aibn Accident Investigation Board Norway

Issued June 2013

REPORT SL 2013/16

REPORT ON AIR ACCIDENT NEAR SØVATNET LAKE IN BJUGN IN SØR-TRØNDELAG COUNTY, NORWAY ON 10 AUGUST 2012 - CESSNA 172RG, D-EIYL

The Accident Investigation Board has compiled this report for the sole purpose of improving flight safety. The object of any investigation is to identify faults or discrepancies which may endanger flight safety, whether or not these are casual factors in the accident, and to make safety recommendations. It is not the Board's task to apportion blame or liability. Use of this report for any other purpose than for flight safety shall be avoided.

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

Photos: AIBN and Trond Isaksen/OSL

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AIR ACCIDENT REPORT

Type of aircraft:	Cessna Aircraft Company 172RG 'Cutlass RG'
Nationality and registration:	German, D-EIYL
Registered owner and operator:	Motorfliegerclub Rosenheim MFC – Rosenheim e.V.
Personal injuries:	3 persons on board, all fatally injured
Accident site:	Steep terrain at the southern end of Søvatnet lake in Bjugn in Sør-Trøndelag county (63° 50.61'N 009° 57.7'E)
Accident time:	Friday 10 August 2012 at 1225 hrs

All times given in this report are local times (UTC + 2 hours), if not otherwise stated.

NOTIFICATION

10 August 2012 at 1240 hrs, the air traffic service in Bodø called to notify the AIBN's officer on duty that a German-registered aircraft of the type Cessna 172 had crashed in Bjugn shortly before. At the time, the injuries were not yet known. The initial notification was followed up in several rounds of more extensive information from the Joint Rescue Coordination Centre for Southern Norway (JRCC-SN). It was eventually confirmed that the three persons who had been on board the aircraft were all fatally injured in the accident. The same afternoon, the AIBN dispatched three inspectors, and the investigation at the accident site started on the following day.

The AIBN informed the authorities in the USA (State of Manufacture) and Germany (State of Registry) of the accident in accordance with ICAO Annex 13, *Aircraft Accident and Incident Investigation*. The European Aviation Safety Agency (EASA) was also notified. The German Federal Bureau of Aircraft Accidents Investigation (Bundesstelle für Flugunfalluntersuchung, BFU) appointed an accredited representative who has assisted during the investigation.

SUMMARY

A German private light aircraft was en route from Lofoten to Trondheim with three people on board. The flight was to be conducted in accordance with the visual flight rules (VFR) but, in Nord-Trøndelag county, the aircraft entered an area of precipitation and reduced visibility. The aircraft was observed flying low over hilly terrain where the highest peaks were shrouded in fog. One witness heard the engine noise increase and saw the aircraft climb until it crashed about half way up the steep terrain at the southern end of Søvatnet lake in Bjugn municipality. All the occupants were fatally injured in the accident. The investigation showed that the aircraft most probably stalled before it hit the ground.

The available weather forecast prior to departure indicated that a warm front over the Trøndelag region might cause problems for the flight, which, according to the plan, would follow the coast to Rørvik in Nord-Trøndelag county and then head inland towards Værnes. The visibility became significantly lower than forecasted. Weather observations issued after the aircraft had passed

Brønnøysund showed that the coastal airports of Rørvik and Ørland no longer had visual meteorological conditions (VMC)[1] permitting VFR flights.

The investigation showed that the flight commander on D-EIYL was informed, both about the poor weather at Ørland and about the better conditions around Namsos. The information that VMC no longer existed along the coast was communicated somewhat later than ideally. In the airspace i question, the air traffic service's responsibility in relation to VFR flights is limited to providing flight information services, i.e. to providing advice and information about matters of importance to conducting safe and efficient flights. No request for assistance or distress call was registered from the aircraft at any time.

The AIBN issues one safety recommendation in connection with its submission of this report.

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Background information

1.1.1.1 A party of nine German pilots, divided between three light aircraft, had taken a few days' holidays in Lofoten. They were all members of the same flying club, Motorfliegerclub Rosenheim e.V., and they had a tradition for taking a long trip together once a year. The level of experience varied between the pilots, and they took turns acting as commander. The three pilots on board the accident aircraft knew each other well and had flown together on many occasions. The whole party was familiar with the information leaflet VFR guide Norway 2012, and had made use of it when planning their trip to Norway. Several of the pilots had experience of flying in challenging mountain terrains, and some had previous experience of flying in Norway.

1.1.1.2 The accident aircraft was of the type Cessna 172RG with registration D-EIYL. The other two aircraft were a Cessna 182 with registration D-EWTE and a Cessna 172 with registration D-EJRW.

1.1.1.3 On the day in question, the plan was for the aircraft to leave Lofoten and fly from Leknes Airport (ENLK) to Bergen Airport, Flesland (ENBR) in accordance with visual flight rules (VFR). The destination for the first leg of the journey was Trondheim Airport, Værnes (ENVA) (see the map in Figure 1). They submitted a VFR flight plan, according to which they would fly across the Vestfjord and then continue via Sandnessjøen, Rørvik and Namsos (routing STT, STO, RVK, LVK, TRM). D-EIYL had reported an expected flight time of 2 hours and 45 minutes, and 5 hours endurance. The flight plan for D-EIYL had been plotted into the aircraft's GPS, and probably also into the personal tablet computers of those on board.

1.1.1.4 The pilots had planned the route together the previous evening. They had studied weather forecasts, satellite images, significant weather maps and wind maps along the route. They were aware that there was a warm front over the Trøndelag region. Prior to departure from Leknes, the pilots once again checked the conditions and weather forecast for the planned route. Though the weather at Leknes was grey that morning, based on the

[1] Visual meteorological conditions (VMC): Weather conditions defined by visibility and distance from cloud corresponding to or better than the stated minimum requirements.

forecasts, they did not expect that the weather would create any problems en route to Værnes.

1.1.2 History of the flight

1.1.2.1 The aircraft departed a few minutes apart at around 0900 hrs. They had different cruising speeds and did not fly together[2]. The party maintained radio contact with each other via the available 123.450 MHz frequency, so that they could exchange experience and inform each other of any changes to the plan en route. The crew on board a Widerøe aircraft that took off after the three German aircraft noted that D-EIYL seemed to perform unusually poorly during take-off. They remarked that the aircraft appeared heavy.

1.1.2.2 According to the other members of the party, the weather north of Brønnøysund was not a problem, though the head winds were stronger than expected. The commander on board the aircraft with the lowest speed (D-EJRW) stated that the head winds sometimes reached 30-35 kt, and that he chose to make a fuel stop at Brønnøysund Airport (ENBN). The time was about 1105, and two hours had passed since departure.

1.1.2.3 D-EIYL flew as the second aircraft in the party and was over the coast between Brønnøysund and Rørvik when D-EJRW landed in Brønnøysund. The AIBN has been informed by others in the party that D-EIYL had at that time decided to fly along the coast. At the time, the fastest aircraft (D-EWTE) was passing over or close to Rørvik at approximately 8 000 ft. It cruised at a higher altitude than the others and continued towards Værnes above the cloud cover (VFR on top). One person in the party stated that the commander on board D-EIYL knew about the weather at Værnes at that time, but it is unclear whether he had updated information about the weather at the airports along the coast: Rørvik Airport, Ryum (ENRM) and Ørland Airport (ENOL) (see Figure 1).

1.1.2.4 When D-EJRW took off again, after a ground stop of approx. 45 minutes in Brønnøysund, the commander chose to fly the fastest route to Værnes in accordance with the instrument flight rules (IFR) in order not to delay the party more than necessary. D-EWTE and D-EJRW landed at Værnes at 1157 and 1307 hrs, respectively.

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[2] The AIBN's description of the history of the flight is based on radio communication records and radar data, reports from Avinor and information from various witnesses.

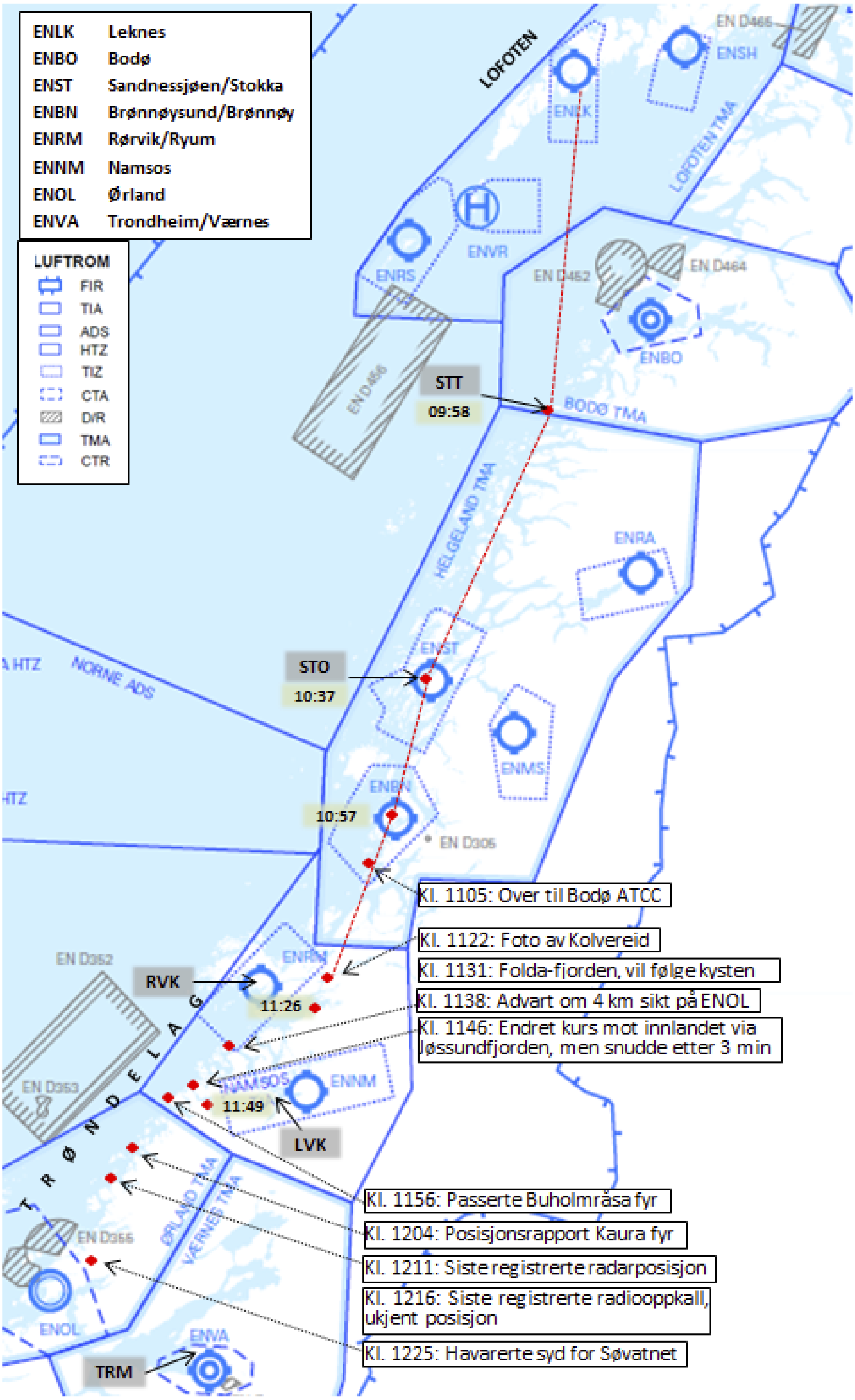


Figure 1: Map section showing airspaces and airports between Leknes and Værnes. The route and positions plotted in for D -EIYL are approximations and partly based on assumptions. See the description below for more details.

1.1.2.5 At 1103 hrs, the AFIS duty officer at Brønnøysund called the AFIS duty officer at Rørvik in order to transfer D-EIYL to the latter's radio frequency. At that point in time, D-EIYL was over the coast 8 NM south of Brønnøysund at 1 500 ft. According to the flight plan, it was to continue via Rørvik and the Leirvik (LVK) radio beacon located approximately 7 NM west of Namsos Airport (see Figure 1 for places and times mentioned in the following sections).

