations, seemed to be and felt undamaged.

Initially, the flight crew thought that they had impacted within, or very close to the aerodrome area, because they perceived the position of the helicopter to be *just before* Haslevvej, when they lost NVG vision.

Then and much to their surprise, the flight crew realized that the helicopter had been further away from the helipad and that the impact took place in the ploughed farm field.

The flight crew decided to abort the landing to runway 23 and diverted to EKSE without any further occurrences.

1.2 Injuries to persons

Injuries	*Crew*	*Passengers*	*Others*
Fatal			
Serious			
None	3		

1.3 Damage to aircraft

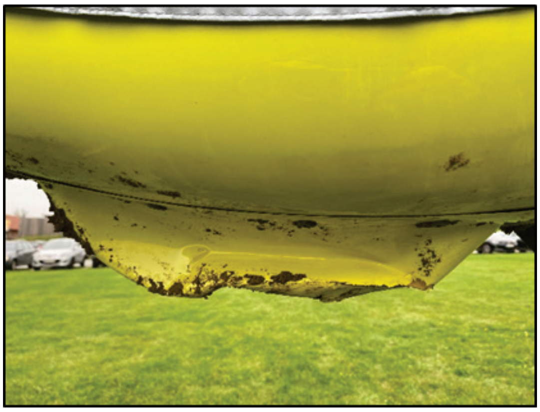
The helicopter sustained damage to the tail bumper and the landing skid.

Due to the impact, the aft crossbeam on the landing skid bent approximately three centimetres (cm).

According to the helicopter manufacturer, a vertical touchdown speed of 200 - 500 ft/minute (min) would result in plastic deformation of the cross tubes but no damages to the fuselage.

A momentary high engine power output caused a main gearbox (MGB) overtorque situation. The operator replaced the MGB.

Picture no. 1 – Damaged tail bumper



Picture no. 2 – Damaged tail bumper

Picture no. 3 – Removed damaged aft crossbeam compared to new installed.
The square black rubber plates mounted on the lower aft part of each skid are known as bearpaws.

1.4 Other damage

None.

1.5 Personal information

1.5.1 The Commander

1.5.1.1 License and medical certificate

The CDR – male, 49 years – was the holder of a valid EASA Airline Transport Pilot License Helicopter (ATPL(H)) issued by the DTCA on 21-3-2017.

The rating EC135/635/IR SP was valid until 31-3-2021.

The medical certificate (class 1) was valid until 1-12-2020. The medical certificate held the limitation VNL (Correction for defective near vision).

The CDR did neither wear corrective lenses during normal flight operation nor when using NVG.

1.5.1.2 Flying experience

	Last 24 hours	Last 90 days	Total
All types	7	89	13,170
This type	7	89	1,728
Total landings	20		27,325
Total landings - night	10		3,975
NVG	4		320

1.5.1.3 Operator training

- On 1-10-2015, the CDR completed the operator Night Vision Imaging System (NVIS) ground training course.
- On 11-10-2015, the CDR completed the operator NVIS flight training course.
- On 4-9-2020, the CDR performed his latest EC135/635 Operator Proficiency Check (OPC).
- On 4-9-2020, the CDR performed his latest NVIS OPC.

Since 2015, the operator had employed the CDR

1.5.1.4 Flight and duty time

Five days before the serious incident flight, the CDR started his duty period.

1.5.2 The Helicopter Technical Crew Member

1.5.2.1 License and medical certificate

The HCM – male, 41 years – did not hold a helicopter pilot license.

According to operator requirements, the HCM had upon initial employment completed:

- The theoretical part of the Private Pilot License Helicopter (PPL(H)).
- The technical part of the type rating course for the EC135/635 helicopter.
- An equivalent number of simulator sessions as required for the type rating course for the EC 135/635, typically 5 sessions/9 hours.

The HCM held a Danish flight radiotelephone operator certificate (N-BEG).

The medical certificate (class 2) was valid until 18-9-2021.

1.5.2.2 Flying experience

	Last 24 hours	Last 90 days	Total
All types	7	79	1,766
This type	7	79	1,766
Total landings	20		4,500
Total landings - night	10		900
NVG	4		290

In addition to the above, the HCM had approximately 400 unrecorded flight hours from a previous employment.

1.5.2.3 Operator training

- On 25-3-2015, the HCM completed the operator NVIS ground training course.
- On 25-3-2015, the HCM completed the operator NVIS flight training course.
- On 4-9-2020, the HCM performed his latest EC135/635 HCM Proficiency Check (HPC).
- On 4-9-2020, the HCM performed his latest NVIS HPC.

Since 2014, the operator had employed the HCM

1.5.2.4 Flight and duty time

The HCM started his duty period on the day before the serious incident flight.

1.6 Aircraft information

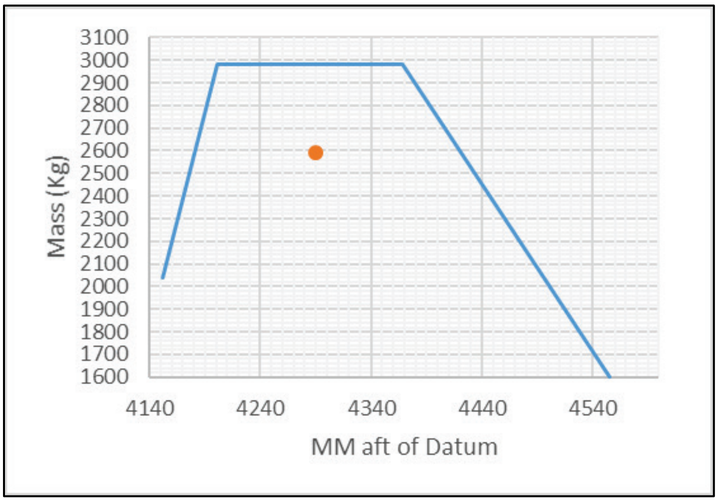
1.6.1 General information

Manufacturer:	Airbus Helicopters Deutschland GmbH
Type:	EC135 P3
Serial number:	1170
Airworthiness review certificate:	Valid until 13-7-2021
Engine manufacturer:	Pratt & Whitney Canada
Engine type:	2 x PW 206B3
Maximum take-off mass (MTOM):	2,980 kilogram (kg)
Maximum landing mass (MLM):	2,980 kg
Fuel on board (TO/LA):	460/410 kg
Endurance at T/O:	2:20 hours at normal cruise speed
Aircraft total flight hours:	4,975

1.6.2 Mass and balance

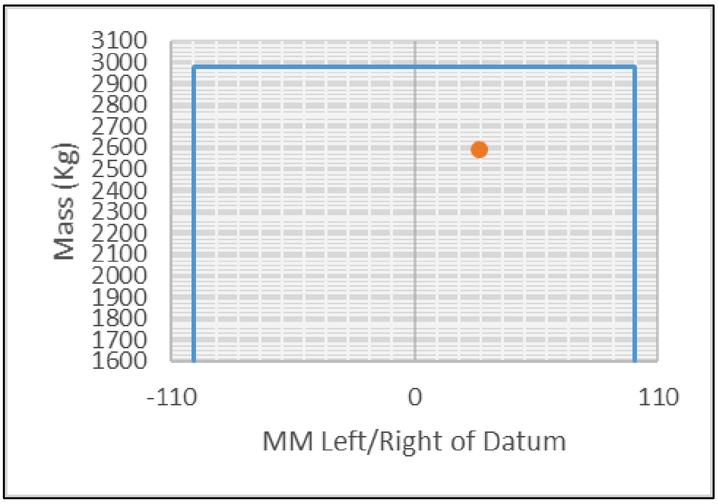
The AIB performed, after the serious incident, a mass and balance calculation.

Longitudinal:	Mass *(kg)*	Arm *(mm)*	Moment *(kgmm)*
Empty mass:	1,928.29	4,478.41	8,635,664.87
Pilot:	82.00	2,412.00	197,784.00
HCM:	74.00	2,412.00	178,488.00
MD:	95.00	4,015.00	381,425.00
Fuel:	410.00	4,180.00	1,713,800.00
Total mass, arm and moment at the time of the serious incident:	2,589.29	4,289.66	11,107,161.87



Picture no. 4 - Longitudinal mass and balance.

Lateral:	Mass (kg)	Arm (mm)	Moment (kgmm)
Empty mass:	1,928.29	22.09	42,600.00
Pilot:	82.00	390.00	31,980.00
HCM:	74.00	-390.00	-28,860.00
MD:	95.00	338.00	32,110.00
Fuel:	410.00	-4.00	-1,640.00
Total mass, arm and moment at the time of the serious incident:	2,589.29	29.43	76,190.00



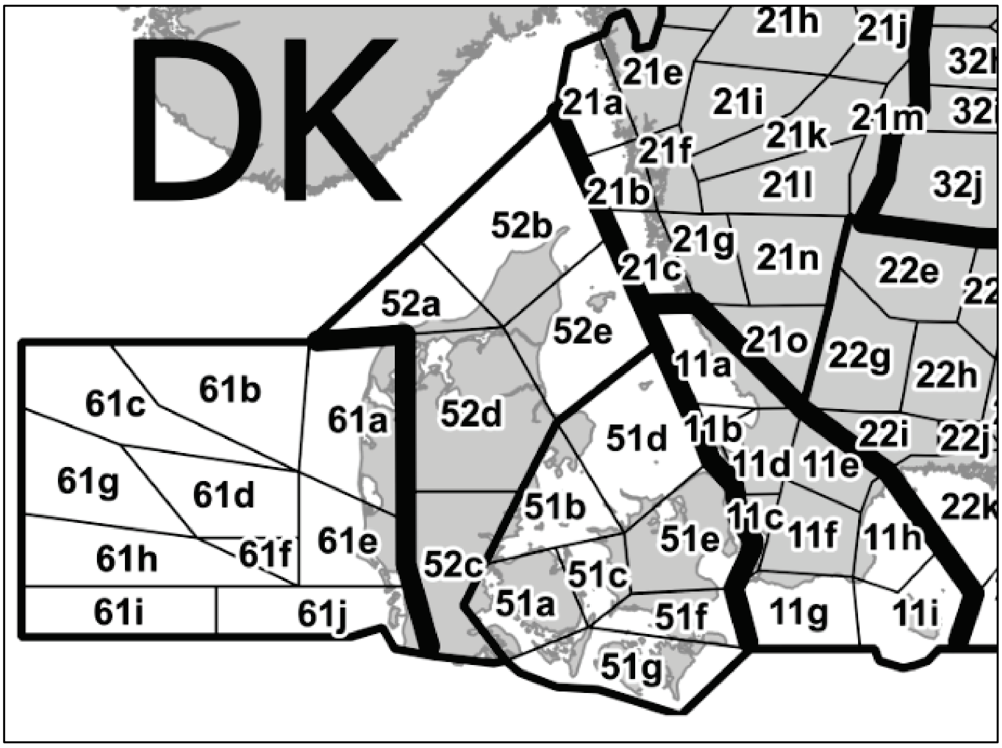
Picture no. 5 - Lateral mass and balance

1.7 Meteorological information

1.7.1 Overview (Low Level Forecast (LLF))

LLF issued on 6-11-2020 at 13:06 hrs, valid between 13:00 hrs and 21:00 hrs.

EKRS was located in area "dk51e", and Slagelse By and EKSE were located on the border between area "dk51e" and "dk51c" (confer chart below).



Picture no. 6 - Dividing of areas for LLF in Denmark

General:	Westerly flow of warm and moist air.
Visibility/Weather/Clouds:	17:00-19:00 hrs: Area dk51e, dk51f: Visibility 1.5 km - >8 km in mist. Cloud base 500 ft - >4000 ft. Area dk51c: Visibility >8 km, locally 1.5 km – 3 km in mist. Cloud base >4000 ft, locally 500 ft – 1000 ft. 19:00-21:00 hrs: Area dk51e, dk51f, dk51c: Visibility <0.8km - >8km in mist, fog. Cloud base <500 ft - >4000 ft.
Surface wind:	Area dk51e: SW-W/2-10 kt. Area dk51c: SW-W/3-8 kt.
Average wind and temperature within the area 2000 ft:	17:00-19:00 hrs: 310/11kt +11° Celcius (C). 19:00-21:00 hrs: 280/8kt +11° C.

NorthAviMet visual presentation of forecasted visibility, cloud base/ceiling and weather valid between 15:00 hrs and 21:00 hrs in two-hour increments – see appendix 5.2.

1.7.2 Terminal Aerodrome Forecast (TAF)

TAF AMD	ekrk	061625z 0615/0624 30012kt 9999 sct008 tempo 0615/0618 3000 br bkn008 becmg 0618/0621 3000 br tempo 0621/0624 0300 fg vv001=
TAF	ekrk	061724z 0618/0703 26004kt 9999 few008 becmg 0618/0620 0100 fg vv001 tempo 0620/0703 2000 br bkn003=
TAF	ekch	061706z 0618/0718 24006kt 9999 sct008 tempo 0621/0624 2500 br bkn006 becmg 0700/0702 0100 fg vv001 tempo 0702/0709 1200 br bkn004 becmg 0709/0711 5000 nsw bkn012 becmg 0711/0714 sct015=
TAF AMD	ekch	061838z 0618/0718 24006kt 9999 sct008 becmg 0618/0620 3000 br becmg 0620/0622 0100 fg vv001 tempo 0622/0709 1800 br bkn004 becmg 0709/0711 5000 nsw bkn012 becmg 0711/0714 sct015=

1.7.3 Aviation Routine Weather Report (METAR)

METAR	ekrs	061750z auto 21000kt //// // ncd 08/08 q1030=
METAR	ekrs	061820z auto 22000kt //// // few001/// 08/08 q1030=
METAR	ekrs	061850z auto 23001kt //// // vv000 08/08 q1030=
METAR	ekrs	061920z auto 25000kt //// // vv000 08/08 q1030=
METAR	ekrs	061950z auto 23001kt //// // vv001 07/07 q1030=
METAR	ekrk	061720z auto 26003kt 6000 br few008/// 09/09 q1030=
METAR	ekrk	061750z auto 25002kt 1300 r11/p1500n r29/p1500u bcfg ncd 08/08 q1030=
METAR	ekrk	061820z auto 23002kt 0200 r11/1000n r29/0700d fg few012/// 08/07 q1030=
METAR	ekrk	061850z auto 21003kt 0350 r11/1300n r29/1300u fg sct012/// 08/08 q1030=
METAR	ekrk	061920z auto 25001kt 0300 r11/1100u r29/0900u fg vv008 08/08 q1030=
METAR	ekch	061820z 24005kt 9999 few008 09/08 q1030 becmg 2500 br=
METAR	ekch	061850z 23005kt 9000 mifg skc 08/08 q1030 becmg 2500 br=
METAR	ekch	061920z 23004kt 7000 mifg skc 09/09 q1030 becmg 2500 br=
METAR COR	ekch	061920z 23004kt 7000 r22l/p1500u r04l/0750d r12/p1500n bcfg skc 08/08 q1030 tempo 0300 fg=
METAR	ekch	061950z 22003kt 4000 r22l/0700u r04l/0900n r12/p1500n bcfg br skc 08/08 q1030 tempo 0300 fg=
METAR	ekch	062020z 23003kt 4000 r22l/0750u r04l/0800d r12/0800n bcfg br skc 08/08 q1030 tempo 0300 fg=

Remarks from Danish Meteorological Institute (DMI):

The visibility measuring sensor and the present weather sensor at EKRS have apparently been out of service, hence the many "//// //" and thus no visibility and weather data for EKRS.