1.1.2.6 The AFIS duty officer at Rørvik stated in the phone call that there was a low cloud cover and that, ten minutes ago, visibility had decreased to a mere 2 000 m with much drizzle in the air. A few minutes before that, a departing Widerøe flight had reported a cloud base of approximately 1 500 ft – 1 600 ft, with intermittent fog patches in the area. The two AFIS duty officers discussed the weather, which appeared to be better in Namsos, and they agreed that it was best to transfer communication with D-EIYL to Bodø Air Traffic Control Centre (ATCC). It is clear that communication was transferred from Brønnøysund AFIS to Bodø ATCC without prior coordination by telephone. According to Brønnøysund AFIS, the weather conditions were not mentioned in its communication with D-EIYL.

1.1.2.7 At 1105 hrs, D-EIYL was back on the Bodø frequency (118.550 MHz). It was then flying at 1 700 ft. Neither the weather nor the routing was mentioned in the brief exchange of messages that followed. D-EIYL had a normal cruising speed (true airspeed – TAS) of 128 kt. Radar records show that the ground speed at that stage was approximately 90 – 100 kt. At 1108 hrs, the aircraft was 17 NM south-south-west of Brønnøysund at 1 600 ft.

1.1.2.8 One witness who came forward after the accident stated that he observed the accident aircraft flying into and out of clouds at a low altitude above the coast on the inside of Leka island, approximately 30 km north-east of Rørvik. The area had patches of cloud down to an altitude of 200-300 m. He estimated that the time was about 1130 hrs.[3] The party to which he belonged had remarked that the pilot must have local knowledge of the area to be able to fly there in such poor weather. They expected that he would land the aircraft at Rørvik. The aircraft flew partly above land and partly above sea. At the time, there was good visibility below the clouds. As far as he could remember, the rain started about ½ – 1 hour later.

1.1.2.9 A camera found inside the aircraft contained a number of photos from the flight. The photo below is of Kolvereid, the administrative centre in Nærøy municipality, seen from the south-east. Kolvereid lies south of Leka, approximately 14 NM east of Rørvik and 23 NM north of Namsos (see Figure 1). Radar records show that the aircraft passed that area at about 1122 hrs.

[3] *The stated times do not agree with other sources.*

Figure 2: Photo taken from D-EIYL when passing Kolvereid at approximately 1122 hrs. (Photo private)

1.1.2.10 The next radio call was made at approximately 1129 hrs, when Bodø ATCC requested that D-EIYL state its position. The answer was *'about 16 NM inbound to LVK'*, which is some way up the Foldafjord.

1.1.2.11 At 1131 hrs, D-EIYL called to report that, due to the weather, they intended to follow the coastline to Trondheim:

> D-EIYL: *DYL is diverting now due to weather to follow the coastline to Trondheim.*
>
> Bodø: *DYL roger, how far west from LVK will you fly?*
>
> D-EIYL: *We are now 15 miles north of LVK.*

1.1.2.12 Apart from this message exchange, there was nothing to indicate a state of emergency or that the aircraft was in need of any kind of assistance. Radar records show that the aircraft subsequently followed the Foldafjord towards the cost.

1.1.2.13 At 1137 hrs, the air traffic controller at Ørland had received a flight progress strip concerning the D-EIYL flight. He called Bodø ATCC and said that the conditions did not permit VFR flight, since visibility was down to 4 km. The air traffic controller in Bodø said that according to the most recent message from D-EIYL, it would fly southwards along the coast due to poor weather, after first having followed a direct course for LVK. The air traffic controllers discussed the weather and remarked that the METAR for Namsos was not too bad, while it was poor for Rørvik (see 1.7 for more details about the weather). The air traffic controller in Bodø said that he would inform D-EIYL about the weather, consult Namsos and inform Ørland if D-EIYL was to change its route again.

1.1.2.14 At 1138 hrs, Bodø ATCC informed D-EIYL that visibility at Ørland was 4 km. Receipt of the message was confirmed. The air traffic controller contacted Namsos immediately afterwards to obtain updated weather information. At the time, visibility southwards from Namsos was 20 km, and visibility southwards from LVK looked good.

1.1.2.15 At 1142 hrs, when D-EIYL was off the coast west-north-west of Namsos, the following messages were exchanged:

Bodø: *DYL from Bodø*

D-EIYL: *DYL go*

Bodø: *DYL reports are that if you fly via LVK you will have better visibility and better weather and better chances to get southbound because along the coast it’s bad right now.*

D-EIYL: *Ok we will consider DYL.*

1.1.2.16 The radar records show that, at 1145 hrs, the aircraft was still flying over the coast approximately 25 NM west of Namsos. During the minutes that followed, it flew a little way up the Jøssundfjord before turning and flying back to the coast. From 1152 hrs, the aircraft continued along the coast while varying its course. The lowest registered altitude was 400 ft. After the accident, a witness contacted the police and reported that the aircraft had been observed at a very low altitude in poor visibility conditions, heading south along the coast of Flatanger.

1.1.2.17 The air traffic controllers in Bodø and at Ørland discussed the weather conditions at Ørland and decided that it would be best if D-EIYL was in direct contact with Ørland in order to obtain updated weather information. Records of the radio communication show that the air traffic controller transferred D-EIYL to Ørland TWR at 1147 hrs. However, it turned out that D-EIYL was below the area of radio coverage from Ørland, and a Widerøe aircraft was asked to convey a message to D-EIYL to switch back to the Bodø frequency. At 1153 hrs, D-EIYL contacted Bodø ATCC again. The following messages were exchanged:

D-EIYL: *Bodo Control D-EIYL back with you.*

Bodø: *D-EIYL, Bodo hello again.*

D-EIYL: *We tried to go to the inland, but the visibility is very low, so we are continuing along the coastline.*

Bodø: *DYL roger. I cannot guarantee that the visibility will increase further south.*

D-EIYL: *Ja, thank you, DYL*

1.1.2.18 After this exchange, the air traffic controllers at Ørland and Bodø spoke again. Bodø said that D-EIYL would continue along the coastline, and Ørland repeated that the weather did not allow for passage.

1.1.2.19 At 1156 hrs, Bodø forwarded the current METAR for Ørland to D-EIYL in its entirety. It stated a visibility of 4 km in rain, and a cloud ceiling of 1 000 ft with scattered clouds at 500 ft. D-EIYL confirmed receipt by sending the message *'copied'*.

1.1.2.20 When the time was nearing 1200 hrs, D-EIYL was asked to state a new estimated time of arrival at Værnes (11:50 was indicated in the initial flight plan). After a first response of *'stand by'*, it came back on the frequency to state *'in 65 minutes'*. At 1203 hrs, D-EIYL was once again transferred to the Ørland frequency, and, this time, contact was established. The recorded radar observations of the aircraft were sporadic during this period, and did not indicate altitude or speed.

1.1.2.21 At 1204 hrs, D-EIYL reported to Ørland TWR that it was en route to Værnes via the coast, and that its position was currently near Kaura lighthouse. One minute later, the air traffic controller at Ørland informed that visibility northwards was now 6 km and appeared to be improving, and that visibility over the Trondheimsfjord was now 10 km. D-EIYL confirmed receipt of the message.

1.1.2.22 At 1210 hrs the air traffic controller contacted the Norwegian air force (Wing OPS) at Ørland Air Base and explained that it might become necessary to let a German light aircraft land, depending on the weather. It was soon clarified that this would not be a problem.

1.1.2.23 At 1216 hrs, Ørland TWR cleared D-EIYL for special VFR flight through the control zone. The following messages were exchanged in the final radio call that was recorded:

D-EIYL: *DYL Ja, request special VFR, VFR to Trondheim.*

ENOL: *DYL; you are cleared special VFR.*

D-EIYL: *Cleared special VFR, DYL.*

1.1.2.24 At 12:28:48, Ørland called D-EIYL. There was no response. The air traffic controller then repeated the call seven times, at intervals of approximately 20–40 seconds, without getting any response, until 1232 hrs. He then notified the Joint Rescue Coordination Centre for South Norway (JRCC-SN). JRCC-SN stated that it had just been notified that somebody had seen a light aircraft crash north-east of Ørland, in steep terrain at the southern end of Søvatnet lake.

1.1.2.25 According to the records the AIBN received from Avinor, the radar position of D-EIYL was last recorded at 1211 hrs. At that time, the aircraft's position was in the vicinity of Stokkøya (64°07'02"N 009°59'42"Ø), approximately 16 NM north of the accident site. The air traffic controller at Ørland had seen sporadic indications on the radar after that time. He had noted a position 14.4 NM from the air base in the north-easterly direction (QDM 226), which is very close to the accident site.

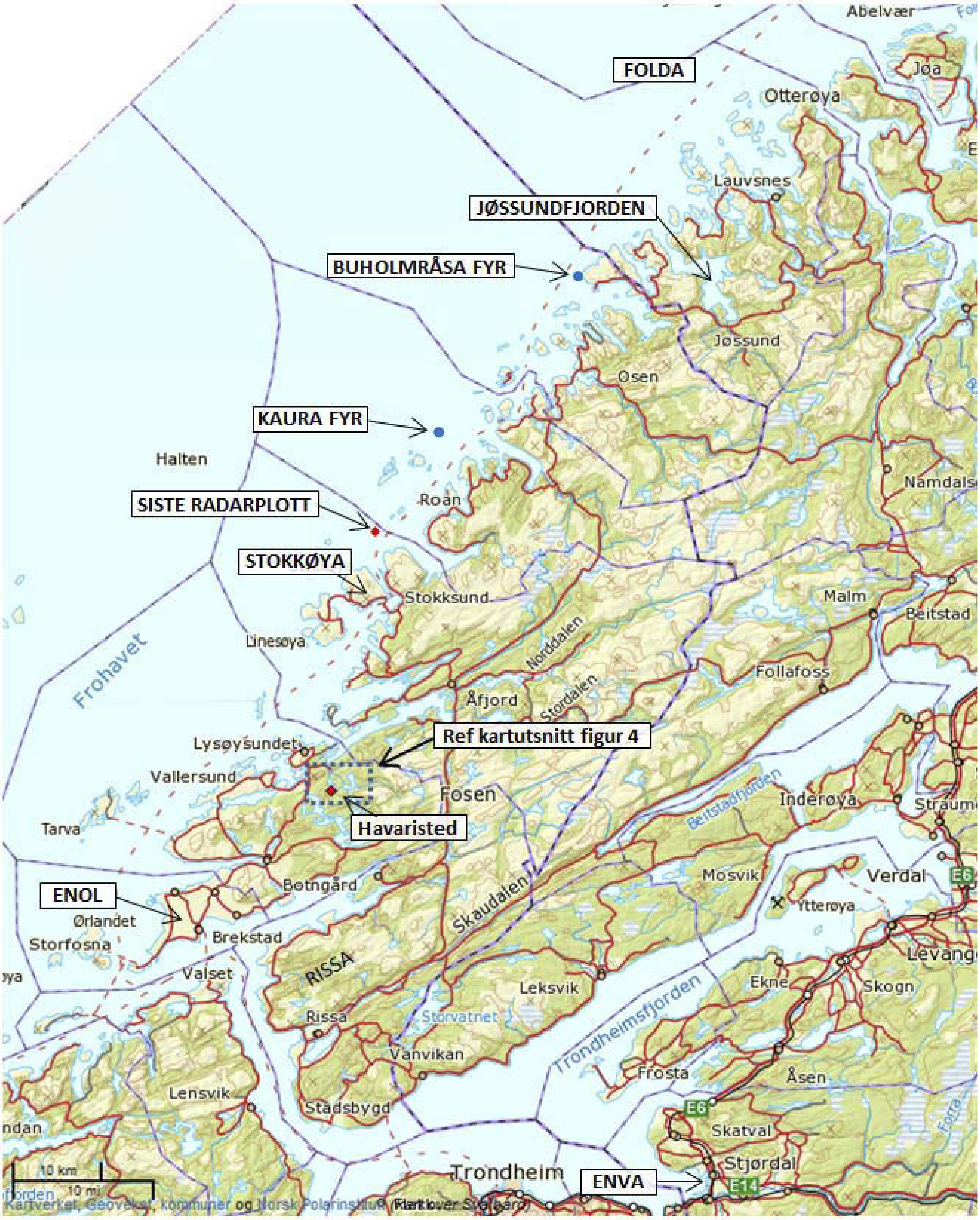


Figure 3: Map section of the Fosen area. See also the section showing the accident site in Figure 4. (Maps: the Norwegian Mapping Authority, Geovekst and municipalities)