TAFs were not issued for EKRS.

No METARs from EKOD after 15:50 hrs and hence no TAF.

All METARs issued for EKRS up to at least 48 hours prior to the serious incident consistently lacked visibility and present weather data.

1.7.4 Significant weather charts (SIGWX)

SIGWX valid on 6-11-2020 at 18:00 hrs (original and amended version) – see appendix 5.3.

1.7.5 Satellite images

Satellite images, 6-11-2020 at 16:44 hrs and 19:42 hrs – see appendix 5.4.

1.7.6 Aftercast valid for EKRS and Slagelse area

DMI aftercast for EKRS and the area between Slagelse and EKRS on 6-11-2020 between 19:00 hrs and 19:40 hrs.

General:	Ridge of high pressure and a weak westerly flow of warm and moist air over Denmark. A widespread cloud cover of overcast stratus clouds (base 300-800 ft) covered Zealand most of the day, but during the late afternoon this cloud cover cleared away in a west-to-eastwards motion, leaving clear sky conditions over most of Zealand by approximately 17:00 hrs (see appendix 5.4). However, the clearing of the clouds combined with the moist airmass led to the formation of widespread radiation fog rather soon after the clearing. By 19:00 hrs, fog had formed in most places all over Zealand. Being typical of radiation fog, the fog formed from the surface and gradually grew upwards. I.e. it probably started being only a few meters thick, but gradually the top of the fog reached higher altitudes as time passed. At DMI's autosynop observation station "Flakkebjerg" (approximately 10 km south of Slagelse), the fog began at 16:30 hrs and persisted all evening (at least until 20:00 hrs).
Weather:	Fog, most likely everywhere between Slagelse and EKRS. Locally it may have been only misty (i.e. surface visibility more than 1000 m but less than 5 km). No precipitation.
Visibility:	The surface visibility between 19:00-19:40 hrs was measured by automatic sensors as follows: Flakkebjerg (approximately 10 km south of Slagelse): 100-200 m. Tessebølle (near Herfølge): 200-500 m. Brandelev (near Næstved): 100 m.

	EKRK: 150-400 m.
	Holbæk: 200-300 m.
Clouds and icing:	Fog/stratus clouds, mainly broken/overcast base or 'Vertical Visibility' 0-200 ft. As seen on the satellite image from 19:42 hrs (see appendix 5.4), there may have locally been sky clear in some places between EKRS and Slagelse. Close to Slagelse (probably between Sorø and Slagelse) at approximately 19:40 hrs, the stratus cloud cover was a little thicker, probably with top up to around 2000 ft. No other, higher clouds above the fog/stratus layer. Note that even though EKRS autoMETAR reported VV 000-VV 001, the ground may have been visible to the pilot directly vertically below the helicopter, confer Figure-35 from World Meteorological Organization (WMO) WMO/TD-No. 1390 – see appendix 5.5.
Surface wind:	South-westerly 0-4 kt.

1.7.7 Automatic Weather Observation Station (AWOS)

The EKRS HEMS base included an AWOS, which sent weather data to several users including DMI. DMI displayed the weather data in various formats via NorthAviMet.

The owner of the HEMS base and the AWOS was Danish Regions (Danske Regioner).

The operator rented the HEMS building from Danish Regions, hence the operator had the daily operation of the building.

The daily operation of the base was described in the Base manual (Base handbook), which had been prepared in co-operation between Danish Regions and the operator.

Danish Regions had subcontracted the installation, calibration and inspections of the AWOS to a private weather data system supplier.

There was not installed any alerting system to warn Danish Regions, the weather data system supplier or the HEMS crew in case of partial or complete failure of the AWOS. This had resulted in some instances, where no, partial or invalid weather data was sent from the AWOS.

Likewise, DMI did not possess an alerting system, if received weather data from the AWOS was incomplete or invalid, or if received and valid weather data failed to be presented via NorthAviMet. Again, this had resulted in some instances, where no or partial weather data was presented.

The HEMS crew could report an observed AWOS failure to the weather data system supplier (24/7 service by telephone) and inform the base management via the operator's internal IT system.

The Base Manual did not describe if or when the on-duty HEMS crew should inspect the AWOS for correct operation/data transfer.

1.7.8 NorthAviMet Observations page

Before the flight, the flight crew checked the latest weather observations for EKRS, EKRK and EKCH using the NorthAviMet Observations pages.

On the selected Observations page "Ceiling/Visibility", ceiling and visibility conditions at aerodromes were displayed by different symbols and colour codes, according to five defined categories.

At that time, the symbol presenting EKRS showed a grey square, which the flight crew interpreted as no weather information was available. The flight crew was not aware that if a grey square was tapped, available data for the location would be presented, alongside with slashed lines representing missing data.

An example of the selected Observations page (not representing the time of the serious incident) and a tapped/mouse clicked grey square – see appendix 5.6.

1.7.9 HEMS Wx

HEMS Wx was an on-location camera system placed at EKRS HEMS base and other operator selected landing sites. The system took pictures and presented local air pressure (QNH) to the helicopter crews. The purpose was to provide the flight crews a visual indication of the actual weather at the individual landing sites.

HEMS Wx pictures from EKRS and EKSE – see appendix 5.7.

1.7.10 UK Met Office Night Illumination Model (MONIM)

The Moon rose at 19:03 hrs as seen from 1,000 ft altitude above EKRS, and at 19:09 hrs as seen from 0 ft altitude at EKRS.

The Moon phase was 68%, i.e. 68% of the lunar disk was illuminated.

The Moon elevation above the horizon increased from 0° at 19:03/19:09 hrs to approximately 4° at 19:39 hrs.

The Moon bearing at 19:39 hrs was approximately 50°, i.e. the Moon was in the northeastern sky, hanging low over the horizon.

Three different values for the illumination level were selected:

A. Illumination level for clear sky conditions, including the cultural light due to being close to a city* (Ringsted).
B. Illumination level for clear sky conditions, not including any cultural light.
C. Illumination level for 'overcast low stratus cloud conditions', i.e. representing conditions in the fog layer (probably assuming a rather thick fog layer).

For EKRS at 1000 ft MSL the values of A, B and C were:

A. 19:00 hrs: 6.7 millilux. 20:00 hrs: 10.3 millilux.
B. 19:00 hrs: 1.7 millilux. 20:00 hrs: 5.3 millilux.
C. 19:00 hrs: 0.4 millilux. 20:00 hrs: 1.4 millilux.

For a graphical and a numerical illustration of the evolution of the illumination levels during the evening – see appendix 5.8.

*) Note. When running the UK Met Office Night Illumination Model, cultural lightning category "5" was chosen, which is "City or within 15km of a large city". If category "4" had been chosen (4 = "Town or within 30 km of a city"), the illumination levels obtained in A) would have been approximately 3 millilux lower.

1.8 Aids to navigation

Not applicable.

1.9 Communication

The flight crew communicated with Copenhagen Information on Very High Frequency (VHF) 127.075 Megahertz (MHz) and with Ringsted Radio on VHF 123.500 MHz.

The VHF of Copenhagen Information was recorded. The AIB obtained the recording, which was useful to the safety investigation.

On VHF 118.000 MHz, EKRS AWOS broadcasted the latest observations (computer generated speech), when the frequency was "keyed" seven times. This was not published in the Danish VFR Flight Guide (VFG). However, the operator flight crew was aware of this functionality.

1.10 Aerodrome information

1.10.1 General information

Aerodrome Reference Point:	55 25 33.07N 011 48 24.56E
Elevation:	115 ft
Runway directions:	05 (048.9° magnetic (MAG)) / 23 (228.9° MAG)
Runway dimensions	733 m x 40 m
Runway surface:	Grass
Runway lighting:	Threshold, edge, and end. Activation of runway lighting - key mike five times within 5 seconds on VHF123.500 MHz. Light remained on for 30 minutes after last keying.
Approach lighting:	None
Visual approach path indicator:	None
Helipad lighting:	Perimeter. The lights were NVG compatible, thus invisible through NVG. The circular shape of the helipad perimeter lights changes to a more oval shape (a compressed circle), as the angle from the helipad is decreased, and vice versa, and can thus be used as a rough indicator of approach angle.

1.10.2 Aerodrome charts for EKRS

Aerodrome chart from the Danish VFG – see appendix 5.9.

Heliport chart from the Danish VFG – see appendix 5.10.

1.11 Flight recorders

On board the helicopter, neither a Flight Data Recorder (FDR) nor a Cockpit Voice Recorder (CVR) was fitted or required. Other data sources were available.

From 5-9-2019, EASA required all commercially operated helicopters (including HEMS) with a MTOM of 2,250 kg or more, and first issued with an individual certificate of airworthiness on or after 5-9-2022, to carry flight recorders.

1.11.1 Avionics

None of the onboard avionic systems logged any faults related to the event.

The helicopter had two flight navigator systems installed (Global Navigation Satellite System (GNSS)/navigation/communication/Multi-Function Display (MFD)).

A separately installed moving map display received GNSS data from a third GNSS receiver, independent of the GNSS receivers installed in the flight navigator systems. The AIB obtained the recordings from the moving map display. They were of good quality and useful to the safety investigation.

1.11.2 Engines

The two helicopter engines were each fitted with a Data Collection Unit (DCU). Both engine DCUs logged an overtorque event with a peak slightly above 130 % torque for less than 0.5 second.

1.11.3 Radar

The Danish Air Navigation Service Provider (ANSP) recorded the flight by use of various radar data types. As the helicopter was fitted with an Automatic Dependent Surveillance-Broadcast (ADS-B) transponder, one of these types of data was ADS-B. The AIB obtained the radar data recordings. They were of good quality and useful to the safety investigation.

The ADS-B data contained the following information about the flight:

- Time.
- GNSS latitude and longitude position.
- GNSS height (with a resolution of 25 ft, and with reference to the world geodetic system 84 (WGS84) ellipsoidal system).
- Pressure height (with a resolution of 25 feet, and with a reference pressure of 1013 hectopascal (hPa)).
- Heading.
- GS, measured in nm/second (sec).

A data point was recorded for every two seconds. The closest ADS-B receiver station was located at EKRK. For this reason, the dataset was missing 16 seconds of data from the time when the helicopter was closest to the ground.

The data was processed and imported to Google Earth – see appendix 5.1.

1.12 Wreckage and impact information

Approximately 210 m short of the helipad/134 m north of Haslevvej and on a magnetic track of approximately 225° (impact marks), the helicopter made a CFIT– see appendix 5.11.

Picture no. 7 - The picture is seen from the opposite direction of the flight path, and shows the impact marks of the tail bumper, the right bearpaw and skid, and the left bearpaw and skid.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

There was no fire.

1.15 Survival aspects

Not applicable.

1.16 Tests and research

None.

1.17 Organisation and management

1.17.1 Operator approvals

The operator held an Air Operator Certificate (AOC) valid for Commercial Air Transport (CAT) with passengers and cargo, issued by the Civil Aviation Authority (CAA) of Norway.

The approved Operations Specifications included (in extract):

- Helicopter operations with the aid of night vision imaging systems.
- Helicopter emergency medical service operations.

The area of operation was Scandinavia and Finland.

The operator was domiciled in Norway and had conducted HEMS operations in Norway since 1977 and in Denmark since 2011.

The operator's Airbus EC135 helicopters were certified for single pilot operation, and all operator Airbus EC135 CDRs were trained for single pilot operation under VFR, IFR and at night.

HEMS flights operations were conducted confer the operator OM-A 4.1.2 (b) (in extract):

On all HEMS Flights, the minimum crew composition is one qualified and current Commander who shall operate the helicopter from the right hand pilot seat and one qualified and current HEMS Crew Member who shall assist the Commander from the left hand pilot seat during the flight.

The Danish operation comprised of four helicopter bases, each equipped with one Airbus EC135 helicopter.

The flight crew consisted of 17 pilots and 16 HCMs, who rotated between the bases at various intervals.

1.17.2 Duty and active time limitations

The maximum allowable active time for any crew member in any consecutive 24-hour duty period were 14 hours.

Active time was defined from time of alarm until minimum one hour after block-on time.

lf there were less than two hours between on-block and the time of a new alarm, the entire time period counted as active time.

The operator procedure when exceeding the active time limit was described in the OM-A 7.2.1 (in extract):

lf a HEMS, SAR, Rapid response vehicle or Air Ambulance is started within the Flight and Active time requirements, the mission can be completed back to the base providing that all crew members agree and feel physical fit.

Note:

lf the crew, after having delivered the patient at definite care level, consider their level of fatigue such that a return flight back to base is not recommended, they should terminate the mission at the nearest suitable location where proper accommodation is available.

The operator had practical procedures in place, on how to handle such an off home base flight termination. These included guarding of the helicopter, crew transportation to home base etc.

Flight crews were normally scheduled for a seven-day consecutive duty period, followed by a longer rest period. During the duty period, the crew stayed at the operator base.

1.17.3 Operator weather requirements

Confer the operator OM-A (in extract):

8.1.0 (e) Weather reports

Before commencing a flight, the Commander shall have obtained, assessed and evaluated the weather. The following tools, but not limited to, are used for weather assessment:

- *METAR and TAF for all relevant airports;*
- *IGA prognosis including freezing level;*
- *Wind and temperature aloft chart for FL050 and 100;*
- *SIG/ WX chart;*
- *Weather radar when relevant;*
- *Local weather checks when relevant;*
- *HEMS WX cameras; and*
- *Other relevant web cameras.*

8.1.4 En-route operating minima for VFR flights or VFR portions of a flight

8.1.4 (a) General

On VFR flights, the Commander shall only commence take-off when the appropriate weather reports and/or forecasts indicate that the meteorological conditions along the part of the route to be flown under VFR will, at the appropriate time, be at or above the VFR limits.

Confer the operator OM-A (in extract):

8.1.4 (e) HEMS operating minima

The weather minima for the dispatch and en-route phase of a HEMS flight are shown in the following Table. In the event that during the en-route phase the weather conditions fall below the cloud base or visibility minima shown, helicopters equipped and certified for IMC Operations may abandon the flight, return to base or convert in all respects to a flight conducted under IFR provided the flight-crew are suitably qualified.

Table 8.1.4-2

HEMS Operating Minima (Note 4) for one Pilot and HEMS Crew Member:	
DAY	
Ceiling	
500 feet and above	*Refer to OM Part A 8.1.4 (d) Note 1*
499-400 feet	*2 000 meters*
399-300 feet	*3 000 meters*
NIGHT	
1 200 feet (Note 2)	*3 000 meters (Note 3)*

Note 2: During the en-route phase, ceiling may be reduced to 1 000 feet for short periods.

Note 3: When flying unaided (Non NVG), minimum visibility shall be 5 000 meters.

Note 4: To operate according to HEMS operating minima, a functional Moving Map / Euronav or equivalent is required.

8.1.6 Interpretation of meteorological information

A flight shall not be commenced unless current meteorological reports, or a combination of current reports and forecasts, indicate that the meteorological conditions are, and will be, such as to make it possible for the flight to be conducted in accordance with XXX operator minima.

When possible, the latest meteorological information from the nearest meteorological observation point and local contacts shall be obtained.

1.17.4 Operator operating procedures

Confer the operator OM-A (in extract):

8.3.2 Navigation procedures

8.3.2 (a) (1) Navigation procedures VFR

Approach and landing

Callouts for speed and height should be used whenever it can improve safety on final approach and landing. The HEMS Crew Member should provide such call outs when the situation dictates regardless of whether the Commander has requested this or not. This includes approaches over featureless terrain, water and dark areas.

Confer the operator OM-B (in extract):

2.8 VFR Approach

The approach should be planned on being established on a straight final at minimum 500 feet height (300 ft. acceptable in pattern work at aerodrome) traffic permitting.

1.17.5 NVIS operations

In accordance with EU Regulation 965/2012 Subpart H SPA.NVIS.100, the operator was approved by the CAA of Norway for NVIS operations. The use of NVIS (NVG) did not lower the VFR weather minima (HEMS minima):

SPA.NVIS.120 NVIS operating minima

(a) Operations shall not be conducted below the VFR weather minima for the type of night operations being conducted.

The NVIS was an aid to night VFR flight operation. NVIS operating requirements, procedures, equipment and training were described in the operator OM-A, OM-B and OM-D, and in the Airbus EC135 helicopter flight manual (FLM) supplement 9.2-86 and flight manual appendix (FMA) 11.42.

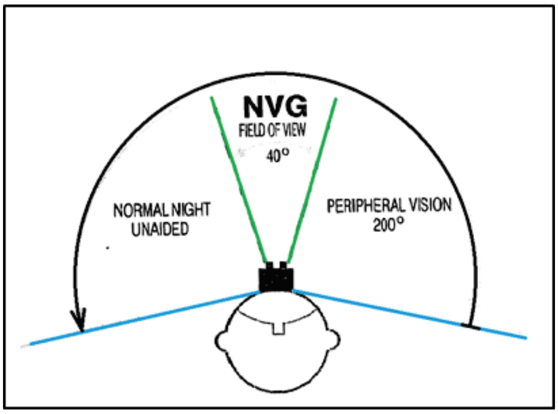
The system comprised of helicopter external and internal NVG compatible lighting, a radio altimeter and a low height warning system giving visual and audio warnings selectable by the CDR and discernable during head-up NVIS operation. The NVG was helmet mounted and included a back-up power supply.

The ITT Series F4949F was the only NVG type approved for NVIS operation at the operator. The below pictures shows a helmet with the NVG in up position (“Goggles off”) and in down position (”Goggles on”):

Picture no. 8 - NVG in position ”Goggles off”

Picture no. 9 - NVG in position ”Goggles on”

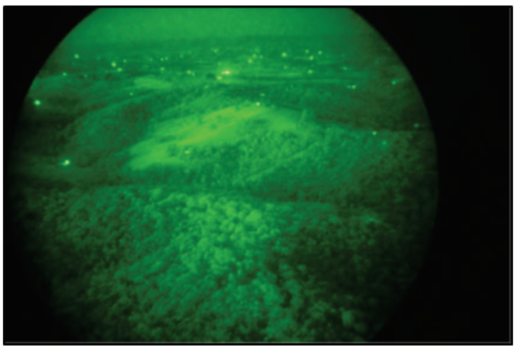
The design allowed the user to look below and around the goggles at the flight instruments and outside, also when the goggles were in the down position (“Goggles on”).



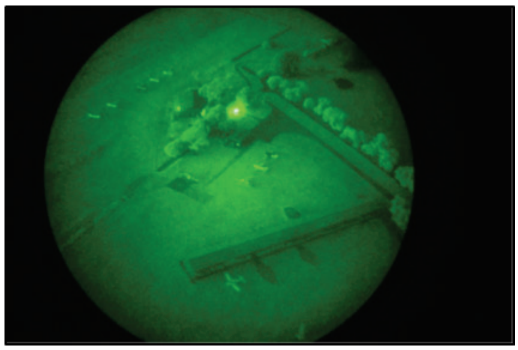
Picture no. 10 – Horizontal FOV

The nominal NVG aided Field of View (FOV) was 40 degrees horizontally and vertically, in comparison to a normal unaided FOV of around 200 degrees horizontally and 120 degrees vertically. See picture no. 10.

Below are two generic model pictures (no. 11 and 12) of typical NVG images for reference purposes.



Picture no. 11



Picture no. 12

Specific operator NVIS procedures for traffic pattern flight and approach and landing were described in the operator OM-A (in extract):

8.10.4 (g) Traffic Pattern Flight Procedure:

1. *The Commander will maintain a general ground-track that will be more oval in shape and be flown closer to the desired landing area to insure that the Commander is able to keep it in sight at all times;*

2. *The Commander will maintain airspeed to keep the traffic pattern smaller, and to assist in maintaining obstacle clearance; and*
3. *The Commander will maintain an altitude to insure proper obstacle clearance.*

8.10.4 (i) NVG Approach and Landings

1. *The Commander shall make a continuous descent and deceleration to insure an appropriate descent path to the intended point of landing;*
2. *The HEMS Crew Member shall, in addition to aiding the Commander in clearing the approach path and landing area, monitor airspeed, vertical speed, and radar altimeter instruments and make appropriate call outs on any deviations;*
3. *The Commander may terminate the approach to the ground or to a hover;*
4. *The Commander should determine the need for artificial lighting before descending below obstacles.*

"Downwind" IAS should not exceed 60 Kts. Max angle of bank is 20 degrees. Altitude, visual groundspeed and rate of closure towards the landing site is hard to estimate when utilizing NVG. The approach speed to the LDP will depend on the terrain and obstacles. It is imperative that the approach is slow enough so as to have time to observe obstacles and loose objects on the ground. As a rule of thumb, the following speeds may be used:

Table 8.10.4-1

Height	***Ground Speed***
500 Ft	*50 Kts*
400 Ft	*40 Kts*
300 Ft	*30 Kts*
200 Ft	*20 Kts*

Rate of descent shall, for the last 100 feet, be less than for day VFR approaches to avoid sudden attitude changes close to the ground.

Notice that the surrounding terrain and vegetation might reduce the contrast and the depth perception during short final.

A safe go-around heading must be announced before descending below safe obstacle clearance altitude or before passing LDP.

Go-around shall be executed if visual contact with the landing site is lost.

NVIS emergency and abnormal procedures were described in the operator OM-A (in extract):

8.10.5 NVIS specific emergency procedures

When using NVG, it is of the outmost importance to be able to identify any defects with the Equipment and execute necessary actions immediately.

The following are Emergency procedures specific for NVIS operation. Emergency checklist for type applies as normal.

The procedures must be practiced with the use of Commanders discretion, adapted to the situation.

8.10.5 (a) NVG defects

F4949F Malfunctions for:

- *Low battery;*
- *Individual tube malfunction.*

Procedure:

The affected Crew Member will immediately announce "GOGGLE FAILURE".

The Crew Member shall then switch to the second battery. If vision is not restored, the Crew Member shall flip up the goggles (stow) and continue flight in the unaided mode.

Note: NVG tube failure is infrequent and usually provides ample warning. Only occasionally will a tube fail completely in a short period of time; rarely will both tubes fail at the same time.

8.10.5 (g) Inadvertent IMC procedures

If inadvertent IMC is encountered the Commander will:

Procedure:

Level flight	*Stabilize in a wings level attitude*
Climb power	*Adjust power to climb power*
Heading	*Decide and maintain heading*
Climb speed	*Establish best rate of climb speed*
Safe Altitude	*Climb to safe altitude*
NVG's	*Stow and configure interior lighting for IFR*
Clearance	*Inform ATC and request IFR clearance*
Proceed according to IFR	

8.10.5 (h) Various NVIS aspects

- *With the help of NVG it is possible to see through thin fog or haze and through light snow with little or none depreciation;*
- *When flying in snow conditions the visibility is strongly reduced if external white- or NVIS lighting is used;*
- *If transition to IMC is performed with external white- or IR-lighting in use, be aware of the danger of spatial disorientation (vertigo). The decision to goggle off is at Commanders discretion.*

Training in the use of NVIS was conducted at initial employment with the operator.

The training course consisted of 11 hours of ground/theoretical training, and five hours of flight simulator training.

The training course included training in normal and emergency operation with NVIS, including (in extract):

- Crew resource management (CRM).
- Night vision human factors (HF) including visual illusions.
- NVG failure.

- Aircraft emergencies.
- Inadvertent IMC.
- Unusual attitude recovery.

In conjunction with the normal PC/OPC simulator training sessions, recurrent NVIS training was conducted in a helicopter flight simulator every six months,. The simulator sessions lasted six hours, of which one hour was dedicated to NVIS training.

1.17.6 VTOL Landing

The VTOL landing procedure was described in the operator OM-A, OM-B and OM-D, and in the Airbus EC135 helicopter flight manual supplement (FMS) 9.1.1.

Confer the Airbus EC135 helicopter FMS 9.1.1. (in extract):

C. VTOL (1) – SURFACE LEVEL OR ELEVATED HELIPORTS

C.1.1. DEFINITIONS

– Landing Decision Point LDP . . . . 120 ft / 20 KIAS / R/D 400 ft/min

For obstacle avoidance, the TDP/LDP can be increased up to 200 ft. Refer to C.5.2. for details.

C.4.2. SURFACE LEVEL OR ELEVATED HELIPORT – VERTICAL LANDING

Procedure

1. Prelanding check	*- Perform*
2. Baro altimeter	*- Set the accurate local QNH of the landing area*
3. Landing approach	*- Initiate 40 KIAS at 300 ft AHE*
4. Continue landing approach	*- 30 KIAS at 200 ft AHE and R/D 400 ft/min* *- 20 KIAS at LDP (120ft RAD ALT AHE or 180 ft BARO ALT) and R/D 400 ft/min*

NOTE Approach airspeeds can be increased by half of the wind speed.

After passing LDP:

5. Speed	*- Decrease slowly to arrive at a 4-ft hover above landing point*
6. Slow vertical descent	*- Initiate to touchdown*

FLIGHT MANUAL EC 135 P3 (CPDS)

AIRBUS HELICOPTERS

VTOL (1) – SURFACE LEVEL OR ELEVATED HELIPORTS

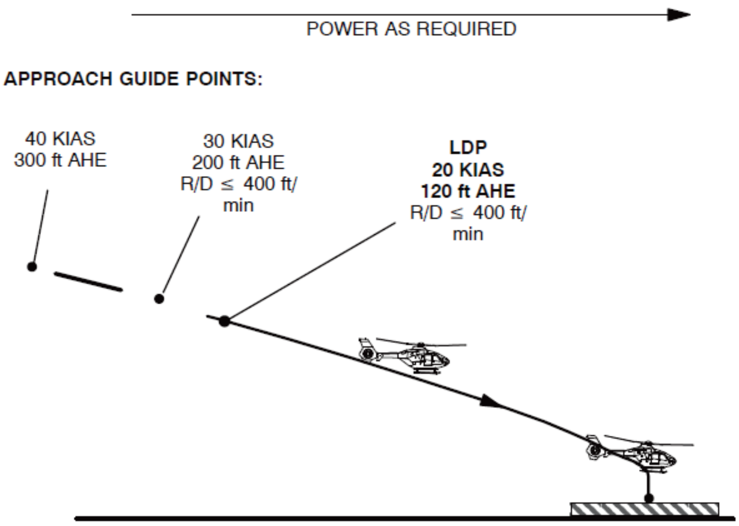


Fig. C9 Vertical Landing Profile (Surface Level or Elevated Heliport)

Picture no. 10 - Vertical Landing Profile (Surface Level or Elevated Heliport)

AIRBUS HELICOPTERS

FLIGHT MANUAL EC 135 P3 (CPDS)

VTOL (1) – SURFACE LEVEL OR ELEVATED HELIPORTS

Fig. C10 Heliport Sight Picture (LDP) - surface level heliport

Picture no. 11 - Heliport Sight Picture (LDP) - surface level heliport

1.18 Additional information

1.18.1 EU Regulation 965/2012

The general weather requirements for CAT (in extract):

CAT.OP.MPA.245 Meteorological conditions — all aircraft:

(c) On VFR flights, the commander shall only commence take-off when the appropriate weather reports and/or forecasts indicate that the meteorological conditions along the part of the route to be flown under VFR will, at the appropriate time, be at or above the VFR limits.

The HEMS weather requirements of the Subpart J (in extract):

SPA.HEMS.120 HEMS operating minima

(a) HEMS flights operated in performance class 1 and 2 shall comply with the weather minima in Table 1 for dispatch and en-route phase of the HEMS flight. In the event that during the en-route phase the weather conditions fall below the cloud base or visibility minima shown, helicopters certified for flights only under VMC shall abandon the flight or return to base. Helicopters equipped and certified for instrument meteorological conditions (IMC) operations may abandon the flight, return to base or convert in all respects to a flight conducted under instrument flight rules (IFR), provided the flight crew are suitably qualified.

Table 1

1 Pilot	
DAY	
Ceiling	*Visibility*
500 ft and above	*As defined by the applicable airspace VFR minima*
499-400 ft	*2 000 m*
399-300 ft	*3 000 m*
NIGHT	
Cloud base	*Visibility*
1 200 ft (**)	*3 000 m*

(**) During the en-route phase, cloud base may be reduced to 1 000 ft for short periods.

1.18.2 Flight crew fatigue

1.18.2.1 Quote by the Australian Transport Safety Bureau (ATSB)

Fatigue is a complex subject and has physical, mental and task-related elements.

Fatigue may be acute or chronic and may be due to sleep deprivation, circadian disruption or excessive activity. In relation to the lack of sleep, fatigue is often underappreciated and compared to people, who are well-rested; people who are sleep-deprived think and move slowly, make more mistakes and have memory difficulties.

1.18.2.2 Flight crew fitness-for-flight assessment

The active time for the 24 hours preceding the serious incident, would exceed 14 hours for the crew upon their "check-out" at EKRS.

The crew were aware of this, and applied on the flight from EKOH to EKRS, at around 18:10 hrs, the procedure to activate the stand-by crew for the EKRS base. At this time, the active time of the crew had not yet exceeded 14 hours.

Shortly after, the crew was asked to respond to the additional medical emergency at Slagelse, which they accepted as per company procedure.

Having attended the additional medical emergency, the active time for the crew exceeded 14 hours.

All three crew members expressed to the AIB that apart from being a bit hungry, they felt at this time fit for flight, and did not experience any fatigue.

The performed HEMS missions during the on-going duty period for the CDR, respectively the HCM, had not involved any severe or out of the ordinary traumatic experiences for the flight crew.

1.18.2.3 Flight crew performance effectiveness

In order to perform an objective post-incident analysis, the Fatigue Avoidance Scheduling Tool (FAST) software was used to determine if flight crew fatigue might have contributed to the sequence of events.

Input were:

- Duty periods (scheduled).
- Off duty periods (scheduled).
- Active periods (operator registered).
- Sleep quantity (flight crew reported).
- Sleep quality (flight crew reported).

The performance effectiveness of the CDR – see appendix 5.12.

The performance effectiveness of the HCM – see appendix 5.13.

1.18.3 Visual illusions

Science, universities, government institutions, private companies and many others have researched into the subject of visual illusions and their impact on aviation safety.

Because the subject is vast and by no means easy to quantify, the AIB has chosen to refer to only certain visual illusions and possible NVG limitations of special interest to this safety investigation.

- *Visual illusions*

The visual system can also suffer from misinterpretation. Given that the visual system is the dominant system for normal orientation, a visual illusion can be very powerful. Visual illusions can occur even in perfect weather, and in many cases the illusions that occur depend on expectations of what the pilot "should" be seeing.