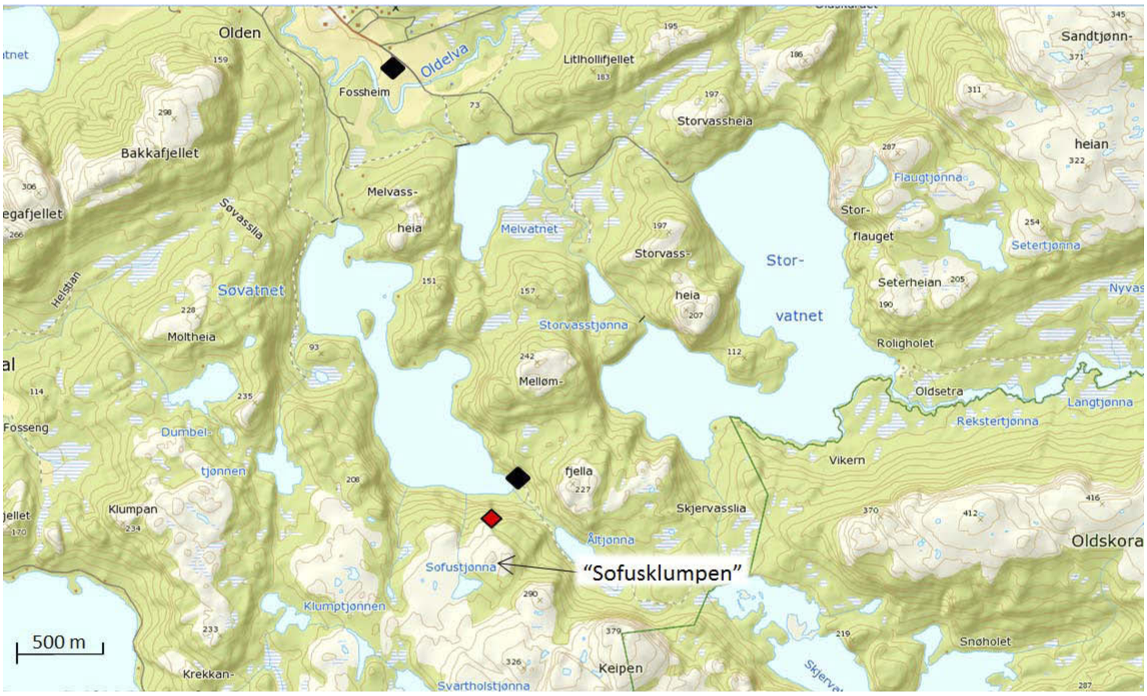


Figure 4: Map section showing the area where the aircraft crashed, the positions of witnesses and the accident site (red marking). (Map: UT.no)

1.1.3 Eyewitness descriptions

1.1.3.1 A witness who was outside on Fossheim farm in Olden (marked by the topmost black diamond in Figure 4) stated that, at about 1223 hrs, he saw the aircraft approaching from the north and flying slowly southwards in the direction of Søvatnet lake approximately 70-90 metres above the farm. He was under the impression that it *'hardly had flying speed'*. The aircraft held a straight course and passed at a very low altitude over the crest of an approximately 100-metre high hill that could just be glimpsed through the cloud cover. It then disappeared from sight. The witness had remarked to someone else on the farm that this could not end well. Ten minutes later, a neighbour called and said that the aircraft had crashed.

1.1.3.2 A married couple was staying in the cabin by the bay at the south-eastern end of Søvatnet (see Figure 4). They heard the sound of an approaching aircraft and an unusual noise, and the wife went to the window. She saw the aircraft flying almost straight over the cabin from the north-east, at a very low height above the terrain. She could see the right-hand side of the aircraft from where she was standing. She described the unusual noise as an increase in the engine's rpm – *'a terrible droning sound'* – and she saw the aircraft climb as it was nearing the higher and steeper terrain at the southern end of the lake, with the peak called 'Sofusklumpen'. She expected the aircraft to turn right to move out across the lake, but that did not happen. Instead, it continued to climb while holding a straight course, apparently at a constant speed. She thought it looked as if it was about to rock its wings in greeting. But a slight waver was all she saw before they heard a terrible bang as the aircraft appeared to her to crash straight into the cliff. She did not register any movement, sound or smoke after the crash.

1.1.3.3 The husband immediately dialled the 113 emergency number to notify of what they had seen, while his wife called up the mountain side in an attempt to establish contact. There was no answer and no sign of life. The call to the Emergency Medical Communication Centre (AMK) was registered as having been received at 1227 hrs.

1.2 Injuries to persons

Table 1: Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	1	2	
Serious			
Minor/none			

1.3 Damage to aircraft

The aircraft was destroyed in the accident, see section 1.12 for more details.

1.4 Other damage

There was no significant damage to the natural environment, see section 1.12 for more details.

1.5 Personnel information

1.5.1 The commander, a 49-year-old man, had held a private pilot licence since 1989. His private pilot licence PPL(A) had been issued in Austria and was valid until 29 May 2013. His most recent medical check-up was on 10 June 2011. His medical certificate (class 2) was valid until 11 July 2013. It included a limitation requiring him to have available corrective lenses for near vision (VNL).

1.5.2 The commander had started to train for his instrument rating in 2007. According to his personal flying logbook, his last IFR training session took place on 13 June 2010. At that time he had logged a total of 33 hours and 22 minutes of instrument flight training. His instrument flight training had not been completed. According to information received by the AIBN, this was because the flying school he attended went bankrupt.

Table 2: Flying experience Commander

Flying experience	All types	On type
Last 24 hours	3 h 30 min	3 h 30 min
Last 3 days	3 h 30 min	3 h 30 min
Last 30 days	6 h 40 min	6 h 40 min
Last 90 days	8 h 50 min	8 h 50 min
Total	432	Unknown

1.5.3 The two other pilots on board the accident aircraft also held private pilot licences. They had approximately 265 hours and approximately 375 hours of flying experience, respectively. Neither of them held an instrument rating. The commanders on board the other two aircraft used by the party had commercial pilot licences, instrument ratings and considerably more flying experience.

1.6 Aircraft information

1.6.1 General information

Manufacturer and model:	Cessna Aircraft Corp. Cessna 172RG
Serial number	172RG – 0886
Year of manufacture:	1981
Class, airworthiness:	Normal, airworthiness certificate with valid ARC
Last inspection:	200-hour inspection on 3 August 2012, at total time 3 605: 39
Total time:	3 626 h 30 min
Engine:	Lycoming O360F1A6-CE2. Time since overhaul: 404 hours
Propeller:	McCauley B2D34C220-B. Time since overhaul: 46 hours
Fuel:	Avgas 100LL
Tank capacity:	250 litres in total, of which 15 litres unusable
Number of seats:	4

Stall speed (max. weight, zero flaps, idle power): 54 KIAS

1.6.2 Other background information

1.6.2.1 The aircraft was owned and operated by Motorfliegerclub Rosenheim e.V., a flying club based at Vogtareuth Airport (EDNV) near Rosenheim in the southernmost part of Germany. The club normally operates two or three aircraft, mainly of the Cessna type. When the accident occurred, the club had around 40 members, approximately 20 of whom were active pilots.

1.6.2.2 The aircraft's airworthiness review certificate (ARC) had been renewed by an EASA 145-approved workshop on 3 August 2012 (one week prior to the accident). Measures in that connection included condition inspection of avionics equipment and 200-hour/annual inspection, with repair of various minor defects that were remarked on. The aircraft was also weighed, and a test flight was carried out without remarks. No technical remarks relating to the flight had been registered after that time.

1.6.2.3 D-EIYL was fully instrumented and approved for IFR flight. It had various additional units of equipment, including an ARC autopilot of the type 300 Navomatic, an ALT HOLD S-TEC SYSTEM 60 PSS and a Garmin GPS type GNS430.

1.6.3 Mass and balance

1.6.3.1 The mass of the fuel on leaving ENLK has been estimated at 158 kg, based on the fact that the aircraft had flown for 45 minutes since the tanks were filled up at Harstad/Narvik Airport Evenes (ENEV) tree days prior to the accident[4].

1.6.3.2 The total mass of the three persons on board, including their clothing, was 249 kg. The passengers were seated in the right-hand front and back seats, respectively.

1.6.3.3 After the accident, most of the baggage that was on board the aircraft was transported to the Ørland and Bjugn police station, where it was dried and weighed. The baggage consisted of six bags, some briefcases and various pieces of loose equipment. In addition to clothes and toiletries etc., the items carried on board included two laptop computers, a printer, a DVD player, extra batteries, various battery chargers and cables, ring binders, cameras and three tablet computers. The total mass of these baggage items was 85 kg.

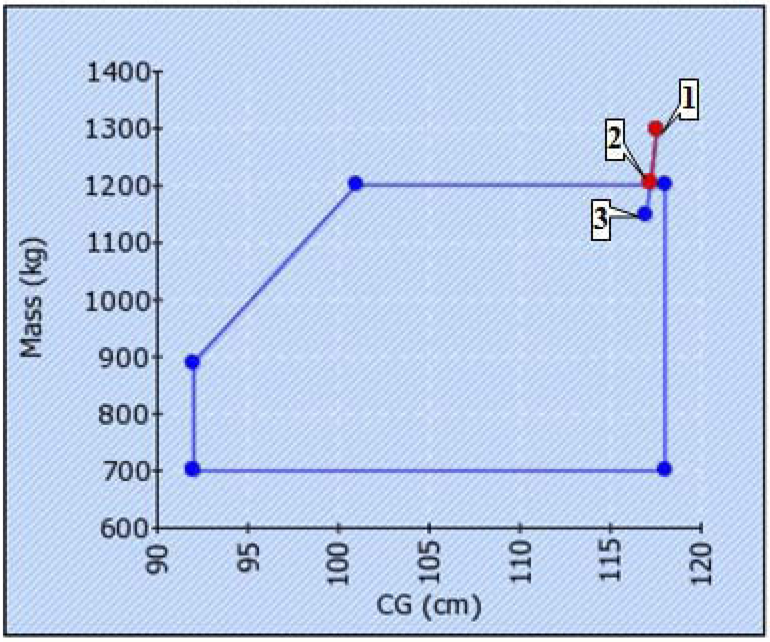
1.6.3.4 The rest of the baggage, together with water containers, oil cans and miscellaneous other equipment not included in the aircraft's empty mass, were weighed after being transported to the AIBN's premises in Lillestrøm together with the aircraft wreckage. These items weighed 25 kg, bringing the total baggage mass to 110 kg.

1.6.3.5 The aircraft's empty mass was 784,9 kg. The take-off mass was then estimated to be 1 300 kg, which is 102 kg more than the aircraft's maximum permitted mass of 1 198 kg. Given that it had flown for 3 hours and 20 minutes, the mass of the aircraft when the accident occurred is estimated at 1 206 kg. The centre of gravity was probably near the rear limit, see Figure 5.

1.6.3.6 According to the flight manual, the total mass of baggage in the baggage compartment must not exceed 91 kg. Some of the baggage had probably been placed in and in front of the free passenger seat. The following mass and balance table was drawn up after the accident:

ITEM	MASS (kg)	ARM (Cm)	MOM (Cm.kg*100)	Max.Limits (kg)
Basic Empty Mass	785.00	99.00	777.15	
Crew	167.00	94.00	156.98	
Row 1	118.00	185.00	218.30	
Row 2	0.00	0.00	0.00	
Row 3	0.00	0.00	0.00	
Row 4	0.00	0.00	0.00	
Baggage	80.00	241.00	192.80	
=Zero Fuel Mass	1150.00	116.98	1345.23	
+Fuel Loading	155.00	122.00	189.10	
=Ramp Mass	1305.00	117.57	1534.33	MRM: 1202.00
-Taxi Fuel	5.00	122.00	6.10	
=Take Off Mass	1300.00	117.56	1528.23	MTOM: 1198.00
-Destination Fuel	93.26	122.00	113.78	
=Landing Mass	1206.74	117.21	1414.45	MLM: 1198.00

[4] *Mass of full tanks: 178 kg (250 litres). Consumption: 37.5 l/hour*



1. *Take-off mass and centre of gravity*
2. *Mass and centre of gravity at the time of the accident*
3. *Mass and centre of gravity without fuel (Zero Fuel Mass)*

Figure 5: Mass and balance calculation, D-EIYL. For the accident flight, the limits were exceeded.