- *The black hole approach*

The black hole approach has resulted in several accidents over the years. As the name suggests, it involves an approach to land at night where there is nothing to see between the aircraft and the intended runway – there is just a visual "black hole" before the runway. The absence of peripheral visual cues, especially below the aircraft, can give an illusion of height, and result in the pilot inadvertently flying lower than necessary. This can result in landing short of the runway or impacting terrain below the glideslope if the illusion is not

recognised and corrected quickly.
Pilots need to monitor the aircraft attitude closely, and maintain an effective instrument scan to ensure that speed, distance and altitude information is consistent with a normal approach. The pilot can be trapped into keeping a constant visual angle with the runway during the approach. This tends to result in a curving approach, marked by an initially steep descent, which then progressively flattens out into a much lower than normal approach.

- *Height perception illusion*

Flight over featureless terrain can give a pilot few visual cues as to their height above ground level. This can give an illusion of lack of movement, since the normal passage of visual details is missing. It can also give the pilot a false sense of their height above ground. Controlled flight into terrain may result from such a misperception of height.

Source: The ATSB Aviation Research and Analysis Report – B2007/0063. *An overview of spatial disorientation as a factor in aviation accidents and incidents.*

NVG adds an additional factor to consider, *as visual and cognitive performance can be affected (visual acuity and contrast sensitivity, stereopsis and depth perception, distance and size estimation, spatial orientation and situation awareness).*

- *Environmental Factors*

Weather. Similar to changes in available illumination from dusk to night to dawn, different weather conditions, such as fog, light clouds, rain, or snow, result in different requirements from NVGs to achieve an adequate luminance level. Clouds act as a filter to the natural night sky illumination, and the extent of its impact on light availability depends on the amount of cloud coverage and the overall density and/or thickness of the clouds. Less ambient illumination is available with thicker clouds or increased overcast. The effect of fog on NVGs is similar to that of clouds.

Another factor that can influence an NVG image is the terrain texture and its reflective characteristics (Sampson et al., 1994). For example, ploughed fields tend to have a rough surface, resulting in very little light reflected, and thus appear dark in the NVG image.

- *Distance estimation*

Erroneous distance estimation has been identified by aircrew members as a serious problem and a factor in some rotary-wing accidents (Johnson, 2004b).

- *Peripheral vision*

Peripheral vision provides optical flow (i.e., motion parallax) cues that are important for tasks such as size and distance estimation (DeLucia & Task, 1995; Zalevski et al., 2001).

- *Spatial orientation and disorientation.*

The NVGs' narrower-than-normal field of vision (FOV) requires the user to constantly scan the peripheral scene to build and maintain an accurate visual picture. Although this scanning helps the operator to maintain awareness of the environment, it may also result in physical and mental fatigue as well as spatial disorientation.
Spatial disorientation, the loss of the ability to maintain and be aware of the body's orientation relative to the environment, is typically associated with aircraft flying but can definitely happen on the ground as well (Johnson, 2004b).
Braithwaite, Groh, and Alvarez (1997; see also Johnson, 2004b; Negrette, 1998) reviewed

the role of spatial disorientation in helicopter accidents in which NVGs were used. About a third of the reviewed accidents involving spatial disorientation were associated with the restricted FOV.

Source: *The Human Factors of Night Vision Goggles: Perceptual, Cognitive, and Physical Factors* (Parush et al., 2011).

1.18.4 Decision making - Human Factors

- *Press-on-itis*

A phenomenon that can impair a pilot's decision making process can be an unconscious desire to continue towards the destination/return to home base. This phenomenon tends to become stronger as the distance/time to the destination decreases.

This Briefing Note (BN) takes a look at how a psychological phenomenon called press-on-itis is related to incidents and accidents. Press-on-itis is simply the decision to continue to the planned destination or toward the planned goal even when significantly less risky alternatives exist. Press-on-itis is also known as "get-home-itis," "hurry syndrome," "plan continuation" and "goal fixation." No matter what it is called, press-on-itis can present a serious problem to flight safety. It is important for a pilot to understand the causes of press-on-itis and to recognize when he or she is suffering from the condition. Knowing the causes and recognizing the symptoms will allow a pilot to recover before anything goes terribly wrong.

Press-on-itis is really the result of a decision-making error that involves continuing toward the destination (objective) despite a lack of readiness of the airplane or crew and the availability of reasonable lower-risk alternatives. Press-on-itis often occurs when there is an unsuitable environment such as bad weather at the destination. The pilot may continue on despite warnings from ATC or other crew members.

Source: SKYbrary Decision-Making, Briefing Note *Operator's Guide to Human Factors in Aviation*

- *Startle Effect*

An exposure to an unexpected event may influence upon an individual's response time.

In aviation, startle effect can be defined as an uncontrollable, automatic reflex that is elicited by exposure to a sudden, intense event that violates a pilot's expectations.

Effects:

In addition to the previously listed temporary physiological changes which follow a high intensity stimulus, studies have determined that, following a startling stimulus such as a loud noise, basic motor response performance can be disrupted for as much as 3 seconds and performance of more complex motor tasks may impacted for up to 10 seconds.

The time that it takes to recover in a cognitive sense, after a startle event, must also be considered. Startle has been found to impair information processing performance on mundane tasks, such as the continuous solving of basic arithmetic problems, for 30 to 60 seconds after the event occurrence.

Source: SKYbrary Startle Effect, *Definitions* and *Effects*

1.19 Useful or effective investigation techniques

None.

2 ANALYSIS

2.1 General findings

The following revealed findings had, in the AIB's opinion, no influence on the sequence of events:

- The licenses and qualifications held by the flight crew.
- The technical status of the helicopter.
- The helicopter mass and balance.
- The technical status of the NVG.

2.2 The operational approval of the operator

The operator requirements in OM-A 8.1.4 a) General were similar to the requirements stated in the EU Regulation 965/2012, CAT.OP.MPA.245 Meteorological conditions — all aircraft, part c).

The operator requirements in OM-A Table 8.1.4-2 were similar to the requirements of the EU Regulation 965/2021 Subpart J, SPA.HEMS.120 Table 1 HEMS Operating minima, except that:

- the operator had omitted the limiting parameter cloud base from the part of the table describing night conditions,
- in Note 2, the operator limiting parameter was ceiling instead of cloud base,
- the Note 3, Non NVG visibility requirement was no longer a valid operator requirement, and should hence be disregarded.

To the AIB, the operational approval of the operator was not a causal factor. However, the wording on ceiling versus cloud base in the approved OM-A might in general have had a negative effect on flight crew decision-making processes.

The flight crew operated according to the operator OM-A.

The OM-A weather requirement of 3,000 m visibility and a ceiling of 1,200 ft (or 1,000 ft en-route for short periods), constituted the weather requirements for the flight crew.

The discrepancy between the operator OM-A and the EU Regulation 965/2012, i.e. cloud base vs. ceiling, was not a factor for dispatch as the weather according to the flight crew at the industrial site in Slagelse was *sky clear.*

En-route the flight crew observed some low fog and fog patches to the south of their track, at an unknown distance, but to the flight crew it did not pose any risk to the flight.

Since a vertical visibility measurement constituted an obscured ceiling, weather conditions in EKRS at the time of the serious incident were below operational weather requirements, whether or not ceiling or cloud base was the limiting factor.

2.3 NVIS training

Both the CDR and the HCM had completed the operator initial and recurrent NVIS training.

Even though, the NVIS training syllabus contained both theoretical and practical training in less than optimum visibility operation, and in various NVG hardware failures, the sudden NVG whiteout came as a surprise to the flight crew.

However, it is hardly possible to include all types of environmental conditions into specific training scenarios, especially when taking simulator capability and simulator NVG compatibility into consideration.

Because NVG was only intended as an aid under VMC, training in flight under inadvertent IMC should focus on maintaining helicopter control and returning to flight under VMC.

This was incorporated in the operator initial and recurrent NVIS training, and implemented in the operating procedures, providing flight crews the necessary prerequisites for safe operation.

2.4 Fatigue and decision making

The CDR had been on duty for five days prior to the event, but with only a limited active duty time. That left sufficient time for rest with just one night of uninterrupted sleep three days prior to the event.

Prior to reporting for duty the day before the event, the HCM had been off duty for more than five days.

Hence, it seems unlikely that the flight crew suffered from cumulative fatigue at the beginning of the 24-hour duty period prior to the event.

During the 24-hour period leading up to the event, the flight crew had been on active duty for more than 14 hours, which was the normal limit. According to the operator procedures, the flight crew had after an internal consultation accepted the extra HEMS mission and the subsequent flight to EKRS.

Except being a bit hungry, no crew members at the time of departure for EKRS expressed fatigue or unfitness for flight. The flight crew perceived state of fitness for flight seems realistic, considering the calculated FAST crew performance effectiveness above 90 % for both flight crew members.

Even though the flight crew reported quality and quantity of sleep during the preceding 24 hours to be less than optimum, the event occurred during a period of natural circadian high.

This most likely reduced the perceived effect of prolonged active time on the crew performance effectiveness and possibly shaded any effects of flight crew acute/transient fatigue.

However, the combined active duty period, the workload experienced during the last seven hours preceding the serious incident flight, the prevailing flight conditions and the nutritious state of the crew, all affected the level of fatigue.

To the AIB, flight crew fatigue was likely not a causal factor. However, it might have contributed to the sequence of events.

Both flight crew members individually stated that if either had felt unfit, they would have parked the helicopter at the industrial site in Slagelse, and that the operator had procedures in place to handle such an event.

To the AIB, this suggests that the operational pressure for returning to EKRS was limited, especially taking the short distance between the industrial site in Slagelse to EKRS into consideration (approximately 25 minutes driving time by car).

However, it must be acknowledged that a subconscious desire to return to the nearby home base possibly could have influenced the flight crew decision making process (get-home-itis syndrome).

Finally, it seems unlikely that the mental capacity or the decision making process of the crew were influenced by short-term traumatic experiences.

2.5 Weather conditions

2.5.1 Pre-flight planning

The flight crew left EKRS just after noon, prior to which the flight crew did a preflight briefing, which included a check of the weather conditions for the Copenhagen Flight Information Region (FIR).

Throughout the afternoon, the flight crew obtained updated weather information on their tablets, primarily using the NorthAviMet Observations pages.

Shortly before departure from EKOH at 18:00 hrs, the CDR noted that the weather for the Zealand area would deteriorate later during the evening. This occurred, like stated in the DMI aftercast, when the flight crew checked the weather again before departure from the industrial site in Slagelse at approximately 19:00 hrs.

At this time, EKRK and EKCH were below HEMS VFR weather minima, but the flight crew was unable to obtain any weather information from EKRS, apart from HEMS Wx pictures.

The flight crew description of the HEMS Wx pictures as *showed misty conditions, but as it was dark it was extremely difficult to assess local weather conditions*, indicated that the flight crew expected weather conditions close to HEMS VFR minima.

Fog and low visibility were forecasted, and actually also reported, for EKRK and slightly later for EKCH, and it is noteworthy that the deterioration came earlier than initially forecasted. However, this information apparently evaded the attention of the flight crew.

It would seem appropriate to check available METAR information from EKRS, EKRK and EKCH in addition to the information on the Observations pages. The AIB finds it probable that this could have made the flight crew realise that the actual weather conditions at EKRS were worse than initially assessed.

However, at the industrial site the flight crew observed *sky clear and with visible stars*. This was most likely a very persuasive observation that in conjunction with the short flight time of approximately 10 minutes, highly likely influenced the flight crew's decision of departing according to VFR towards EKRS.

The possibility to change to IFR status seemed a viable option given the available endurance, in case a return to the lighted helipad at EKSE proved impossible.

Whether the flight crew adhered to all aspects of the operator OM-A 8.1.0 and 8.1.4 concerning weather planning can be debated, but the flight could depart according to VFR and if needed convert to IFR.

2.5.2 AWOS EKRS

Recordings of NorthAviMet presented autoMETARs for EKRS showed that the failure had been in effect for at least two days prior to the serious incident flight.

The HEMS flight crew had not noticed this and taken corrective action, and since there was no installed alerting system, the partial fault remained.

It seems likely that the fault was related to the AWOS and not DMI.

This caused not only a partial loss of AWOS weather information (visibility and present weather conditions) to the flight crew, but also a full loss of AWOS information, because the crew were unable to access the “hidden” data on the Observations pages.

2.5.3 En-route weather

En-route towards EKRS, the flight crew observed sporadic low fog and fog patches towards the south, while the area towards the north was clear.

Approaching Ringsted city, typical phenomena associated with reduced visibility and high relative humidity, like glare and halo effect from lights, started appearing.

This might be perceived as a precursor to conditions with more widespread fog.

The visibility at 1,000 ft agl was most likely not affected, and the flight crew were able to see all surrounding terrain, buildings, cars etc. and were *by no means uncomfortable with the weather conditions*.

This might have obscured the intensity of the low fog from the flight crew, and thereby mentally blocking for the potential threat of low visibility close to the ground.

In addition, when the flight crew shortly after saw the EKRS aerodrome beacon, the runway lights, the aerodrome buildings and the helipad, the flight crew perceived it safe to initiate the left hand visual approach.

As the helicopter approached EKRS and joined the left hand downwind for runway 23, the moon was positioned directly ahead and less than five degrees above the horizon. As soon as the helicopter turned towards left base any blinding effect from the moon would have disappeared, and only the illumination effect would remain.

It is difficult to assess how much the moon contributed to the total illumination of the aerodrome and the surrounding area, but according to the flight crew, the level of light was sufficient.

2.6 Visual approach to EKRS

2.6.1 OM-A requirements and helicopter flight path

The operator OM-A 2.8 VFR Approach stated that the approach should be established on a straight final at minimum 300 ft height, while OM-A 8.10.4 (g) Traffic Pattern Flight Procedure called for a general ground-track to be more oval in shape.
Furthermore, the indicated airspeed (IAS) and the GS should be limited according table 8.10.4-1 in order to fly a smaller traffic pattern and to avoid any obstacles. Finally, flight altitude should ensure sufficient obstacle clearance.

The radar/ADS-B recordings showed an oval shaped ground-track, and one can argue that the helicopter was on final from 19:37:53 hrs, as the offset at this time to the extended centerline only was around 35°, and even less to the helipad.

As the wind was calm at the surface, and probably no more than 5 kt from the southwest at 500 ft agl, the GS and IAS of the helicopter seemed slightly higher than suggested when the helicopter was on the downwind leg and until established on the base leg. For the remaining part of the visual approach, the helicopter GS seemed to follow the suggested speed vs. height scheme.

The intention of the CDR, to perform a shallow approach until the beginning of the VTOL letdown in order to see obstacles ahead of, instead of from above, seems irrational to the AIB.

From an obstacle point of view, the flight crew were intimately familiar with the area surrounding EKRS and knew that no obstacle higher than local farms and trees would have to be taken into consideration. So in that respect, obstacle clearance was assured. Nevertheless, general (surface) obstacle clearance was decreased, lowering the margin for a vertical flight path error, and the distance to any ground fog below.

A shallow approach also seemed somewhat in contrast to the operator OM-A part 8.10.4 (g) 3 and part 8.10.4 (i) 1.

It suggests to the AIB that the flight crew did not perceive that a shallow approach might be more affected by the prevailing weather conditions compared to a steeper approach.

2.6.2 The visual approach

The helicopter joined the left hand downwind after the CDR had performed the approach briefing and the final cockpit preparations had been completed.

Flight visibility allowed the crew to see all required references unaided below the NVG, including Haslevvej. The flight crew was aware of the presence of sporadic fog or fog patches, but did not perceive this as a problem in order to perform the visual approach.

The flight altitude of approximately 600 ft agl was probably sufficient to allow the flight crew to “look down” through the fog or fog patches below. This likely gave the flight crew a false impression of better visibility conditions and less fog compared to actual conditions.