1.7 Weather

1.7.1 General

1.7.1.1 On the day of the accident, the Trøndelag region experienced southerly and south-westerly winds as a result of a low-pressure front over the Norwegian Sea combined with a high-pressure front over England. A relatively weak warm front over Sør-Trøndelag county was moving slowly eastwards (see Figure 6). At ground level there was a south to south-westerly strong breeze (around 20 – 30 kt) along the coast. At altitudes up to 5 000 ft, there was a south-westerly wind of around 20 – 30 kt.

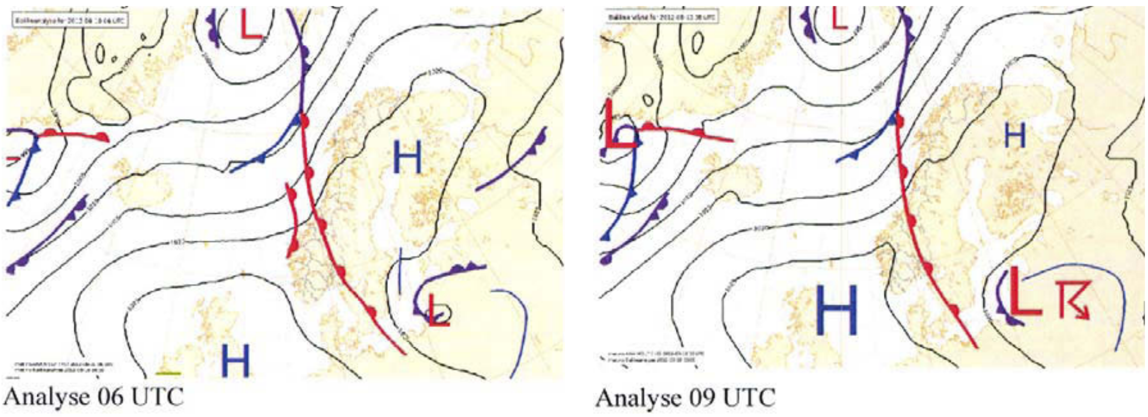


Figure 6: The weather situation at 0800 and 1100 hrs.

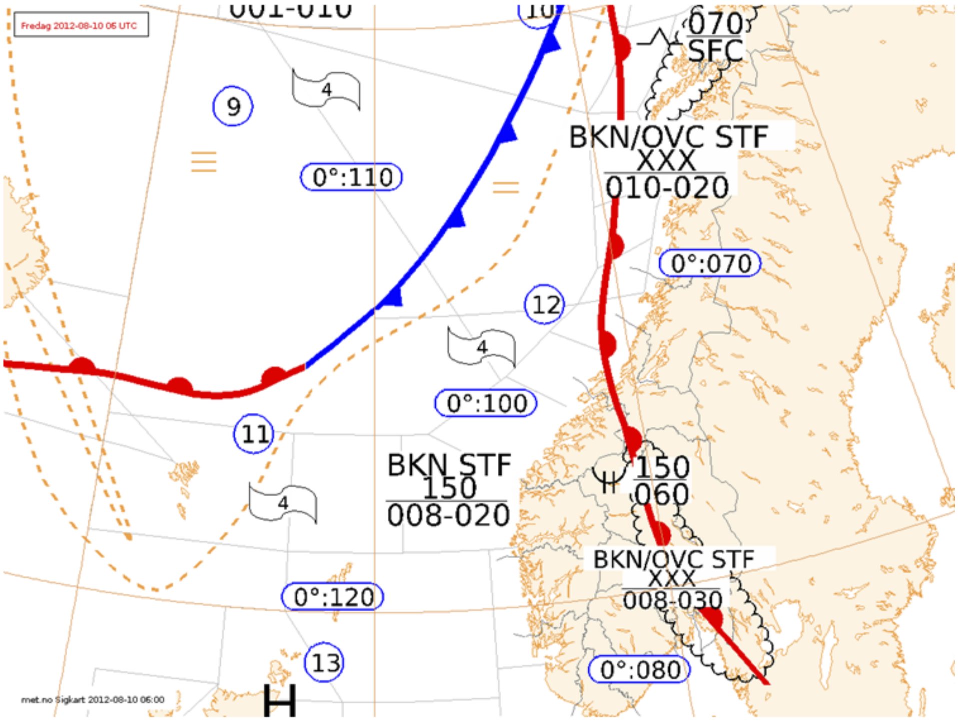


Figure 7: Significant weather map at 0800 hrs.

1.7.1.2 The Norwegian Meteorological Institute has provided the following summary of visibility and cloud ceilings along the coast of Trøndelag and the inland areas:

> *The cloud cover [at the coast] was between 1 000 and 2 000 ft with patches of cloud (FEW) at lower altitudes. Visibility was between 4 km and +10 km (more than 10 km). Inland, visibility was better and generally +10 km throughout the period in question. Namsos reported a cloud ceiling of between 2 000 and 2 500 ft.*

1.7.1.3 The Norwegian Meteorological Institute concluded that the warm front in the area of the accident probably caused reduced visibility of 3-4 km and ceiling down to 700-1 200 ft, possibly with patches of cloud down to 500 ft. Turbulence is unlikely to have been more than light. The 0-isotherm was between FL070 and FL100 (between approx. 7 000 and 10 000 ft), so there would have been no icing under 5 000 ft.

1.7.2 METAR (routine weather observation for aviation purposes, times in UTC)[5]

(The accident occured at 1025 UTC.)

1.7.2.1 *Brønnøysund Airport Brønnøy (ENBN)*

0650UTC 18009KT 9999 SCT020 BKN030 14/10 Q1020=
0750UTC 18009KT 9999 SCT020 BKN030 14/10 Q1020=
0850UTC 18009KT 9999 VCSH FEW012 SCT020 BKN025 14/10 Q1020=
0950UTC 18009KT 9999 VCSH FEW012 SCT020 BKN025 14/10 Q1020=
1050UTC 21009KT 7000 -SHRA DZ SCT005 BKN008 13/10 Q1021=

[5] *For decoding of meteorological abbreviations, see: https://www.ippc.no/ippc/help_met.jsp and https://www.ippc.no/ippc/help_metabbreviations.jsp*

1.7.2.2 *Rørvik Airport Ryum (ENRM)*

0650UTC 20011KT 9999 BKN017 13/11 Q1020=
0720UTC 20010KT 9999 BKN015 13/10 Q1021=
0750UTC 20010KT 9999 BKN015 13/11 Q1021=
0820UTC 20010KT 9999 BKN015 13/11 Q1021=
0850UTC 20012KT 9999 7000SW -RADZ BKN015 13/11 Q1021=
0920UTC 19010KT 5000 -RADZ SCT012 BKN015 12/11 Q1021=
0950UTC 20011KT 9999 5000NE -RADZ SCT012 BKN015 12/11 Q1021=
1020UTC 20011KT 9999 8000SW VCSH SCT011 BKN015 12/12 Q1021=
1050UTC 20011KT 3000 RADZ VV008 12/11 Q1021=

1.7.2.3 *Namsos Airport (ENNM)*

0620UTC 17010G21KT 140V210 9999 FEW015 SCT025 BKN045 13/10 Q1021=
0750UTC 18012KT 9999 FEW015 BKN025 13/10 Q1021=
0850UTC 18010KT 140V230 9999 FEW015 SCT025 BKN040 13/10 Q1022=
0920UTC 18010KT 140V220 9999 VCSH FEW015 SCT025 BKN040 13/10 Q1022=
0950UTC 19008KT 140V240 9999 FEW015 SCT023 BKN040 13/09 Q1022=
1020UTC 19009KT 140V220 9999 FEW015 SCT023 BKN040 13/10 Q1022=
1050UTC 18010KT 150V220 9999 -RADZ FEW015 SCT020 BKN030 13/10 Q1022=

1.7.2.4 *Ørland Air Base (ENOL) with two-hour forecast (TREND)*

0650UTC 18008KT 9000 -RADZ FEW007 BKN015 12/10 1022 TEMPO BKN008=
0720UTC 18008KT 9000 -RADZ FEW006 BKN012 12710 1022 TEMPO BKN008=
0750UTC 19010KT 9000 -DZ FEW006 BKN012 12/10 Q1022 TEMPO BKN008=
0820UTC 19010KT 5000 -DZ FEW005 BKN010 12/10 Q1022 BECMG 9999 BKN015=
0850UTC 19009KT 9999 FEW005 BKN012 12/11 1022 TEMPO BKN010=
0920UTC 19009KT 9000 -DZ FEW005 BKN012 12/11 1022 TEMPO BKN010=
0950UTC 20009KT 4000 -RA FEW005 BKN010 12/11 Q1022 TEMPO 9999 BKN015=
1020UTC 19009KT 5000 9999S -RADZ FEW005 BKN010 12/11 Q1022 TEMPO 4000 RADZ =
1050UTC 21009KT 9999 5000N -DZ FEW005 BKN010 13/11 Q1022 TEMPO 4000 RADZ =

1.7.2.5 *Trondheim Airport Værnes (ENVA) with two-hour forecast (TREND)*

0650UTC	08002KT 9999 -RA FEW002 SCT025 BKN034 11/10 Q1023 TEMPO -RA BKN014 RMK WIND 670FT 16006KT=
0720UTC	08002KT 9999 -DZ FEW006 SCT045 BKN057 12/10 Q1023 TEMPO -RA BKN014 RMK WIND 670FT 15007KT=
0750UTC	VRB02KT 9999 FEW006 SCT045 BKN057 12/10 Q1023 NOSIG RMK WIND 670FT 15007KT=
0820UTC	05003KT 9999 -DZ FEW006 SCT045 BKN057 12/10 Q1023 NOSIG RMK WIND 670FT 14005KT=
0850UTC	07003KT 040V100 9999 -DZ BKN036 13/10 Q1023 NOSIG RMK WIND 670FT 14007KT=
0920UTC	VRB02KT 9999 BKN036 13/10 Q1023 NOSIG RMK WIND 670FT VRB02KT=
0950UTC	00000KT 9999 FEW018 BKN042 13/11 Q1023 NOSIG RMK WIND 670FT VRB02KT=
1020UTC	VRB01KT 9999 FEW018 SCT041 BKN061 14/10 Q1023 NOSIG RMK WIND 670FT 00000KT=
1050UTC	35003KT 320V020 9999 VCSH FEW018 SCT041 BKN061 14/10 Q1023 NOSIG RMK WIND 670FT 22004KT=

1.7.3 TAF (airport forecasts, times in UTC)

The following weather forecasts with time horizons of between 9 and 24 hours were issued during the period from before take-off until just after the accident:

1.7.3.1 *Brønnøysund Airport (ENBN)*

0500UTC 1006/1015 20008KT 9999 FEW015 BKN030 TEMPO 1010/1015 BKN012=

0800UTC 1009/1018 20010KT 9999 FEW012 BKN020 TEMPO 1010/1012 BKN012 TEMPO 1012/1018 4000 DZRA BKN005=

1100UTC 1012/1021 20010KT 9999 FEW012 BKN020 TEMPO 1012/1021 4000 DZRA BKN005=

1.7.3.2 *Rørvik Airport Ryum (ENRM)*

0500UTC 1005/1015 16008KT 9999 SCT018 BKN040 BECMG 1009/1012 22015KT TEMPO 1009/1015 4000 RADZ SCT008 BKN012=

0800UTC 1009/1018 22012KT 9999 FEW008 BKN020 TEMPO 1009/1018 4000 RADZ SCT008 BKN012=

1100UTC 1012/1021 22012KT 9999 FEW008 BKN020 TEMPO 1012/1021 3000 DZRA BKN005=

1.7.3.3 *Namsos Airport (ENNM)*

No TAF issued.