When the helicopter turned base, the flight crew saw Haslevvej and shortly after the small group of trees in the ploughed field. During this period, the CDR went “NVG On” *and everything was perfectly clear in the NVG*. The impression of sudden improved visibility could have suppressed any clues to deteriorating flight visibility at lower altitude due to intensifying fog. However, both flight crew members saw the small group of trees below their NVG, and sporadic fog patches close to the ground. This indicates that even overhead the ploughed fields, where conditions for widespread fog were likely due to radiation heat loss, fog was most likely only present in patches.

From 19:37.53 hrs and until 19:38:41 hrs, the helicopter flew the 35° off-set final. This was overhead ploughed fields with no lights and sparsely ground contours, except for the group of trees, which at some point most likely disappeared from view due to the helicopter structure. The forward vision of the flight crew was through their NVG, and peripheral cues, especially from below, was likely limited, and probably perceived as dark.

Approaching the left turn onto the last part of the final, the helicopter had an estimated GS of 15-20 kt and an estimated altitude of 150 ft agl.

Despite a slight decrease in visibility, the flight crew still *had fine references* and could see all runway lights and beacons, and below their NVG, lights from cars on Haslevvej and the helipad.

This prevented the flight crew from observing the runway lights and the helipad lights through the same “source of vision”, which seems less than optimum, as it could make any shape changes of the helipad perimeter lights harder to observe.

After the CDR had completed the final left turn, the speed vs. height of the helicopter seemed to be within the parameters for the VTOL approach, and probably quite close to the 120 ft LDP height.

As the CDR raised the nose of the helicopter to lower forward speed, it caused the position of the runway lights and helipad to move down in the flight crews field of view. This change in angle might have given an impression of being closer to the helipad, and approaching the correct position for the LDP 120 point, roughly overhead Haslevvej.

Possibly, due to the difficulties associated with depth perception when using NVG, in combination with a lack of peripheral cues, the flight crew did not realise they still were approximately 150-200 m short of the LDP position. Other visual illusions might have influenced the situational awareness of the flight crew, like the black hole effect or the height illusion effect.

It is also possible that the time spent on the off-set leg, tricked the flight crew into believing they were closer to the helipad.

Likely, due to a further speed reduction, or to a control input caused by a flight crew position awareness error, the helicopter descended into a fog patch/widespread fog, which the flight crew were unable to see from above.

The atmospheric conditions of the fog likely exceeded the operational capabilities of the NVG causing a very bright image to appear, which the CDR perceived as a whiteout.

Because the whiteout came as a complete surprise to the CDR, his reaction time was likely longer than it would have been, if he were prepared for the possibility of a whiteout. An identification of possible criteria requiring a go-around might have removed or decreased the startling effect of the CDR.

Descending through 50 ft RH, and without any outside visual references, the CDR initiated a go-around.

Due to the helicopter descent rate, the power application came too late to prevent the helicopter from impacting the farm field. However, the power application most likely reduced the descent rate and thereby the consequences of the impact.

Because the impact seemingly happened with low forward speed and in a close to upright position, the spring effect of the undercarriage assisted in getting the helicopter airborne again.

The HCM assisted with speed and altitude callouts, and the go-around seemed to be in line with the operator procedure.

The CDR regained NVG vision as soon as helicopter speed increased, which supports the AIB opinion that atmospheric conditions and not NVG technical issues caused the whiteout.

3 CONCLUSIONS

3.1 Findings

1. The licenses and qualifications held by the flight crew, the technical status of the helicopter, the helicopter mass and balance and the technical status of the NVG had no influence on the sequence of events.
2. The operational approval of the operator (OM-A HEMS Night VFR requirements: ceiling vs. cloud base) did not reflect the requirements in EU Regulation 965/2012.
3. The operator NVIS training and operational procedures seemed satisfactory.
4. The crew exceeded the normal 14 hours of active duty, which was allowed cf. the operator procedures.
5. Flight crew fatigue was likely not a causal factor. However, it might have contributed to the sequence of events.
6. The operator had procedures in place for ending flight operation at off-base locations.
7. The visibility sensor and the present weather sensor at EKRS were out of service.
8. Neither procedures nor alerting systems existed to prevent EKRS AWOS failures.
9. No alerting systems to prevent missing weather data presentation through NorthAviMet existed.
10. During the afternoon, the flight crew checked the weather conditions for the Zealand area several times including available METAR and TAF information for EKRS, EKRK and EKCH.
11. The weather check prior to the serious incident flight was performed using the NorthAviMet Observations pages, which did not include METAR and TAF information for EKRS.
12. Weather conditions at EKRK and EKCH were below HEMS VFR weather minima.
13. The flight crew could not obtain any weather information from EKRS, apart from HEMS Wx pictures.
14. If required, the flight crew could convert to IFR status.
15. En route and overhead EKRS, weather observations included shallow fog and fog patches at low altitude.
16. The flight crew did not properly identify a threat of low visibility due to fog.
17. A decision to perform a shallow approach lowered the vertical distance to any ground fog present below the approach flight path.
18. Flight crew home base experience/knowledge probably contributed to the CDR’s decision on performing a shallow approach.
19. The helipad perimeter lights at EKRS were NVG compatible and thus invisible through NVG.
20. The use of NVG most likely masked decreasing visibility during the final approach.
21. Visual illusions likely contributed to a loss of flight crew situational awareness on short final.
22. Visual illusions likely contributed to an early descent into unseen fog or fog patches on short final.
23. Fog or fog patches most likely caused a NVG whiteout below an estimated height of approximately 100 ft.
24. Startling effect delayed the initiation of a go-around.
25. The CDR was unable to obtain outside visual reference at 50 ft RH.

26. Application of go-around power did not stop the helicopter descent in time to prevent a CFIT.
27. Application of go-around power, helicopter low forward speed and helicopter attitude reduced the consequences of the impact.
28. Upon becoming airborne again, the flight crew regained control of the helicopter and outside visual references.

3.2 Factors

1. The flight crew did not properly identify a threat of low visibility due to fog.
2. A decision to perform a shallow approach lowered the vertical distance to any ground fog present below the approach flight path.
3. Visual illusions likely contributed to a loss of flight crew situational awareness on short final.
4. Fog or fog patches most likely caused a NVG whiteout at (or below) an estimated height of approximately 100 ft.
5. Startling effect delayed the initiation of a go-around.
6. Application of go-around power did not stop the helicopter descent in time to prevent a CFIT.

3.3 Summary

On short final during a night visual approach to runway 23 (helipad), the helicopter inadvertently entered IMC and impacted a field northeast of the aerodrome.

Adhering to go-around procedures, the helicopter became airborne again and diverted to EKSE without further incident.

The following causal factors led to a CFIT serious incident:

- A less than optimum pre-flight weather briefing.
- An action plan on flying a shallow approach under VFR conditions with low fog and fog patches.
- Difficulties in assessing height and depth while using NVG.
- Loss of situational awareness due to visual illusions.
- NVG whiteout at low altitude.

4 SAFETY RECOMMENDATIONS

4.1 Safety recommendations

No safety recommendations were issued.

However, the AWOS on-line status was identified as an area of safety concern.

4.2 Preventative safety measures

Following the serious incident, the operator implemented a number of preventive safety measures.

Operational approval (implemented)

- The OM-A Table 8.1.4-2 limiting parameter was changed from ceiling to cloud base.

Simulator training (implemented):

- One safety measure was additional simulator training, with a weather scenario mirroring the conditions experienced during the serious incident, and with special focus on go-around decision making and execution.
- Simulator pre-flight briefing subjects included spatial disorientation, shortcomings of NVIS in fog, and pre-planning and call-outs in relation to go-around.

Take-off and Landing Brief (in process):

- Another safety measure targeted improved crew cooperation, and identification of specific threats during take-off and landing, including mitigating actions to limit the associated risk.

5 APPENDICES

5.1 The helicopter flight path.
5.2 NorthAviMet Area forecast, valid 13:00 - 21:00 hrs.
5.3 Significant weather charts (SIGWX).
5.4 Satellite images.
5.5 Figure-35, World Meteorological Organization.
5.6 NorthAviMet Observations page.
5.7 HEMS Wx pictures EKRS.
5.8 UK Met Office Night Illumination Model.
5.9 Aerodrome chart for EKRS.
5.10 Helicopter chart for EKRS.
5.11 CFIT position.
5.12 CDR performance effectiveness.
5.13 HCM performance effectiveness.

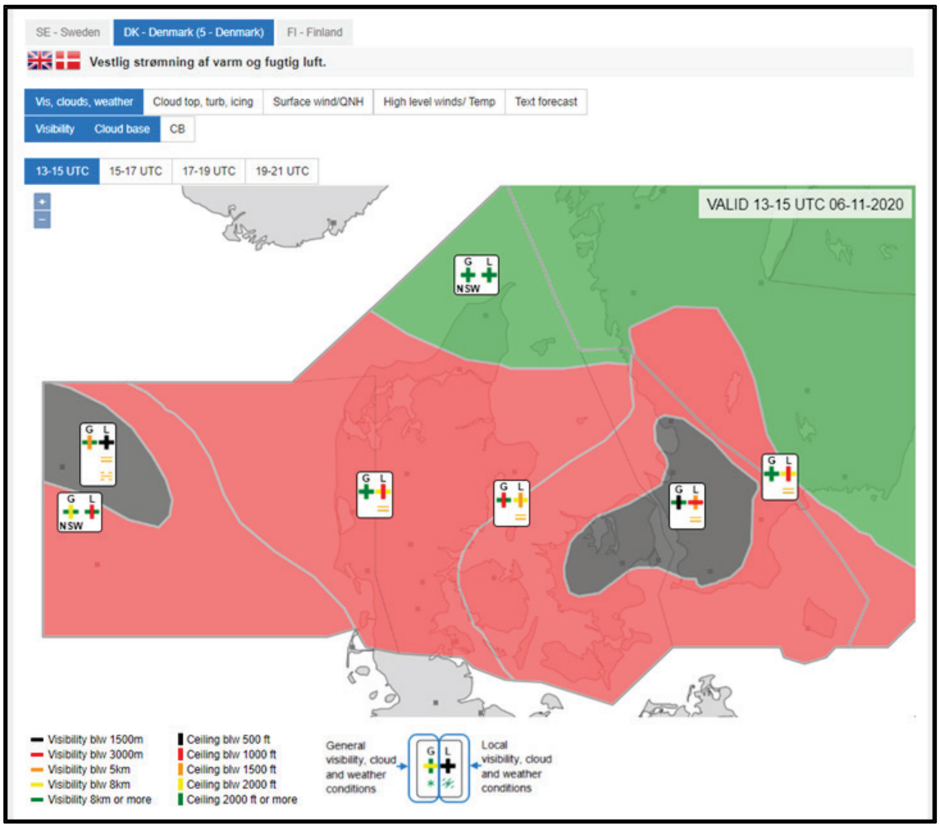
5.1 The helicopter flight path

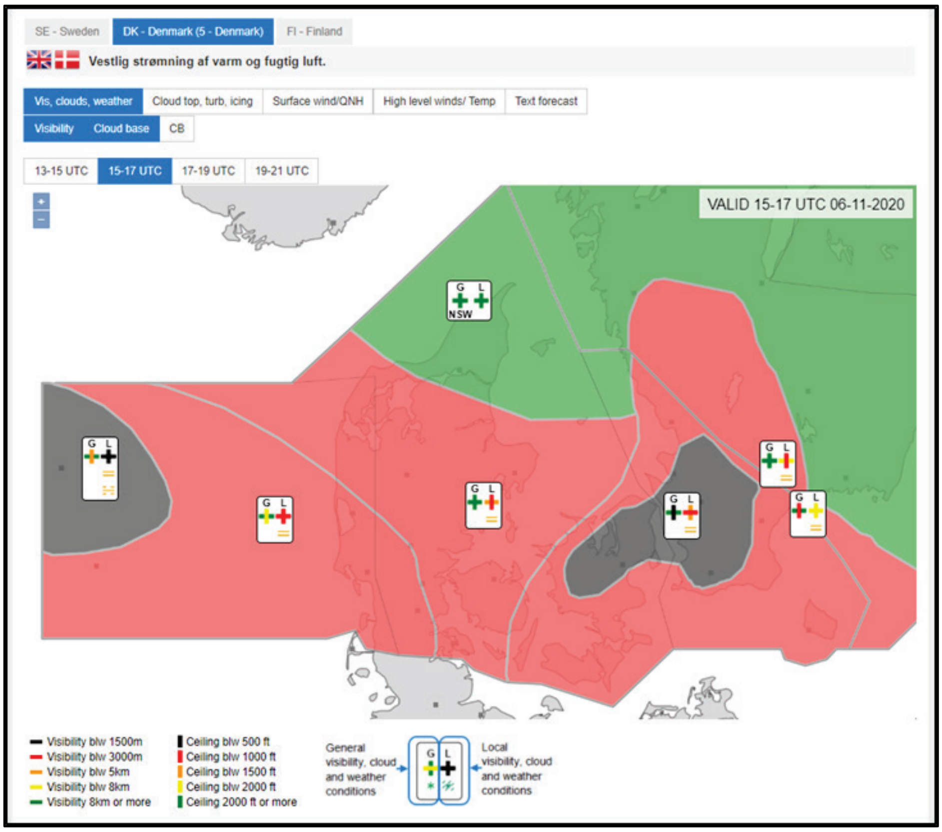
Return to history of flight Return to radar

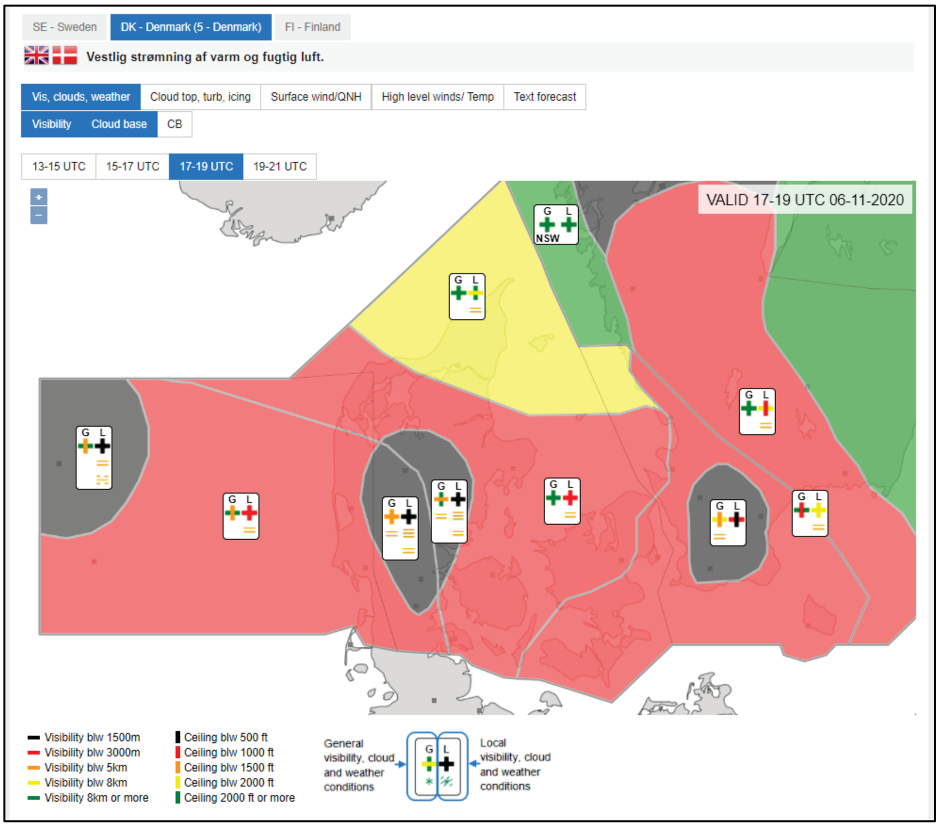
Altitudes are heights above ground level. Airspeeds are groundspeeds. Both values are approximated.

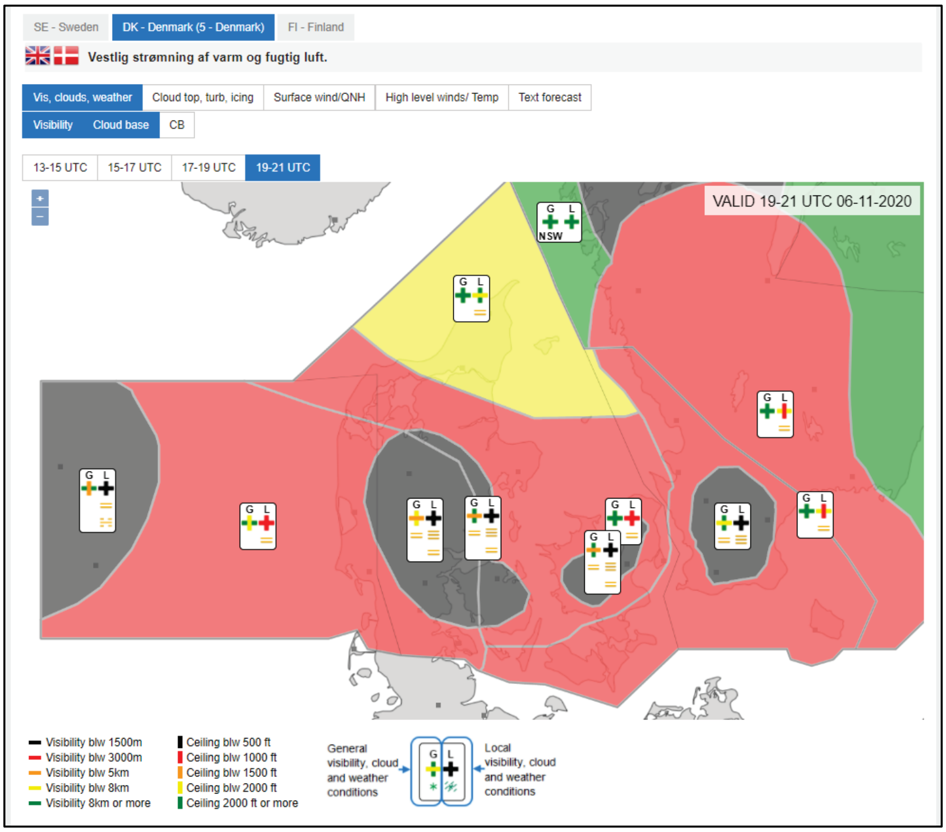
5.2 NorthAviMet Area forecast, valid 13:00 - 21:00 hrs

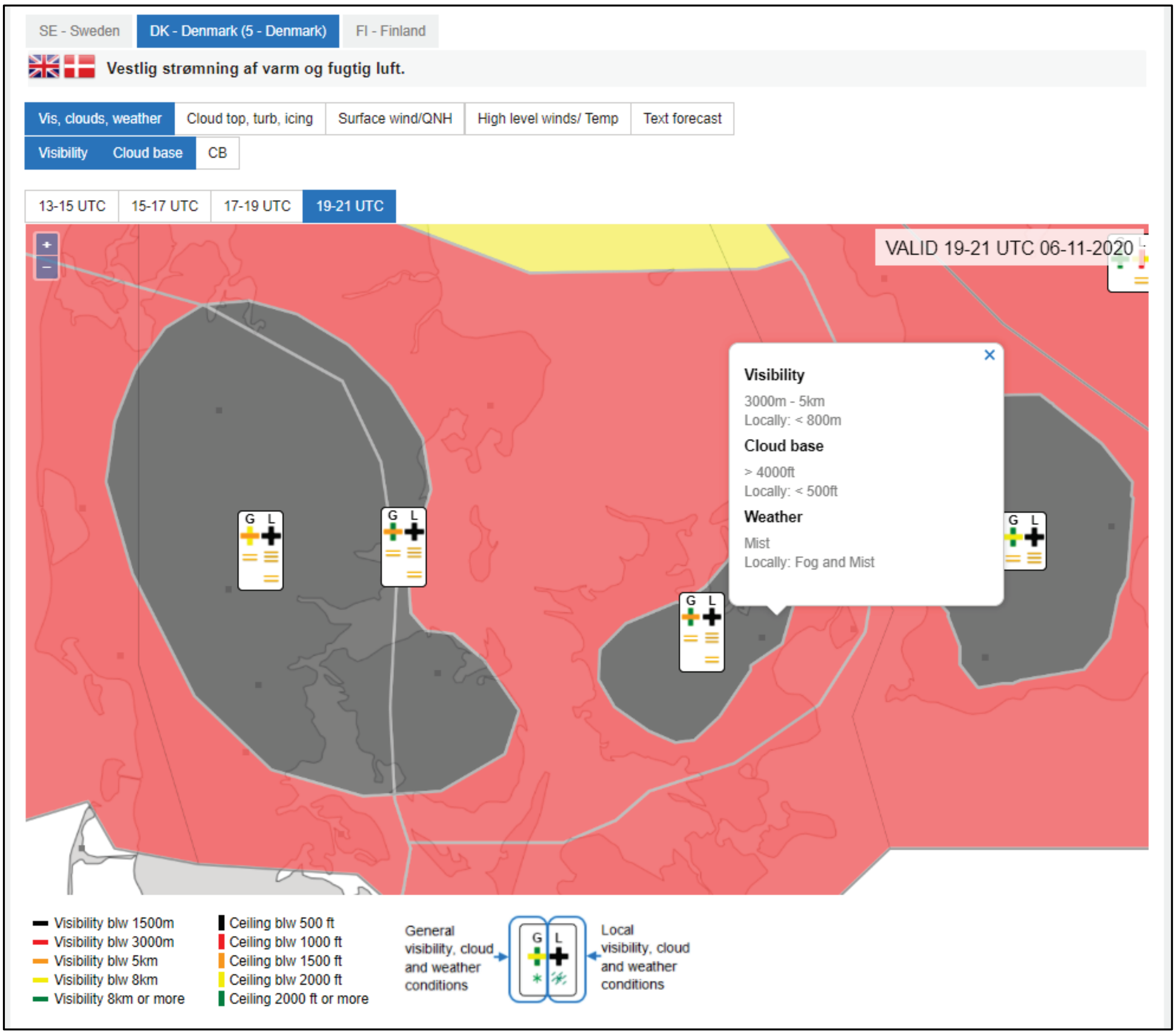
Return to overview Low Level Forecast






SE - Sweden
DK - Denmark (5 - Denmark)
FI - Finland
Vestlig strømning af varm og fugtig luft.
Vis, clouds, weather
Cloud top, turb, icing
Surface wind/QNH
High level winds/ Temp
Text forecast
Visibility
Cloud base
CB
13-15 UTC
15-17 UTC
17-19 UTC
19-21 UTC
VALID 17-19 UTC 06-11-2020
Visibility blw 1500m
Visibility blw 3000m
Visibility blw 5km
Visibility blw 8km
Visibility 8km or more
Ceiling blw 500 ft
Ceiling blw 1000 ft
Ceiling blw 1500 ft
Ceiling blw 2000 ft
Ceiling 2000 ft or more
General visibility, cloud and weather conditions
Local visibility, cloud and weather conditions


SE - Sweden
DK - Denmark (5 - Denmark)
FI - Finland
Vestlig strømning af varm og fugtig luft.
Vis, clouds, weather
Cloud top, turb, icing
Surface wind/QNH
High level winds/ Temp
Text forecast
Visibility
Cloud base
CB
13-15 UTC
15-17 UTC
17-19 UTC
19-21 UTC
VALID 19-21 UTC 06-11-2020
Visibility blw 1500m
Visibility blw 3000m
Visibility blw 5km
Visibility blw 8km
Visibility 8km or more
Ceiling blw 500 ft
Ceiling blw 1000 ft
Ceiling blw 1500 ft
Ceiling blw 2000 ft
Ceiling 2000 ft or more
General visibility, cloud and weather conditions
Local visibility, cloud and weather conditions

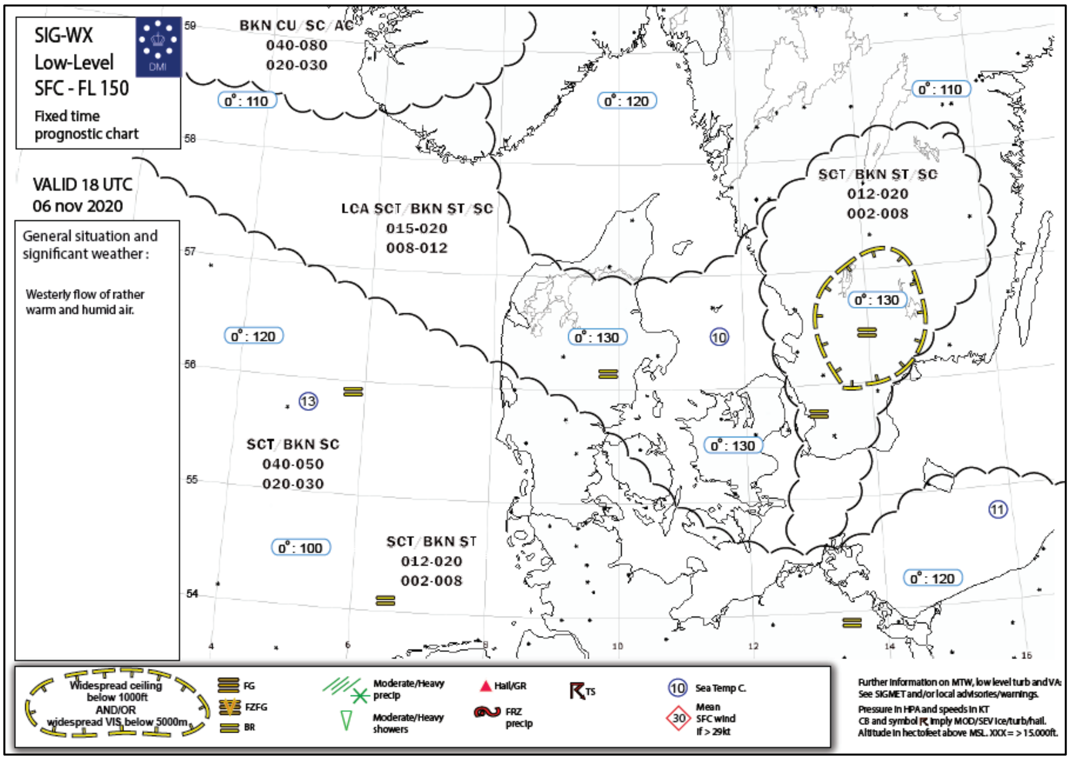


The picture shows a zoomed-in version of the 19:00 - 21:00 hrs chart.

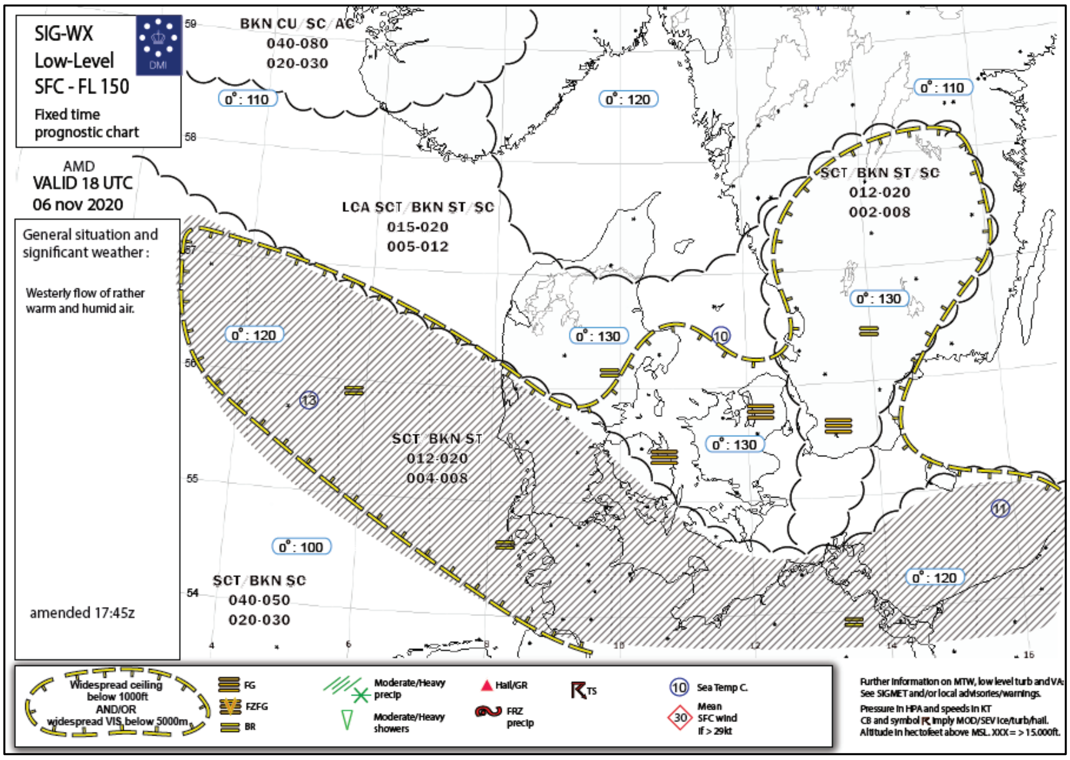
Upon mouse clicking an area, a textual decoding of the forecasted conditions within the chosen area appeared, here shown the grey coloured area encompassing EKRS, Ringsted city, EKSE and Slagelse.

5.3 Significant weather charts (SIGWX)

Return to significant weather charts



Original 18:00 hrs chart, issued about 11:40 hrs.



Amended version of the 18:00 hrs chart, issued about 17:45-17:51 hrs.