1.7.3.4 *Ørland Air Base (ENOL)*

0500UTC 1006/1106 VRB05KT 9999 -RA FEW008 BKN025 TEMPO 1006/1008 RA BKN008 BECMG 1009/1012 24012KT=

AMD[6] 0800UTC 1009/1109 24012KT 9999 -RA FEW008 BKN020 TEMPO 1009/1015 4000 RADZ BKN010=

1100UTC 1012/1112 24012KT 9999 -RA FEW008 BKN020 TEMPO 1012/1015 4000 RADZ BKN010=

1.7.3.5 *Trondheim Airport Værnes (ENVA)*

0500UTC 1006/1106 VRB07KT 9999 -RA FEW015 BKN025 TEMPO 1006/1106 BKN014=

0800UTC 1009/1109 VRB05KT 9999 -RA FEW010 BKN030=

AMD 1100UTC 1012/1112 VRB05KT 9999 FEW010 BKN030 PROB40 TEMPO 1012/1018 4000 -DZ BKN014=

1.7.4 IGA prognosis for the relevant coastal and fjord areas

1.7.4.1 Nordland county

```
IGA PROG VALID 100600-101700 UTC Aug12 NORWAY FIR N OF N6500

WIND SFC........: SW/10-25KT, STRONGEST COT
WIND 2000FT.....: SW/20-40KT, STRONGEST N PART COT
WIND/TEMP FL 050: 200-220/15-35KT, STRONGEST N PART
                  COT/PS02-PS05
WIND/TEMP FL100.: 200-260/10-25KT, STRONGEST N PART
                  COT/MS04-MS00
```

[6] *In the met.no system, the original TAF had incorrectly been filed as identical to AMD. However, it forecast better weather.*

```
WX.............: SCT RA, ELSE NIL
VIS............: 6-9KM IN RA, ELSE+10KM
CLD............: LCA BKN 0800-1500FT S PART LATE, ELSE
                 FEW/SCT/BKN 2000-4500FT
0-ISOTHERM.....: FL060-080.
ICE............: LCA FBL, ELSE NIL
TURB...........: LCA FBL IN LOFOTEN AREA, ELSE NIL
```

1.7.4.2 Trøndelag county

```
IGA PROG 100500-101500 UTC Aug 12 NORWAY FIR COASTAL AND FJORD AREAS N6200 TO N6500

WIND SFC.......: SW/05-10KT, COT 10-20KT
WIND 2000FT....: SW/15-25KT, BECMG LCA 30KT S-PART
WIND/TEMP FL050: 220-260/15-25KT, BECMG 240-270/15-25KT, LCA 30-35KT S-PART. TEMP:
                 PS02-PS06
WIND/TEMP FL100: 270-300/10-15KT N-PART FIRST HR, ELSE 290-330/15-20KT, LCA 25-30KT S
                 OF ENKB. TEMP: MS02-PS02
WX.............: SCT RA/RADZ, LCA BR
VIS............: LCA 3-10 KM IN WX
CLD............: FEW/SCT 0800-2000FT, BKN 2000-3000FT, LCA BKN 1000-1400FT
0-ISOTHERM.....: LCA FL065-FL080 N-PART FIRST HR, ELSE FL080-FL115
ICE............: FBL/MOD, LCA FBL/MOD N-PART FIRST HR
TURB...........: NIL/FBL
```

1.7.5 Weather information from witnesses

1.7.5.1 The commander of the air ambulance that took off from the air ambulance base at Heimdal in Trondheim five minutes after the accident has contributed information about the flying conditions in the area. When they approached higher terrain in the Rissa area, visibility was so poor that they had to fly along the fjord in order to be able to continue (ref. Figure 3). They followed the Stjørnfjord for a while before setting a course over land in an attempt to reach Søvatnet from a south-easterly direction. There was rain and drizzle in the air with scattered clouds, and the cloud ceiling varied from 200 to 1 500 ft. Visibility was the main problem, estimated at 800–1 000 m. In order to be able to fly under VFR, it was sometimes necessary to reduce the speed to as little as 20–30 knots. The first attempt had to be aborted. After turning back and flying north for a while, they succeeded in crossing the terrain west of Søvatnet. They located the aircraft wreckage before landing on the hill above the accident site. When they left the site after completing their assignment at 1500 hrs, the weather conditions had improved sufficient for them to fly the direct route back to Trondheim.

1.7.5.2 Witnesses in the cabin near the accident site stated that it had rained all morning, and that there was fog, rain and light wind in the area at the time of the accident. Contours and mountain peaks on the other side of the lake were vaguely visible through the fog.

1.7.5.3 The last photo found from the crashed aircraft was taken about half an hour before the accident, when the aircraft passed Buholmråsa lighthouse. The cloud base appears to have been high and visibility to the ground/lake good as long as they were photographing, with somewhat reduced flight visibility in the final photos.

1.7.5.4 After the accident, the commander of D-EJRW remembered having been in contact with D-EIYL also after he departed from Brønnøysund. An attempt to take a short-cut over land that had to be aborted due to poor weather was mentioned, and they told that they had got a special VFR clearance. Nothing in the conversation gave the impression that this gave rise to any stress or worry. The commander of D-EJRW was aware of previous instances in which the crew on board D-EIYL had either cancelled flights or turned back due to the weather. In his opinion, there was no pressure to reach Værnes, and they were not in a hurry.

1.8 Aids to navigation

1.8.1 Formally speaking, the flight was carried out in accordance with visual flight rules. To aid him in the navigation, the commander had maps in addition to integrated GPS. The GPS display had colour codes for terrain altitudes and a flashing “TERRAIN ALERT” would trigger in case of risk of collision. According to the commander of D-EJRW, the aircraft's GPS was normally the primary navigational aid on board D-EIYL.

1.8.2 The back-seat passenger had a tablet computer of the iPad2 type strapped to his thigh at the time of the accident. In addition, two similar tablet computers with holders were found lying lose in the cabin. According to witnesses, it was normal for them to cooperate as a crew, and to assist each other with navigation and other tasks during a flight. It has not been possible to determine to what extent tablet computers or smartphones on board were used as navigational aids and/or as a source of weather information during the flight in question (ref. section 1.16).

1.9 Communications

D-EIYL was in routine contact with local air traffic service units along the route. No communication errors or irregularities have been reported. The air traffic service has stated that the pilots of all three German planes acted in a professional manner when communicating by radio.

1.10 Aerodrome information

Not relevant.

1.11 Flight recorders

The regulations do not require aircraft of D-EIYL's size/mass to carry flight recorders, and no such equipment was fitted in D-EIYL. The integrated GPS receiver does not store a tracklog. An attempt was made to download data from two destroyed tablet computers found in the wreckage. However, no location data were found in the files that could be analysed (ref. 1.16).

1.12 Wreckage and impact information

1.12.1 <u>The accident site</u>

1.12.1.1 The aircraft crashed in steep, inaccessible wooded terrain at the southern end of Søvatnet lake in Bjugn municipality (position 63° 50,61’N 009° 57,7’E), approx. 13 NM north-east of Ørland Air Base. The wreckage was found at an altitude of 130 metres above sea level (430 ft), up against the trunks of a couple of solid trees near the edge of a steep cliff approx. 85 metres (280 ft) above the lake. The terrain where the wreckage came to rest slopes approx. 30° in the north-south direction. There are several peaks of more than 200 metres in the area, see the photo in Figure 8 and the map in Figure 4.

Figure 8: The terrain at the southern end of Søvatnet lake. The red ring marks the accident site, with the wreckage at the centre. The prominent peak that is partly obscured by fog in the background to the left in the photo is the 379 m (1 240 ft) high Keipen.
(Photo: 330 Squadron – taken from the north looking south a few hours after the accident.)

1.12.1.2 The impact zone showed a clear crater with a diameter of just over two metres in which heather and moss was mixed with wet earth. A 4.8 m long groove/elongated mark led from the crater up towards an approx. 18 m tall pine tree that had had its crown broken and a few branches torn off. The left wing tip cover and various fragments of glass and small parts were scattered around the area. The whole aircraft wreckage was otherwise found in one place further down the hill (ref. Figure 9). There were no other clear marks or trees with visible damage in the area of the accident site.

1.12.2 <u>The aircraft wreckage</u>

1.12.2.1 The aircraft wreckage came to rest located approx. five metres from the impact site (ref. Figure 9 and Figure 10), up against some solid tree trunks. The fuselage had split in the transition between the cabin and tail section. The cockpit and cabin section was heavily deformed and partly compressed. All important parts of the aircraft were found on the accident site.

1.12.2.2 The front part of the wreckage was lying on its right side, partly rolled over onto its roof, with the front pointing roughly to the north. The underside of the fuselage had been pushed in, from the front and back to the main wheels. All windows were broken except for the windows in the doors. A considerable amount of baggage was found in the cabin.

1.12.2.3 The tail section was lying 'the right side up' with the tail fin pointing up. The tail was partly bent around a tree trunk that had obviously helped to stop it going over the edge of the cliff. The structure was severely deformed on the right-hand side. All tail surfaces were virtually undamaged. The emergency locator transmitter (ELT) had been mounted in front of a joint between two plates in the tail, while the antenna had been mounted on the detached tail section. The cable had been torn away from the antenna.

1.12.2.4 The left wing was broken at the wing strut, and most of the leading edge had been pushed in from below. The left wing tip cover was knocked off and was found lying on the ground further up, between the pine tree and the elongated mark. The right wing was broken and partly folded up underneath the wreckage.

1.12.2.5 The cowling was severely deformed, but the engine was still attached to the fuselage. The spinner was severely deformed, and both propeller blades were bent backwards. One of the blades had scratches resulting from rotation, and the propeller shaft was bent. The landing gear and flaps had not been extended.

Figure 9: The accident site viewed in a north-easterly direction. The cabin by the lake where the eye witness was located is visible in the background. The groove created by the left wing and the crater left by the engine are visible in front of the wreckage. (Photo: AIBN)

Figure 10: The front of the wreckage. The engine lies on top of the folded-up right wing. (Photo: AIBN)

1.12.2.6 The indications and positions of instruments, controls and switches were registered partly at the scene of the accident, partly after the aircraft had been transported to the AIBN's premises in Lillestrøm for further examination. Some of the indications must be deemed to be unreliable as a result of the accident. The following was noted:

- Right control column broken
- Trim settings approximately neutral, for both rudder and elevator
- Fuel selector: right tank
- Throttle: approx. 1 inch from full throttle
- Mixture: fully depressed (rich)
- Carburettor heat: on
- Propeller: 'Full fine'
- Altimeter setting: 1020 hPa, and the altimeter showed 715 ft
- Airspeed indicator: 0
- Vertical speed: 920 ft/min climb
- Attitude indicator: broken
- Horizontal Situation Indicator (HSI): heading bug 130°, course selector 200°
- Master switch: ON
- Magneto switch: BOTH
- Autopilot: OFF

1.13 Medical and pathological information

1.13.1 All three persons on board were brought to St. Olavs Hospital in Trondheim for post-mortem medical examinations. There were no signs of illness or of intoxicating or narcotic substances that could affect the commander's performance. This was also the case for the two passengers.

1.13.2 The examination reports showed that the presumed cause of death for the two passengers was head injuries and, for the commander, internal bleeding in combination with head injuries. They all had severe fractures in their lower bodies. All three are assumed to have died shortly after the injuries were sustained, and the head injuries that were found would normally result in immediate loss of consciousness.

1.14 Fire

The fuel tanks were destroyed in the accident, and most of the fuel leaked into the damp forest floor. No fire occurred.

1.15 Survival aspects

1.15.1 All three persons on board were strapped into their seat belts at the time of the accident. The front seats had shoulder harnesses. The front seats were partly torn loose on impact with the ground. All three were wearing inflatable life jackets, as they usually did, according to their travel companions. D-EIYL was equipped with an emergency locator transmitter, but no signals were registered from it.

1.15.2 Eye witnesses reported the accident to the Emergency Medical Communication Centre (AMK) immediately after it occurred. The Joint Rescue Coordination Centre for Southern Norway (JRCC-SN) led the rescue effort. The air ambulance was notified immediately, and took off from its base at Heimdal in Trondheim within a matter of minutes. It would normally have taken approx. 16 minutes to fly the distance in question but, due to poor visibility in the area, it took 32 minutes before they landed at the crest of the hill just above the site of the accident, approx. 40 minutes after the accident.

1.15.3 It was complicated to access and examine the three persons on board the badly damaged aircraft wreckage, but the air ambulance doctor established that all three had been killed in the accident.

1.15.4 A Sea King search and rescue helicopter from Ørland Air Base was briefly unavailable at the time of the accident, but was ready about 30 minutes after having been scrambled and was in the process of transporting police and fire service personnel and equipment from the nearest road to the site an hour after the accident. The accident site was secured, and the deceased and their baggage were removed that evening.

1.16 Tests and research

1.16.1 The AIBN deemed it likely that the tablet computers on board were used as navigational aids, and maybe also for weather updates. Two of the tablet computers were therefore sent to the data recovery company Ibas AS for analysis. The information on the tablet computers is encrypted, and a built-in safety standard will lock the computers if incorrect PIN codes are entered too many times.

1.16.2 The units were damaged by water, deformed and crushed. After carrying out repairs and replacing damaged electronic components, Ibas succeeded in retrieving data from one of the units, whose PIN code was known (belonging to the commander). No indications were found of widely used applications such as Air Navigation Pro or AeroWeather etc. having been installed; nor were any location data or other data that could be useful to the AIBN's investigation found.