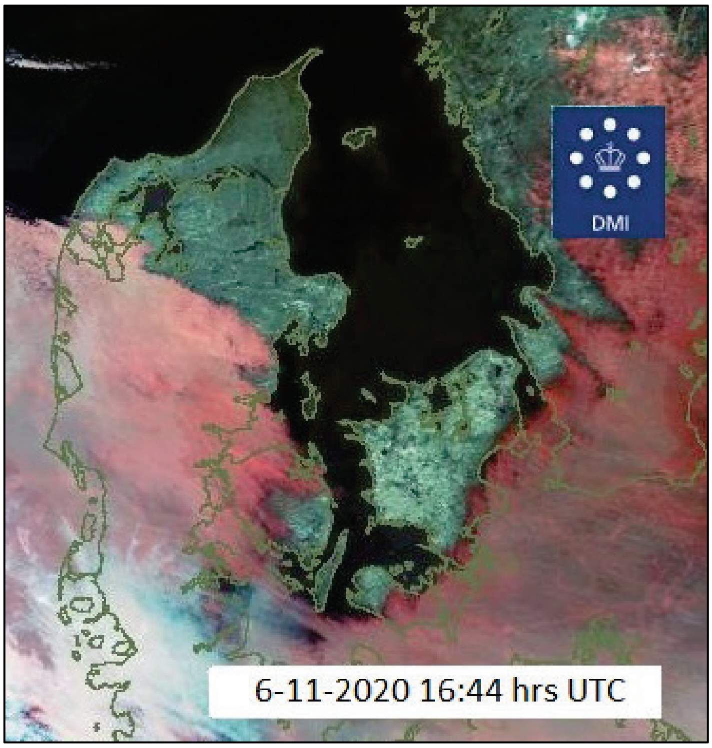
Appendices

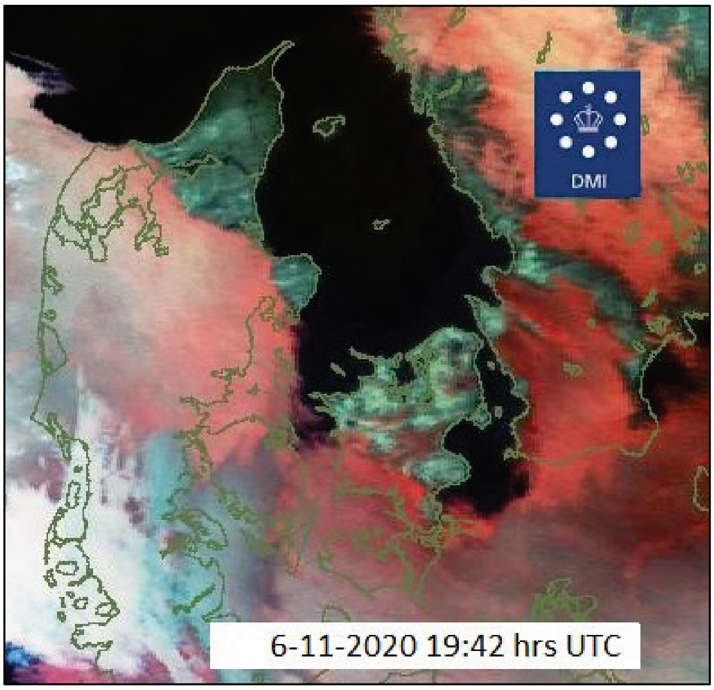
Appendices

5.4 Satellite images

Return to satellite images   Return to aftercast valid for EKRS and Slagelse area

Remark: The reddish-grey colours are stratus clouds or fog, the greenish-grey colours are cloud-free land surfaces. Low-topped fog may occur even in the greenish-grey coloured areas, since thin fog cannot necessarily be seen in satellite images





5.5 Figure-35, World Meteorological Organization

Return to aftercast valid or EKRS and Slagelse area

WORLD METEOROLOGICAL ORGANIZATION

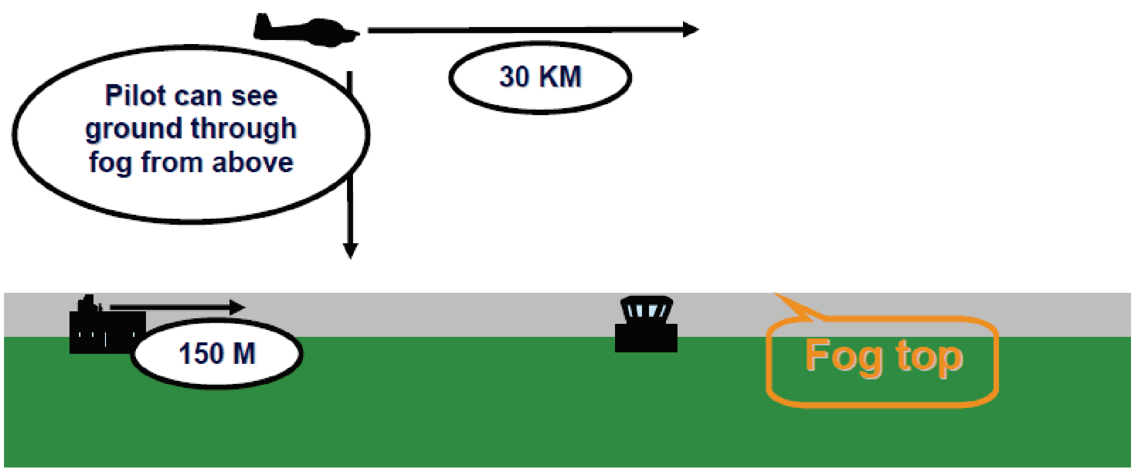


Figure-35. Example of a pilot overflying a layer of fog. The pilot may see the ground and building from above, possibly quite clearly. However, on approach to land and on descent into the fog the pilot will experience a rapid reduction of visibility into fog limits.

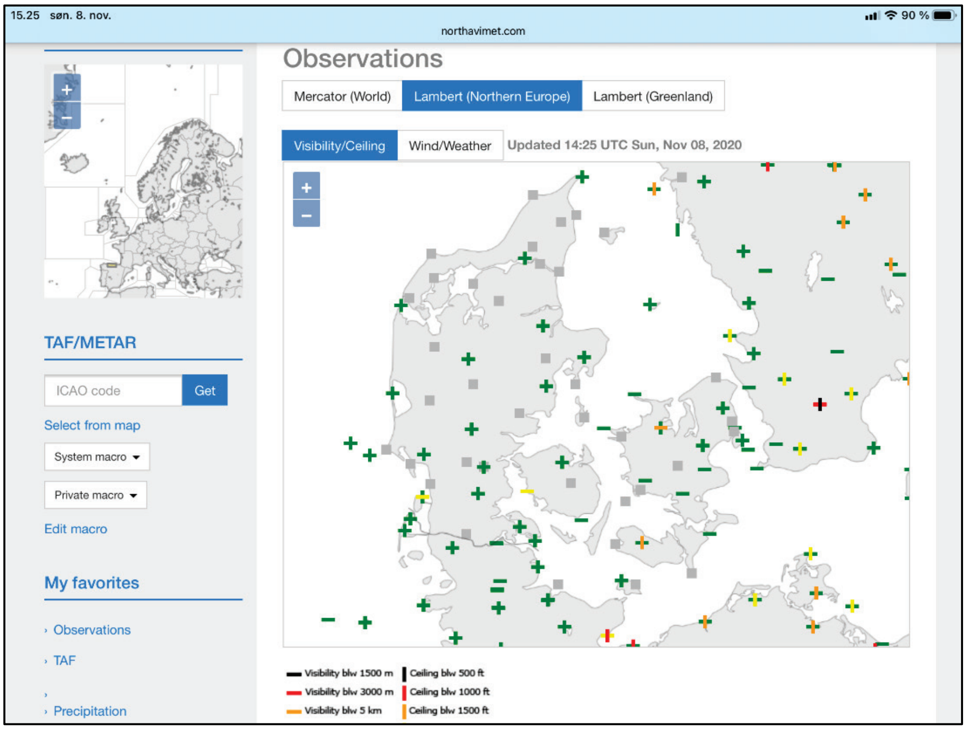
Figure from WMO/TD-No. 1390.

The AIB intention by this reproduction is to illustrate that there is a significant difference between the surface visibility (visibility in the fog) and the visibility above the fog.

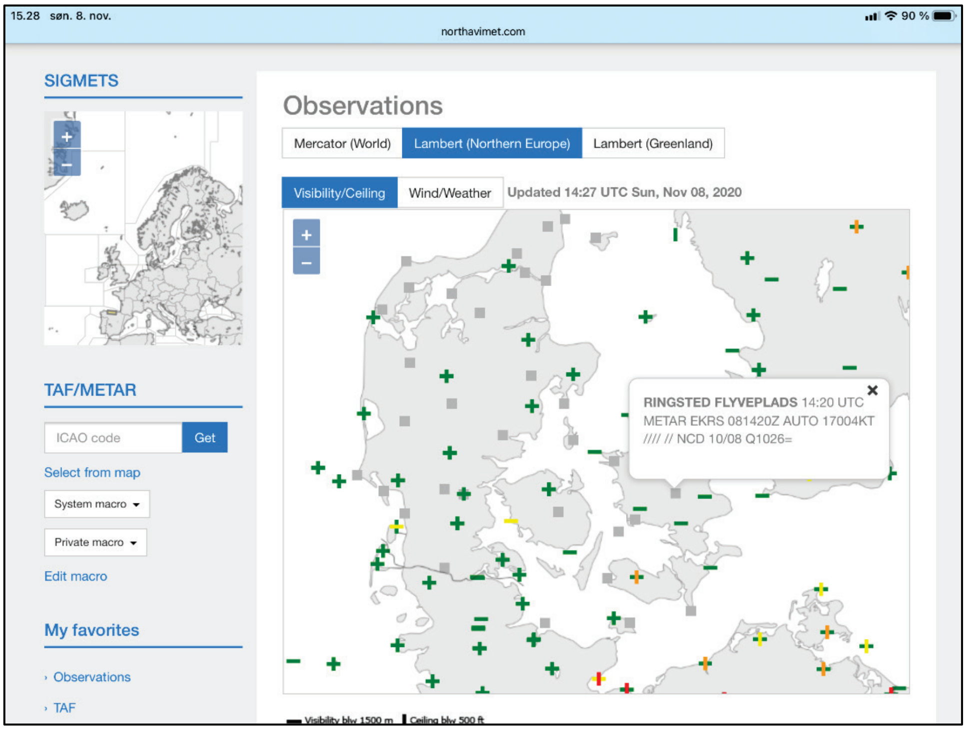
The numbers in the figure are just examples without reference to the specific situation in EKRS.

5.6 NorthAviMet Observations page

[Return to NorthAviMet Observations pages](#)



Example of Observations page "Visibility/Ceiling"



Example of Observations page "Visibility/Ceiling" with "hidden" information shown when mouse clicked/tapped at selected observation station.

5.7 HEMS Wx pictures EKRS and EKSE

Return to HEMS Wx

HEMS Wx pictures taken at 19:14 and 19:09 UTC in direction north (*Nord*) and southeast (*Sørøst*) from the operator hangar building in EKRS.

HEMS Wx pictures taken at 19:14 and 19:23 UTC in direction north (*Nord*) and southeast (*Sørøst*) from the operator hangar building in EKRS.

Note. Camera directed towards the northeast (*Nordøst*) at EKRS was out of operation at the time of the serious incident.

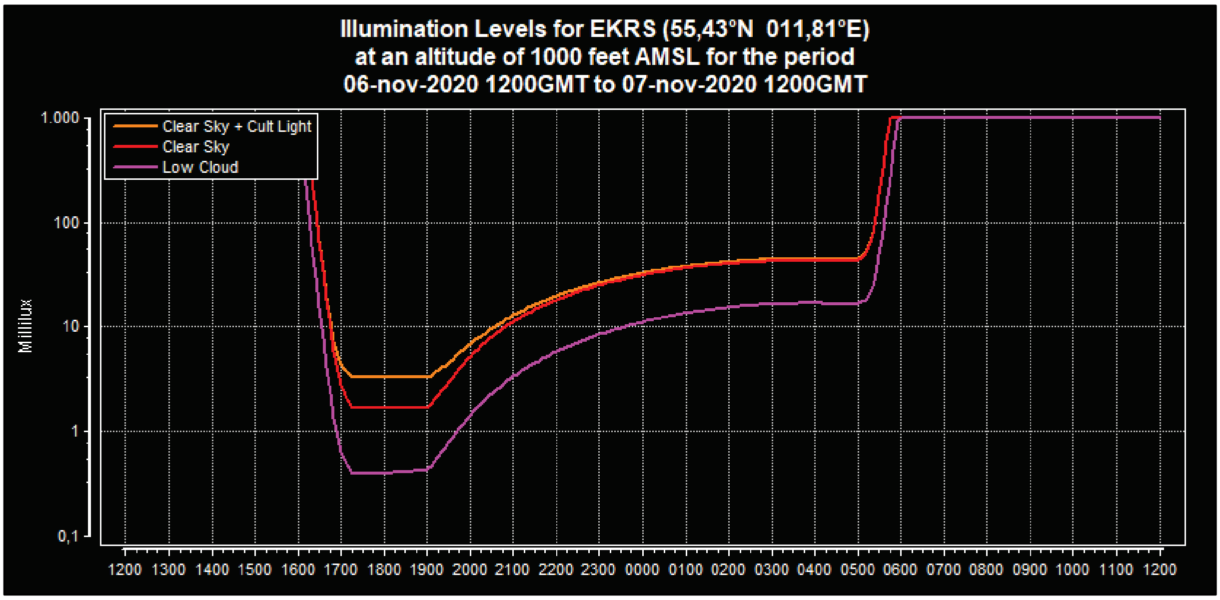
HEMS Wx pictures taken at 19:28, 19:32 and 19:38 UTC at EKSE in direction southwest (Sørvest), west (Vest) and southeast (Sørøst).

HEMS Wx pictures taken at 19:44, 19:46 and 19:51 UTC at EKSE in direction southwest (Sørvest), west (Vest) and southeast (Sørøst).

Note. The above HEMS pictures from EKRS and EKSE were not identical with actual tablet presentation available to the operator helicopter crews, but reconstructed pictures produced after the serious incident by computer software.
According to the operator, the quality of the pictures were of a higher quality when presented "live" on a tablet compared to the above presentations.

5.8 UK Met Office Night Illumination Model

Return to UK Met Office Night Illumination Model



The graph illustrates the evolution of the illumination levels during the evening.

Met Office Night Illumination Model (MONIM)

File Options Help

NVIS-Lux | Millilux | P-Values | Clear Sky Cult Light | Clear Sky | OVC CS | OVC AS | OVC ST | OVC NS | Fore cast | Setup F/C Cloud

Day View Scroller: Change Units to Millilux

Input | Graphs | Tables

Set/Rise/Twilight Times for Period | Illumination Levels for Period | Daily Summary

Time GMT	Forecast Cloud	Forecast Illumination	Clear Sky Cult Light	Clear Sky	High Cloud OVC CS	Medium Cloud OVC AS	Low Cloud OVC ST	Solid Cloud OVC NS	Sun Elevation	Sun Bearing	Moon Elevation	Moon Bearing	Moon Phase
1200	Clear Sky	****	****	****	****	****	****	****	17,7	195,9	2,7	312,7	71,1
1300	Clear Sky	****	****	****	****	****	****	****	14,3	210,4	-2,8	324,7	70,7
1400	Clear Sky	****	****	****	****	****	****	****	9,2	224,2	-6,8	337,3	70,3
1500	Clear Sky	****	****	****	****	****	****	****	2,6	237,0	-9,1	350,4	69,9
1600	Clear Sky	****	****	****	****	****	855,0	694,2	-5,0	249,3	-9,6	3,8	69,5
1700	Clear Sky	2,8	7,8	2,8	0,9	0,8	0,6	0,5	-13,2	261,3	-8,1	17,0	69,1
1800	Clear Sky	1,7	6,7	1,7	0,5	0,5	0,4	0,3	-21,7	273,5	-4,9	29,9	68,7
1900	Clear Sky	1,7	6,7	1,7	0,7	0,5	0,4	0,3	-30,1	286,6	-0,1	42,2	68,3
2000	Clear Sky	5,3	10,3	5,3	2,5	1,9	1,4	1,0	-37,9	301,4	5,9	53,9	67,9
2100	Clear Sky	11,4	16,4	11,4	6,4	4,6	3,4	2,3	-44,4	318,6	12,9	65,3	67,5
2200	Clear Sky	18,3	23,3	18,3	11,7	7,9	5,8	3,7	-48,9	338,8	20,6	76,4	67,1
2300	Clear Sky	25,1	30,1	25,1	17,6	11,5	8,5	5,2	-50,3	1,3	28,7	87,9	66,7
0000	Clear Sky	31,4	36,4	31,4	23,3	14,8	11,2	6,6	-48,5	23,6	36,8	100,3	66,3
0100	Clear Sky	36,6	41,6	36,6	28,1	17,5	13,5	7,8	-43,8	43,5	44,6	114,3	65,9
0200	Clear Sky	40,5	45,5	40,5	31,6	19,4	15,3	8,7	-37,1	60,4	51,4	131,1	65,5
0300	Clear Sky	42,7	47,7	42,7	33,6	20,4	16,5	9,2	-29,3	75,0	56,5	151,7	65,1
0400	Clear Sky	43,2	48,2	43,2	34,1	20,7	16,8	9,3	-20,9	88,0	58,7	175,9	64,7
0500	Clear Sky	44,4	49,4	44,4	33,9	20,8	16,8	9,5	-12,4	100,2	57,5	200,6	64,3
0600	Clear Sky	****	****	****	****	****	****	****	-4,3	112,2	53,1	222,4	63,9
0700	Clear Sky	****	****	****	****	****	****	****	3,2	124,5	46,6	240,2	63,5
0800	Clear Sky	****	****	****	****	****	****	****	9,6	137,4	39,0	254,9	63,1

The numerical table illustrate the evolution of the illumination levels during the evening.