1.17 Organisational and management information

1.17.1 General

General rules of the air apply to all aviation in Norway. In addition, the Norwegian operations regulations for non-commercial aviation with aircraft also applied to the flight in question. The commander is responsible for the safe operation of the aircraft and for the safety of all persons on board during flight.

1.17.2 Excerpts from the relevant flight operations provisions

1.17.2.1 The following applies to the planning of flights pursuant to the Norwegian operations regulations for non-commercial aviation with aircraft *(private flying)(BSL D 3-1)*:

> *4.4 Weather reports and flight planning*
>
> *4.4.1 A flight must not commence before the pilot in command has familiarised him/herself with all available meteorological information necessary for the intended flight. Flight preparation must include:*
>
> *a) examination of relevant weather reports and weather forecasts;*
>
> *b) planning of an alternative procedure if the flight cannot be carried out as planned due to weather conditions;*
>
> *c) preparation of an operational flight plan for all IFR flights and for VFR flights to be performed more than 50 NM from the departure aerodrome.*
>
> *[…]*

1.17.2.2 In addition, the following operational restrictions resulting from weather conditions apply to the planning of VFR flights. The planning shall be based on the worst case scenario of the available weather observations/information for the estimated time of passing/arrival.

> *4.5.1.1 A VFR flight that is planned to take place below clouds more than 50 NM from the departure airport, must not commence if the available weather observations/information along the route to be flown under VFR indicate that visibility and cloud ceiling height will be less than 5 km and 1 000 feet.*
>
> *4.5.1.2 A VFR flight on top of clouds is only permitted in daylight and must not commence unless there are available weather observations/information showing that the following requirements can be met for the flight in question:*
>
> *a) Along the route or part of the route that will be flown under VFR, the clouds' extent and layer must be such that flying under VFR is possible.*
>
> *b) At the destination or in the area around the landing site, the amount of clouds must not exceed 4/8 in the layers that the flight is scheduled to take place above.*

c) At the destination or in the area around the landing site, the visibility and cloud ceiling must not be less than 5 km and 1 000 feet, respectively.

1.17.2.3 Pursuant to the *Regulations on rules of the air (BSL F 1-1)* the following minimum requirements apply to flight visibility[7] and distance from cloud for flying under VFR:

> ***Section 2-36.*** *Minimum requirements for flight visibility and distance from cloud for VMC*
>
> *(1) In ATS airspace classes A, C, D and E, flight visibility shall be 8 km at or above FL 100 and 5 km below FL 100. The distance from cloud shall be 1.5 km horizontally and 300 m vertically. The same applies in ATS airspace class G when flying at a height of more than 300 m above the ground or water.*
>
> *(2) When flying at a height of less than 300 m above the ground or water in ATS airspace class G, flight visibility shall be 5 km, and there must be sufficient distance from cloud to keep the ground or water in sight. When the airspeed does not exceed 140 kt IAS, flying is permitted with flight visibility equal to or greater than 3 km, alternatively equal to or greater than 1.5 km for in the landing circuit and with the airport in sight.*

1.17.2.4 Special weather minima apply to flying under VFR in control zones:

> ***Section 3-3:*** *Weather minima for VFR flights in control zones and for special VFR flights*
>
> *(1) Unless clearance has been obtained for special VFR flight or it concerns a flight as mentioned in Section 3-2, flying under VFR shall not take place in a control zone when the ground visibility at the aerodrome in question is less than 5 km and/or the cloud ceiling is lower than 450 m.*
>
> *(2) If ground visibility or flight visibility is less than 3 km, special VFR flights shall not take place except in the following cases:*
>
> > *a) Airplanes wishing to perform the flight as a whole within a control zone or to fly into a control zone to land in that zone can be permitted to carry out a special VFR flight when ground visibility is equal to or greater than 1.5 km. At the same time, flight visibility must not be less than 1.5 km and the speed of the aircraft must not exceed 140 kt IAS.*
> >
> > *b) Helicopters can be permitted to carry out special VFR flights when ground visibility is equal to or greater than 800 m. At the same time, flight visibility must not be less than 800 metres, and the helicopter's speed must be adapted to the flight visibility so that it is possible for the commander to identify obstacles and avoid collision.*
> >
> > *c) For ambulance flights and flights in connection with search and rescue operations, the flight visibility requirements and, if applicable, the stated speed restriction for special VFR flights can be deviated from as specified in Section 3-2 for such flights.*

---

[7] *Regulations on Rules of the Air BSL F 1-1, Section 1-3 Definitions: Flight visibility: Forward visibility from the cockpit of a flying aircraft.*

1.17.2.5 The general provision regarding minimum height reads as follows:

> ***Section 3-5*** *Minimum height*
>
> *(1) VFR flights shall not be flown at a height less than 300 m (1 000 ft) above the highest obstacle within a radius of 600 m from the aircraft over the congested areas of cities, towns or settlements or over an open-air assembly of persons, or elsewhere at a height less than 150 m (500 ft) above the ground or water.*

1.17.3 Airports, airspace and air traffic services

1.17.3.1 Some Norwegian airports (including Leknes, Brønnøysund and Rørvik) do not fall under the definition of 'controlled aerodrome'. Aerodrome Flight Information Service (AFIS) units have been established at these airports. AFIS units do not carry out air traffic control services; they simply provide air information and alerting services to aircraft prior to departure, in the manoeuvring area and during flights within specified limits in the non-controlled airspace around the airport (TIZ/TIA[8]).

1.17.3.2 Formally speaking, the flight with which we are concerned was conducted as a VFR flight from departure until the accident. The aircraft is not likely to have entered the Ørland control zone before crashing, and was thus in uncontrolled airspace (class G ATS airspace, including TIZ/TIA) for the whole period of flying south of Brønnøysund. No clearance was required; it was the commander's responsibility to avoid collision with other aircraft. The service provided [in uncontrolled areas] is limited to flight information and alerting services for known traffic. A description of the structure, areas of responsibility and types of air services provided by the air traffic service can be found in AIP Norge GEN 3.3.

1.17.3.3 A definition of the flight information service is found in Section 1-3 of the Regulations on Rules of the Air (BSL F 1-1):

> *A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.*

1.17.3.4 Subject to certain adjustments and special provisions, Procedures for Air Navigation Services – Air Traffic Management, ICAO PANS-ATM Doc 4444 are implemented as Norwegian regulations for air traffic management (BSL G 8-1). None of the special provisions seem to be of relevance to this accident. According to guidelines, the CAA-N intends to develop regulations concerning AFIS.

1.17.3.5 Norwegian regulations (BSL G 2-2[9]) requires the service provider to be able to demonstrate that its working methods and operating procedures are compliant with the standards in the Annex 11 to the Convention on International Civil Aviation, where amongst other the following is stated:

---

[8] *Traffic information zones (TIZ) and traffic information areas (TIA) are non-controlled airspaces of certain dimensions where two-way radio communication is required, in which flight information and alerting services are provided. Services within a TIZ are normally provided by an AFIS unit. Services within a TIA are normally provided by an air traffic control centre.*

[9] *COMMISSION REGULATION (EC) No 2096/2005 of 20 December 2005 laying down common requirements for the provision of air navigation services Annex II para. 4*

> *[4.2.4] Flight information service provided to VFR flights shall include, in addition to that outlined in [4.2.1], the provision of available information concerning traffic and weather conditions along the route of flight that are likely to make operation under the visual flight rules impracticable.*

1.17.4 Weather Service

The aviation weather service in Norway is provided by the Norwegian Meteorological Institute. The Regulations on the aviation weather service (BSL G 7-1) were adopted in 2008. The following is quoted from Section 10 *Observations and reports*:

> *(1) Regular observations (METAR) shall be carried out at least once every hour during the period when air traffic services are provided. The information is to be announced as METAR code via AFTN, see Section 7. If METARs are only prepared once an hour, a SPECI must also be issued when the weather conditions so require.*

The Regulations were adopted by the Civil Aviation Authority Norway. It is clear from the quoted section that there is no requirement for issuing SPECIs where METARs are issued every half hour. The Norwegian Meteorological Institute has issued guidelines[10] that explain the criteria for what constitute significant changes, among other things. One criteria is that visibility deteriorates and passes through 5 000, 3 000, 1 500 and 800 metres, respectively.

1.18 Additional information

Not applicable.

1.19 Useful or effective investigative techniques

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

2. ANALYSIS

2.1 Introduction

2.1.1 Based on the available information, the AIBN believes that there is no doubt that this was a weather-related accident. The flight was to be conducted under VFR but, in the en-route phase, D-EIYL entered an area with instrument meteorological conditions[11] (IMC). It can be established that the flying height was reduced to below the applicable minimum height during the final part of the flight, probably in an attempt to maintain sufficient flight visibility. The aircraft was observed to be climbing immediately before it hit the terrain approx. 250 ft above the lowest point in the immediate vicinity (ref. 1.1.3.2).

2.1.2 The investigation revealed no indications of defects or malfunctions in the aircraft. It was reportedly in good condition, and had recently been to a maintenance check. The position of the carburettor heat handle indicated that it was turned on when the accident happened,

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[10] *These guidelines are based on ICAO Annex 3 and are found in the code book 'Meteorologiske koder for flyværtjenesten' ('Meteorological codes for the aviation weather service').*

[11] *Weather conditions that in terms of visibility, cloud clearance and cloud ceiling did not meet the minimum requirements for visual meteorological conditions.*

and the aircraft had plenty of fuel on board. That a witness to the accident heard the engine's rpm increase and saw the aircraft climb towards the upwards sloping terrain until it crashed supports the conclusion that the accident was not caused by technical problems. The temperature conditions indicated no risk of icing at heights of less than 5 000 ft, and the wind at the accident site was weak.

2.1.3 Statistically, accidents that occur in connection with VFR flights into IMC often have a fatal outcome. Many accident reports and international studies describe the risks associated with VFR flights in reduced visibility. The studies also emphasise the importance of developing knowledge and skills to avoid unintentional flights under instrument conditions. Key elements include thorough planning, including of an alternative procedure, knowledge of air masses, interpretation of weather conditions and obtaining up-to-date information during the flight. Among other things, the studies also discuss the human factors relating to decision-making and the importance of turning back in due time and always having a safe option. The prevention of pressure on pilot/crew as a result of the expectations of passengers and others is also emphasised as important.

2.1.4 The AIBN has chosen to refer to some Norwegian accident reports and relevant safety studies in this report (see References). These documents also contain references for further reading. The analysis of the D-EIYL accident is limited to flight operations, including interaction with the air traffic service, and an assessment of the weather, the accident sequence and the survival aspects.

2.2 Flight preparations

2.2.1 The preparations for the flight appear to have been thorough in many ways, but characterised by mostly having been carried out the previous evening. For example, the morning forecast was 20-40 kt south-westerly winds at 2,000 ft along the coast of Nordland county (ref. 1.7.4), without these head winds being reflected in the estimated flight time given in the submitted flight plan.

2.2.2 According to the commander of D-EJRW, the whole party expected visual meteorological conditions. However, the IGA prognosis that was available before departure in the morning stated that there was a risk of local precipitation with visibility as low as 3 km in the coastal and fjord areas of the Trøndelag region (ref. 1.7.4.2). Temporary visibility of 4 km was also forecast for Rørvik (ref. 1.7.3.2). Flight planning shall be based on the worst case scenario of the available weather information for the estimated time of passing (ref. 1.17.2.2). This means that, pursuant to the regulations, the flight could not be planned further south than to Brønnøysund.

2.2.3 The weather in Norway is greatly influenced by the terrain, and it changes rapidly. For VFR flights, it is important to consider the local forecast (IGA prognosis) in conjunction with METAR and TAF. In the AIBN's opinion, the reassessment of the weather conditions carried out before departure was apparently not thorough enough. The weather during the flight is discussed in section 2.3.

2.2.4 On departure from Leknes the mass of the aircraft exceeded the permitted maximum by approx. 8% (ref. 1.6.3.5), which is a significant exceedance. It is understandable that witnesses reacted to the aircraft's poor ability to climb (ref. 1.1.2.1). In the AIBN's experience, private pilots who set out on long trips often underestimate the mass of the equipment they carry. This was obviously the case here, and the AIBN questions the judgement exercised on this point. If the pilots in D-EIYL had a more correct perception of the aircraft's mass, they should have planned for an additional fuel stop instead of filling up the fuel tanks before the return flight. However, it is assumed that this had no bearing on the accident. At the time of the accident, the aircraft was only slightly overloaded, and this would not have had any significant impact on its stability or stall speed.

2.3 Weather and availability of weather information during the flight

2.3.1 It is not known exactly when and where D-EIYL entered an area of poor visibility, but the witness observation north-east of Rørvik indicates that the weather was already so poor that the aircraft should have turned back[12] (ref. 1.1.2.8). The photo of Kolvereid, which must have been taken after the witness observation, shows that the aircraft was flying at a good height and that visibility in the sector shown was adequate. Precipitation and dark clouds can be glimpsed by the coast, however. The choice of route will be discussed in more detail in section 2.4.

2.3.2 There are no records of radio calls from D-EIYL requesting weather information. Any information obtained from the other aircraft in the party was probably of little use, since they had chosen a different route (IFR and VFR on top).

2.3.3 It is uncertain whether the people on board D-EIYL took the opportunity to obtain up-to-date weather information from Rørvik and Ørland by means of smartphones or tablet computers (Aeroweather application). If they had done so, METAR with TREND at the time of passing Kolvereid would have shown that VMC were expected at Ørland for the next two hours (9000 -DZ FEW005 BKN012 TEMPO BKN010, ref. 1.7.2.4).

2.3.4 As the morning wore on, visibility at Rørvik and Ørland became poorer than forecast. This was particularly unexpected at Ørland. No reduction in visibility was forecast at the time when D-EIYL chose to divert to the coast due to poor weather. The message that local visibility had decreased to 4 km came approx. 7 minutes later (ref. 1.1.2.11). Until that time, weather observations for Ørland had mostly shown good visibility despite persistent precipitation.

2.3.5 After being specifically told that the weather was better further inland at Leirvik and poor along the coast, D-EIYL changed its course and started flying inwards from the coast, along the Jøssundfjord (ref. 1.1.2.15 and 1.1.2.16). This suggests that they saw a need to avoid the coastal area. When this attempt had to be aborted, the commander chose to continue along the coast towards Ørland all the same.

2.3.6 It is only natural to follow the coast under reduced visibility conditions, but it is the AIBN's opinion that the limits may at this point have been stretched beyond what was safe. At times, D-EIYL was only sporadically visible on the radar, and then only at an altitude of 400 ft or with no altitude given. This, together with the fact that Ørland was unable to achieve radio contact with the aircraft, indicates that it was flying low. A little while later, the commander responded with a *'thank you'* to the air traffic controller's message that there was no guarantee of better visibility further south along the coast (ref. 1.1.2.17). The AIBN finds that the aircraft crew may possibly have misunderstood this

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[12] *On a general basis, the AIBN would like to stress that it can be difficult for eye witnesses on the ground to determine whether an aircraft is actually flying into and out of clouds.*

message. The recording had poor sound quality, which can also have something to do with the aircraft flying low.

2.3.7 Visibility quickly became a topic when communication with D-EIYL had been transferred to Ørland. The air traffic controller provided unsolicited information that visibility seemed to be improving, to up to 6 km to the north-east and better further up the Trondheimsfjord (ref. 1.1.2.21). No more was said about the weather after this, and the aircraft was cleared for special VFR in accordance with the regulations. The air traffic service's responsibilities and role are discussed in more detail in section 2.7.

2.4 Choice of route

2.4.1 Had the flight initially gone no further than to Brønnøysund, this might have had a bearing on the choice of route and alternative planning. This illustrates the safety aspect incorporated into the weather provisions concerning flight planning (ref. 1.17.2). Stricter requirements apply to planning than to execution, since they are designed to take account of uncertainties and changes that may occur. Extra safety margins are required for VFR flights longer than 50 NM from the departure airport. The AIBN will base its further assessments of the weather and choice of route on the aircraft being in the en route phase, during which other rules apply (ref. 1.17.2.3).

2.4.2 Had the commander of D-EIYL had a complete overview of the weather situation on passing Brønnøysund, it is conceivable that he would have considered a route further inland in the hope of avoiding the frontal zone. Terrain altitudes in the inland areas indicate that a cloud ceiling of approx. 3,000 ft would be required in order to fly along that stretch of the route. During the period in question, Namsos, which is located at sea level between the inland and coastal areas, had scattered clouds at 2,300 ft and a ceiling at 4,000 ft (ref. 1.7.2.3). However, at the time, there was little to suggest that visibility along the alternative route along the coast would become as poor as it actually did.

2.4.3 When flight visibility became poor after the aircraft had crossed the Folda fjord (1.1.2.11), the commander chose to change course towards the coast and continue south instead of turning back. This choice brought the aircraft into the precipitation zone where the meteorological conditions were below required VMC, with more than one and a half hour's flying time remaining to the destination.

2.4.4 The D-EIYL's new estimated time of arrival at Værnes (ref. 1.1.2.20) suggests that the plan was to follow the coast to Uthaug and fly up the Trondheimsfjord. Why the aircraft left the coast and headed inland over higher terrain over the Fosen peninsula is unknown. At the time of the accident, the aircraft still had enough fuel for about two hours' flight, so there would have been no need to take a short-cut for fuel reasons.

2.4.5 It is not possible to reconstruct D-EIYL's exact route during the final part of the flight, since the aircraft was not visible on the radar and the attempt to find a tracklog on the examined equipment found on board was not successful. Among other things, it is impossible to determine whether they attempted to turn back. The time it took the aircraft to fly from its last registered radar position to the accident site gives an average ground speed of just under 70 kt, if one assumes that it flew in a straight line (approx. 16 NM in approx. 14 minutes, ref. Figure 3). This indicates that the aircraft flew at a reduced speed and/or variable course, which also agrees with witness descriptions of what happened during the final minutes.

2.4.6 Witness statements describing rain in the air and low clouds/fog indicate that flight visibility must have been very poor towards the end. Continuing under such conditions entail a formidable risk and the workload on board can quickly become unmanageable. At safe altitudes, the aircraft instruments can be used as a reference in an emergency, provided that the crew possesses the required equipment and skills. However, given that they flew at such a low altitude over the terrain, it would have been absolutely necessary to look for external references. As a consequence, low priority would have been given to monitoring of the aircraft instruments and the colour codes on the GPS etc. Most important would have been to maintain control of the aircraft, avoid collision with the terrain and find a way out of the immediate critical situation as quickly as possible.

2.4.7 The AIBN believes that the pilots on board D-EIYL may have felt a self-imposed pressure to get to Værnes, despite the fact that the party was not short of time. It is human not to want to inconvenience others. One of the findings of the safety studies listed by the AIBN under References, is that the limits are typically pushed near the end of a flight. The final fifth of a flight is the most dangerous part. The importance of turning back in time and always have a safe alternative available cannot be emphasised often enough. A precautionary landing, for example in a field, will often only result in material damage, while loss of control in the air or a collision with the terrain during blind flying will usually have fatal consequences.

2.5 The accident sequence

2.5.1 The marks on the ground, the condition of the aircraft wreckage and the fact that only one tree in the woodland surrounding the crash site was broken indicates that the aircraft came down at a very steep angle. In the AIBN's opinion, it can be ruled out that the aircraft crashed into the forest at cruising speed. That would have resulted in more broken trees, and the aircraft would have continued to move in the direction of travel. The pattern of damage is more consistent with a crash following a stall (the aircraft's wing suddenly ceases to produce lift). The aircraft's exact course prior to the accident is unknown. The broken pine crown up from the wreckage and the witness statement suggests that the aircraft may have experienced a wing drop (asymmetric stall) before it hit the ground.

2.5.2 Without witness statements, it would be natural to assume that the commander suffered an attack of vertigo as a result of loss of visual references. It changes the impression somewhat that witness statements suggest that the people on board had ground visibility right up until the accident occurred. With flight visibility of 800 – 1 000 metres in the area and a variable and diffuse cloud base, as experienced by the air ambulance just under half an hour after the accident, there may nevertheless have been a real risk of sensory illusions. Knowledge of sensory illusions and recognition of how quickly a person can suffer an attack of vertigo (false illusion about the position of the aircraft) are essential to understanding the risk of flying without sufficient references. The AIBN would like to stress that nobody, not even an experienced pilot, is immune to sensory illusions.

2.5.3 It is recommended procedure for pilots who inadvertently enter an area of poor visibility to reduce airspeed in order to be able to detect obstacles in time and reduce the turning radius. Since a certain safety margin to prevent stalling must be maintained, there is of course a limit to how far it is safe to reduce the speed. Flap extension can increase the margin in an emergency, but this is not recommended procedure, since pilots are not expected to place themselves in situations where the safety margins are so small. In addition to the risk associated with losing visual references, the D-EIYL accident also serves as a reminder of the risk involved in low and slow flying.

2.5.4 The visibility conditions described, the terrain conditions in the area and the witness statements lead the AIBN to believe that D-EIYL probably intended to pass over the terrain with little margin, in the same way as it had passed over the crest of the hill just north of the accident site. With the course they had, they would have steered clear of the highest terrain in the area, but the AIBN also believes that the 240 m high 'Sofusklumpen' peak may have been covered in clouds or become visible too late to prevent the accident. Given the low altitude at which the aircraft was flying, already at low speed and full engine power, the margins were insufficient to climb above a suddenly appearing obstacle. If the control wheel is instinctively operated to increase the altitude or make an evasive manoeuvre, that could provoke a stall.

2.6 Survival aspects

2.6.1 Some new types of light aircraft are delivered with airbags, including new versions of the Cessna 172. It is also possible to install seatbelts with integrated airbags in older airplanes. Assuming that there is survivable space in the cabin, these airbag-systems will generally give best G-force protection in the forward speed direction, which is when the torso of a seated person is thrown forward in an accident.

2.6.2 The injuries described in the autopsy reports, suggests that there might have been some survivable space left in the cabin of D-EIYL. As an example, none of the deceased had lethal injuries to the torso area. But in addition to head trauma, which was not survivable, all three on board had severe fractures (ref. 1.13). Especially fractures to the pelvis and femur may result in severe haemorrhage – 'bleeding to death'. If D-EIYL had been equipped with airbags, it might have reduced the head trauma, but the injuries sustained to the lower body/hips would probably not have been affected. Personnel protective gear like airbags would therefore most likely not have had an impact on the outcome in this accident.

2.6.3 The search and rescue operation was initiated exceptionally quickly because there were eye witnesses to the accident and an air ambulance was available nearby. The outcome would have been the same even if personnel had arrived at the scene of the accident sooner.

2.6.4 The emergency locator transmitter was of no use in locating the aircraft wreckage, since the connection between the transmitter and the external antenna had been severed.

2.7 Role of the air traffic service

2.7.1 The commander's responsibility for the flight and safety can be said to be 'all-embracing' when flying under VFR. On its part, the air traffic service shall contribute flight information. According to international provisions, the purpose of this service is to provide advice and information of importance to the safe and efficient conduction of flights (ref. 1.17.3.3). For a controlling unit, providing an air traffic control service is the first priority. At what level flight information services should be provided has not been unambiguously established. Advising and assisting VFR pilots who have stated that they are uncertain about their position or have inadvertently entered areas of instrument meteorological conditions are described in regulations and must be expected. Other than that, the service provided will vary depending on the traffic load and the capacity and judgement of the individual air traffic controller or AFIS duty officer.

2.7.2 Records of messages exchanged by the air traffic service units show what was done to assist D-EIYL in the period that followed. Seven activities have been registered during the period from Ørland contacted Bodø with information that visibility was down to 4 km until the air traffic controller in Bodø transferred communication with D-EIYL back to Ørland approx. 25 minutes later. Four of these activities were weather-related messages directly to D-EIYL.

2.7.3 The AIBN's impression is that in this case, Bodø ATCC put considerable effort into communicating relevant information to D-EIYL as soon as Ørland TWR gave notification that the conditions were no longer VMC in the area. It was a good idea to connect the commander to the local air traffic service at Ørland to communicate information about the relevant weather conditions in the best possible way (ref. 1.1.2.13). When D-EIYL turned out to be out of radio range, it was commendable that the air traffic controllers took necessary steps to return the aircraft to the Bodø frequency. Under the circumstances, it was important to be able to communicate information about the flying conditions without delay. It was also positive that the air traffic controller at Ørland took the initiative to prepare for landing at the air base should that become necessary. The high level of activity that went into assisting this VFR flight was possible because the units involved had a low to moderat workload during the period in question.