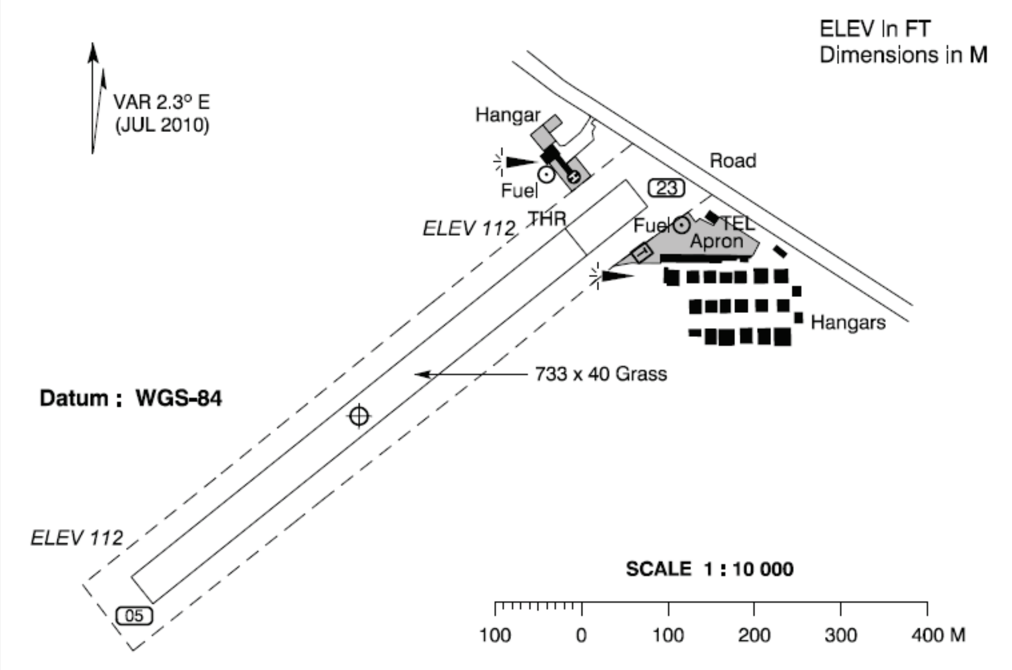
5.9 Aerodrome chart for EKRS

Return to aerodrome charts for EKRS

VFR Flight Guide
Denmark

AD 2. EKRS - 7
27 APR 17

Aerodrome Chart - **EKRS** **Ringsted**



RWY	Direction	THR PSN	TORA	TODA	ASDA	LDA	Strength
05	051.2° GEO 048.9° MAG	55 25 26.55N 011 48 10.31E	643	643	733	733	
23	231.2° GEO 228.9° MAG	55 25 39.59N 011 48 38.82E	733	733	733	643	

RWY day marking : THR, Edge.

RWY Lighting: THR, Edge, End.
Secondary power supply: NIL.

Activation of RWY LGT: Key mike 5 times within 5 SEC on VHF FREQ 123.500 MHZ.

Light remain on for 30 MIN after last keying.

APRON
Pavement : Grass

RWY slope : -

HELIPORT : For data, see AD 2. EKRS - 9

5.10 Helicopter chart for EKRS

Return to aerodrome charts for EKRS

VFR Flight Guide
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AD 2. EKRS - 9
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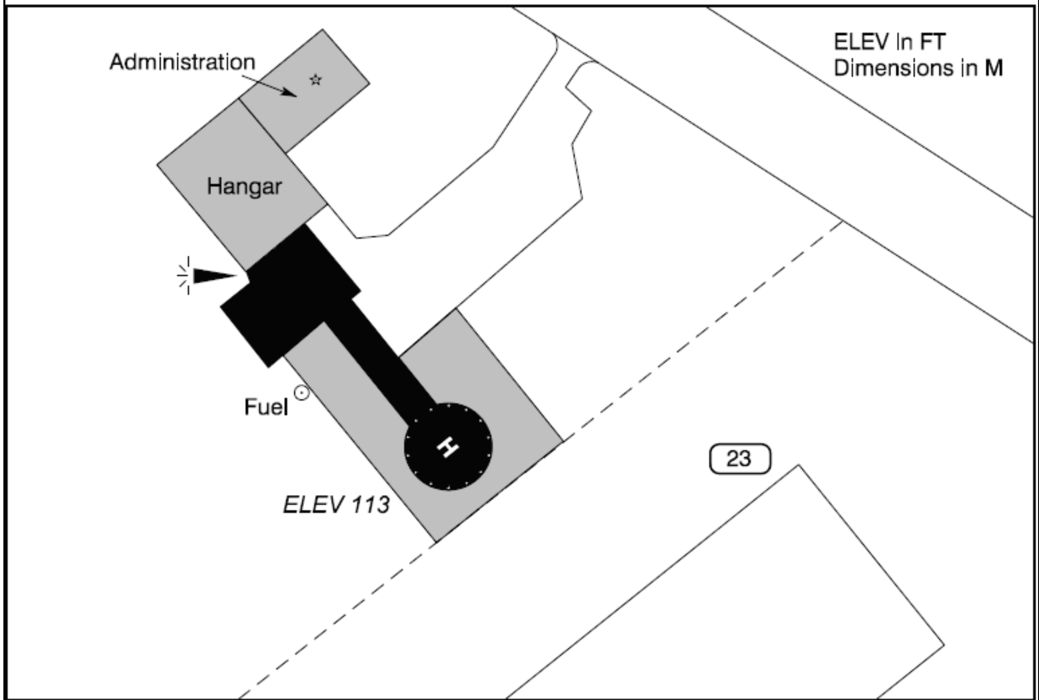
Heliport Chart - **EKRS** **RIngsted**

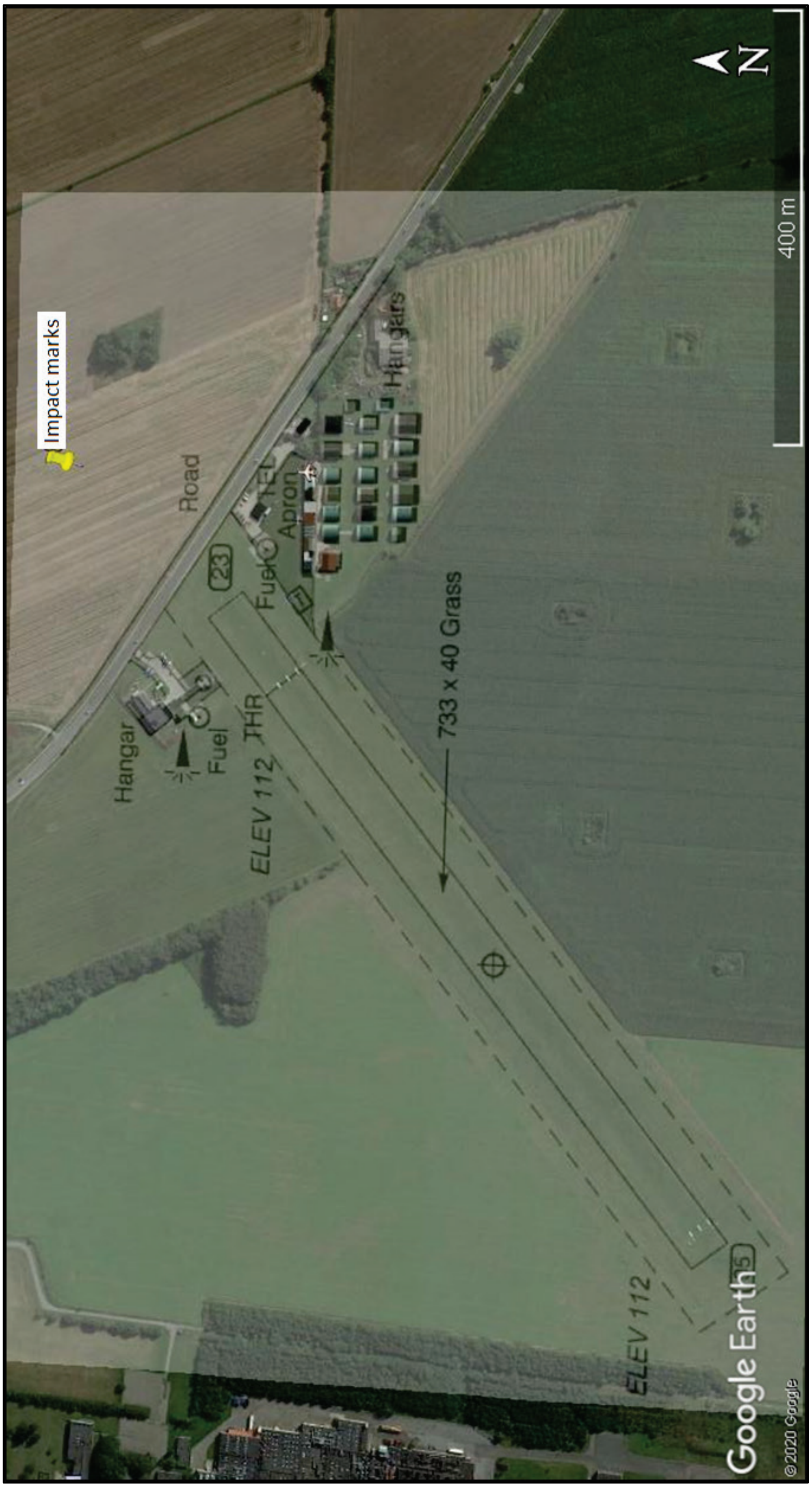


FATO - TLOF coordinates	55 25 42N 011 48 38E
Dimensions Surface Strength (MTOM) MarkIngs	Ø 15 Concrete 10.000 KG White edge, white "H"
FATO bearIngs TLOF bearings	050° MAG 230° MAG
Declared distances	-
TWY	-
Lighting : Heliport beacon APP Alignment FATO edge TLOF edge AlmIng polnt TWY	 On admInIstratIon BLDG, FLG (4) W EV 2 SEC - - Green edge, white flood - -
Secondary power supply	-
Obstacles	-

5.11 CFIT position

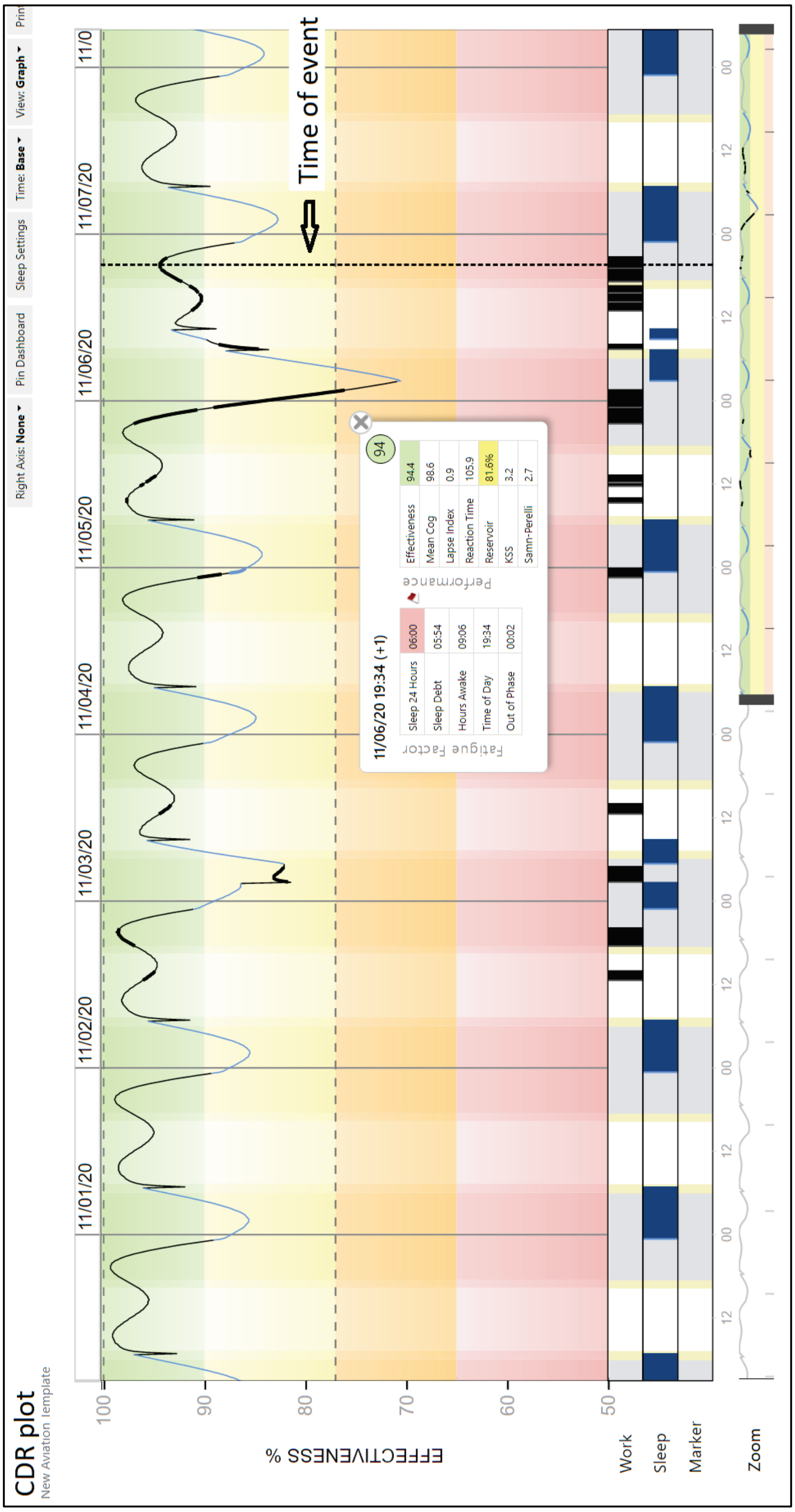
Return to wreckage and impact information

Note. The Google Earth overlay is not to scale.



5.12 CDR performance effectiveness

Return to flight crew performance effectiveness



5.13 HCM performance effectiveness

Return to flight crew performance effectiveness