2.7.4 In the AIBN's opinion, there is reason to believe that Avinor would have started its active efforts to inform D-EIYL about the weather half an hour earlier had visibility been a topic as early as during the coordination between Brønnøysund AFIS and Bodø ATCC (ref. 1.1.2.6). This would also be in line with the intent of ICAO Annex 11 (ref. 1.17.4). In hindsight, it can therefore appear that the measures taken during the transfer were not optimal in terms of providing advice and information of importance to the safe and efficient execution of the flight. If the commander had been in direct contact with Rørvik, he would probably have been informed about the very poor visibility immediately. Whether this would have had a bearing on his choice of route and the course of events that followed is uncertain, however.

2.7.5 Experience shows that the bar in relation to turning back is often higher than for adjusting the course en route. This also appears to have been the case for D-EIYL. On a general basis, the AIBN would claim that it would improve flight safety if all parties that are able to do so help to prevent VFR flights from entering instrument meteorological conditions. This applies regardless of what the regulations, strictly speaking, require of each party. The AIBN would particularly like to emphasise how important it is that VFR pilots do not hesitate to call the air traffic service to request information and seek advice if possible.

2.8 Provisions regarding communication of weather conditions

2.8.1 Recordings of coordination between the air traffic service units indicate that at one time (at approx. 0955 hrs, ref. 1.1.2.6), between two METARs, visibility as low as 2 000 metres was measured at Rørvik, without this being reflected in the published observations. When METARs are issued every half hour, there is no requirement for a SPECI to be issued even in the event of significantly reduced visibility (see 1.17.4). This can entail delays in the information flow that seem unnecessary in our time.

2.8.2 In the AIBN's opinion, the special topographical conditions and rapid weather changes in Norway justify announcing information about significant weather changes without delay. A safety recommendation is therefore submitted to change the regulatory requirement on this point.

2.9 Concluding comments

2.9.1 On a general basis, as far as workload and decision-making is concerned, the AIBN can see both advantages and disadvantages in there being several pilots on board and in belonging to a party of several aircraft. These are among the factors discussed in the aforementioned safety studies. It is impossible to know what was decisive in the accident involving D-EIYL, and the AIBN refrains from speculation.

2.9.2 There used to be a limit to how far a VFR pilot could 'push' the weather before becoming lost. Since the introduction of the GPS as a common navigational aid on board light aircraft, it has become much easier to determine one's own position. The technology also provides new possibilities which can contribute to increased safety margins. As an example ‘moving map’ function with elevation graph can increase the pilot’s awareness of terrain height ahead of the airplane based on predicted track. However, AIBN believes that this new technology also has contributed to greater courage among VFR-pilot’s when attempting to 'push' through areas in marginal weather conditions. This development would be an example of risk-compensation (also known as risk homeostasis), which means that all or part of the potential safety benefits gained through technology improvement is lost because the user of the equipment is taking greater risks.

2.9.3 With good access to online information in the planning phase, direct contact between the pilot and the meteorologist in the planning phase has virtually become redundant. Lately, smartphones that display up-to-date weather information during the en route phase have also become a welcome aid to many. However, up-to-date METARs and real-time satellite images of precipitation does not provide information about amount of cloud and visibility between airports, and the AIBN has previously warned against relying on digital information alone.

2.9.4 As regards the alternative of flying VFR on top, the AIBN wishes to point out that it is a risky alternative. For example, critical situation can arise if the holes in a broken cloud cover are 'in the wrong place' when an aircraft needs to descent for landing. There have been several cases in Norway where pilots flying VFR on top have required extensive assistance from the air traffic service, see for example the AIBN report SL2011/05. Report SL2012/01 tells the story of an VFR flight on top that entered IMC and was saved by the airframe parachute system.

2.9.5 The aforementioned VFR guide for Norway published by the Norwegian Civil Aviation Administration contains many good tips, including some about special challenges posed by sudden weather changes and considerations relating to terrain conditions and emergency landing possibilities. It was positive that the pilots in the party had used the guide to plan their trip to Norway. An important reason why this publication was initially developed on the basis of an AIC and has since been regularly updated was the high incidence of weather-related accidents and incidents in Norway involving foreign registered aircraft.

2.9.6 The AIBN believes that the description of the history of the flight and the issues discussed in this report are suitable for training purposes and as topics of self-study for VFR pilots and air traffic service personnel.

3. CONCLUSIONS

3.1 Findings

a) The aircraft was registered in accordance with the applicable regulations, and its airworthiness review certificate was valid. The aircraft was equipped for IFR flights.

b) The commander held a valid private pilot licence. Neither he nor the two other private pilots on board were licensed for IFR flying.

c) The worst case-scenario part of the available weather forecast for the estimated time of passing the Trøndelag counties indicated that VFR planning criteria were not met for the final part of the flight from Leknes to Værnes.

d) The airport forecasts that were available for Rørvik and Ørland before departure from Leknes indicated better weather conditions than they proved to be when the aircraft had been in the air for just over two hours and entered the Trøndelag region.

e) The air traffic service did not inform the commander about the unexpectedly poor visibility conditions at Rørvik.

f) The provisions that govern the aviation weather service do not require a SPECI to be issued for significant changes when METARs are issued every half hour.

g) After the aircraft had passed Rørvik to the east some distance inland, the commander stated over the radio that he would follow the coast south due to the poor weather. He did not at any time send a distress call or request any type of assistance.

h) Visibility at Ørland unexpectedly deteriorated to 4 km.

i) The air traffic service informed the commander that visibility at Ørland was 4 km, and continued with active efforts to obtain and communicate weather information.

j) The commander attempted to fly inland over the Jøssundfjord, but had to abort this attempt due to poor visibility and continue south along the coast, despite the fact that the weather at Ørland meant that flying in the control zone would have to be conducted as a special VFR flight.

k) The commander may have put himself under pressure to reach Værnes, where they were to meet the two other aircraft in the party.

l) Radar records of the last half hour of the flight show only sporadic records of the aircraft, some at 400–500 ft and some with no altitude registered, which suggests that it was flying at a low altitude.

m) It is unknown why D-EIYL left the coastline to head inland over hilly terrain.

n) Witness observations of the flight indicate that just before the accident, the aircraft was clear of the clouds, but that it was flying at a very low height over hilly terrain in reduced visibility with patches of fog around the peaks in the area.

o) The investigation has not uncovered any defects or malfunctions to the aircraft or irregularities in its maintenance that could have contributed to the accident.

p) The witness' observation of increasing engine rpm as the aircraft climbed towards the steep terrain, as well as the propeller damage, supports the assumption that the engine was producing power.

q) The aircraft crashed into the terrain at a steep angle and was totally destroyed as a result of the impact forces created by the accident.

r) Marks at accident site indicate that the aircraft stalled before it hit the ground.

s) The aircraft appears to have been structurally intact prior to impact.

t) Its mass at the time of the accident was probably just over the maximum permitted value, but that is not believed to have had any bearing on the accident.

u) The post-mortem examination of the commander found no signs of illness and no traces of intoxicating or narcotic substances.

v) The impact forces with the ground inflicted non-survivable injuries on the people on board.

3.2 Significant findings

The AIBN believes that the following findings were of decisive importance to the history of the flight or are particularly important from a safety point of view:

a) The flight continued into an area with marginal weather conditions rather than turning back in time.

b) Eventually, the aircraft was flying low over hilly terrain heading towards peaks covered by clouds, which made it impossible to continue with safe terrain clearance.

4. SAFETY RECOMMENDATIONS

The flight operations elements discussed in this report are well known and regulated, and form no basis for safety recommendations. However, the AIBN feels that the investigation has uncovered a weakness in the current aviation weather service provisions, and the following safety recommendation is therefore submitted[13]:

4.1 Safety recommendation SL No. 2013/05T

At one time, between two METARs, visibility dropped from more than 10 km to 2 000 metres without this being reflected in published observations. When METARs are issued every half hour, there is no requirement for a SPECI to be issued even in the event of significantly reduced visibility. Delays in communicating information are unfortunate in a country such as Norway, where the weather changes rapidly due to the topographical conditions.

The Accident Investigation Board Norway recommends that the Norwegian Civil Aviation Authority considers whether the aviation weather service provisions should be amended to include requirements for faster announcement of significant weather changes.

Accident Investigation Board Norway

Lillestrøm, 4. June 2013

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[13] *The Ministry of Transport and Communications forwards safety recommendations to the Civil Aviation Authority and/or other involved ministries for evaluation and monitoring, see Section 17 of the Norwegian Regulations on public investigations of accidents and incidents.*

REFERENCES

Various AIBN reports:

- Accident Cirrus SR20 VFR on top into IMC Sirdal (SL2012/01)
- Serious incident Sikorsky S-61 VFR into IMC Bodø (SL2011/15)
- Fatal accident Eurocopter AS 350 B3 VFR into IMC Rostadalen (SL2011/08)
- Serious incident VFR on top Piper PA-28-181 Oslo Area (SL2011/05)
- Accident Eurocopter SA 315 B VFR into IMC Tovenfjellet (SL2009/20)
- Accident Bell 206B VFR into IMC Eggemoen (SL2009/16)
- Accident Reims F172 VFR into IMC Hadeland (SL2007/27)
- Fatal accident Piper PA-28 VFR into IMC Sunndalsøra (2007/24)
- Serious incident Piper PA-28-181 VFR into IMC Bardufoss (SL2006/22)
- Fatal accident Cessna 180H VFR into IMC Slettefjell near Notodden (SL2006/16)
- Incident PA-28-140 VFR into IMC Rukkedalen near Dagali SL2005/30
- Fatal accident MD 369E VFR into IMC Valdresflya (SL2003/09)
- Accident VFR into IMC SAAB MFI 9B Meråker (SL2002/18)
- Fatal accident Cessna C182Q, D-EPEE VFR into IMC Reinøya (SL2000/61)
- Fatal accident Eurocopter AS 350B2 VFR into IMC Tyin (SL2000/09)
- Incident Socata-Groupe Aerospatiale TB 9, D-EVEN near Sola (1999/BUL32)
- Incident Piper PA-28RT-201 VFR into IMC near Varhaug (1999/BUL23)
- Fatal accident Cessna 172 VFR into IMC near Biri (SL1994/07)

Safety studies:

- National Transportation Safety Board (NTSB/SS-05/01): Safety Study – Risk Factors Associated with Weather-Related General Aviation Accidents
- Australian Transport Safety Bureau (ATSB): General Aviation Pilot Behaviours in the Face of Adverse Weather

- Accidents involving Visual Flight Rules pilots in Instrument Meteorological Conditions

- European General Aviation Safety Team (EGAST)[14] Safety promotion leaflet 4: Weather anticipation for general aviation pilots.

- SKYBrary[15]:
  SKYbrary – VFR Flight Into IMC

- Civil Aviation Authority Norway:
  VFR guide for Norway 2012

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[14] *EGAST is one of the pillars of the European Strategic Safety Initiative (ESSI), which is a partnership between EASA, other regulators and the industry. Its purpose is: '… to further enhance safety for citizens in Europe and worldwide through safety analysis, implementation of cost effective action plans, and coordination with other safety initiatives worldwide'.*

[15] *SKYbrary is described as 'an electronic repository of safety knowledge related to ATM and aviation safety in general. It is also a portal, a common entry point that enables users to access the safety data made available on the websites of various aviation organisations - regulators, service providers, industry'. (SKYbrary Content Management).*

APPENDICES

ABBREVIATIONS

AIC	Aeronautical Information Circular
AFIS	Aerodrome Flight Information Services (local flight information service)
AMK	Emergency Medical Communication Centre
ARC	Airworthiness Review Certificate
CAR Norway	Civil Aviation Regulations
GPS	Global Positioning System
hPa	Hectopascal
JRCC-SN	Joint Rescue Coordination Centre South Norway
IAS	Indicated airspeed
IPPC	Internet Pilot Planning Center
KIAS	Indicated airspeed in knots
Kt/KT	Knots, i.e. nautical miles per hour
MASL	Metres above sea level
METAR	Routine weather observations for aviation (in meteorological code)
MTOM	Maximum Take Off Mass
N	North
PANS-ATM	Procedures for Air Navigation Services – Air Traffic Management
QNH	Q code stating air pressure
TAF	Terminal Area Forecast (in meteorological code)
UTC	Universal Time Coordinated
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
Z	Zulu time, corresponds to UTC
E	East