Accident Investigation Board Norway

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REPORT SL 2012/01

REPORT ON AIRCRAFT ACCIDENT IN SIRDAL, VEST-AGDER, NORWAY ON 28 MAY 2010 INVOLVING CIRRUS SR20, LN-BCD

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Photos: AIBN and Trond Isaksen/OSL

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AIRCRAFT ACCIDENT REPORT

Aircraft:	Cirrus Design Corp SR20
Nationality and registration:	Norwegian, LN-BCD
Owner:	Private
User:	Private
Accident site:	Sirdal, Vest-Agder, Norway (59°04'40"N 006°58'30"E)
Accident time:	Friday, 28 May 2010 at 1906 hrs.

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

NOTIFICATION

On 28 May 2010, at 1959 hrs, the Joint Rescue Coordination Centre notified the officer on duty with the Accident Investigation Board Norway (AIBN) that a Cirrus SR20 aircraft had had an accident in Sirdal in Vest-Agder County. The AIBN sent two inspectors of accidents to the site the following day.

In accordance with ICAO Annex 13, Aircraft Accident and Incident Investigation, the AIBN notified the authorities in the State of manufacturing USA about the accident. The US National Transportation Safety Board (NTSB) appointed an accredited representative to assist in the investigation. The representative was supported by advisors from the aircraft manufacturer.

SUMMARY

The private aircraft was en route from Stavanger airport Sola to Tønsberg airport Jarlsberg when clouds made it necessary to turn back to maintain visual references. When turning, the aircraft entered clouds with severe icing and turbulence. Control was lost as the pilot in command, who had no experience with instrument flying, suffered from vertigo and as ice built up on the wing and most likely made the aircraft stall prematurely. A probable total loss with a fatal outcome was prevented by the pilot's activation of the aircraft's rescue parachute. The aircraft came down in rough terrain north of Ådneram in Sirdal with significant structural damage, but none of the four occupants sustained injury.

The opinion of the Accident Investigation Board Norway is that insufficient planning ahead of departure and too little distance to rapidly growing clouds (towering cumulus) were contributing factors to the accident. This report makes one safety recommendation.

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 The plan was that the pilot would fly from Stavanger airport Sola (ENZV) to Jarlsberg (ENJB) with three friends on a Friday afternoon. The trip had been agreed several months earlier. They were going to a concert in Oslo on Sunday, and would stay in the Tønsberg area until Monday.

1.1.2 The pilot was one of the owners of the aircraft, a 2008 model Cirrus SR20 equipped with modern cockpit instrumentation and a rescue parachute. The pilot was familiar with the area, having used a light aircraft to transport himself along the same route about 40-50 times in connection with work. The trip was planned to take place under visual flight rules (VFR).

1.1.3 In the morning, the pilot monitored weather developments on the internet. He paid particular attention to radar images on IPPC (Internet Pilot Planning Centre), and observed squalls in the area. He has stated that following the coastline was one alternative, but that in his experience it was preferable to fly on top instead of under the cloud cover along the coast, where he risked having to fly lower than desirable. Before departure, he called people he knew in Egersund and was told that there was thunder with rain and sleet squalls in the area. He therefore decided to observe the weather as he encountered it on the direct route via Sirdal, Nissedal and Skien, and adjust the course a bit further north if necessary. He submitted a flight plan in accordance with this. The trip was calculated to take one hour and ten minutes in calm wind conditions.

1.1.4 The pilot inspected the aircraft without remarks in the hangar prior to departure. Fuel on board was 23 U.S. gallons (87 litres), which was approximately 6 gallons more than he would need for the planned trip, including reserve. The passengers had been told to bring as little baggage as possible, and the mass and balance calculations showed values within limits. The pilot briefed the passengers on emergency procedures and emergency equipment, including the Cirrus Airframe Parachute System (CAPS). Following start-up, he did engine run-up, listened to the weather report (Automatic Terminal Information Service, ATIS) and entered the operative flight plan in the aircraft's designated systems.

1.1.5 LN-BCD took off from Sola at 1840 hrs and was initially cleared to climb to 6 000 ft. The autopilot was activated when passing 1 200 ft. When they gained altitude, the pilot saw clouds in front of them, over Langfjella (see Figure 1). To clear the clouds, he requested permission to climb to flight level FL090 (about 9 000 ft) at 1901 hrs. He was cleared to climb to FL090 and was informed that there was no other traffic in the area.

1.1.6 The pilot had access to relevant, decoded METAR and TAF for Torp and Kjevik on his smartphone while flying (Aeroweather application). He was aware that there were a lot of squalls in the area. The recorded radio correspondence shows that scheduled flights in the area requested course corrections to avoid the cumulonimbi and that a light aircraft flying VFR along the coast clearly struggled to stay VMC (visual meteorological conditions).

Figure 1: Photo taken at 18:54:24 hrs on the trip in question (about 12 minutes before the incident).

1.1.7 The pilot has explained that they became established on top in FL090 with clouds approximately 500 ft below and on both sides of the aircraft. The wind was about 7 kt from the northwest. He described how they flew in a four-kilometre wide cloud valley, with clear blue skies visible all the way in the direction they were going. Having flown about two-three minutes on top, the cloud-free area became narrower and a course adjustment about 30-35 degrees to the north (to the left) became necessary to keep clear of the clouds. Not long after that, the clouds started approaching from below and the area in front of them was also filling with clouds. It was not possible to climb fast enough to avoid the clouds, as the climb rate of the aircraft at this altitude was reduced to about 200 ft per minute. The pilot realised that they had to turn back. At this time, he considered it possible to continue on top after first climbing to FL110 west of the clouds.

1.1.8 The remaining course change needed to turn around was about 150 degrees to the left. A tight turn was necessary to avoid the clouds, and the pilot has stated that he deliberately chose to let the autopilot make the turn instead of flying manually. He believed a "standard rate[1]" turn on the autopilot would be safest, even if this would lead them into the clouds for a short period of time. The autopilot was set to "heading mode", and the course could be easily adjusted by setting the heading bug on the screen to the desired course (cf. 1.6.2).

1.1.9 According to the statement of the pilot, they entered clouds after completing about one-third of the turn. The pilot has explained that he set the autopilot to a slow descent at 200 ft/minute to increase the speed, based on a desire to get out of the clouds as fast as possible. After a few seconds, they could see that soft and sleety ice was forming on the

1 Banking that gives a course change of 3 degrees per second front windows and on the wing leading edges. The pilot has explained that he turned on the pitot heat switch[2] when the clouds coalesced. The thickness of the layer grew over 10-15 seconds to about 4-5 cm while they were in what one of the passengers described as a turbulent blizzard. Ice also formed on the propeller. At this time, the autopilot disengaged, and the pilot had to take over and fly manually.

1.1.10 The pilot understood that the aircraft was stalling. He could not remember hearing any stalling warning. On the screen in front of him where the aircraft's speed, vertical speed and altitude are normally displayed, there were only three red X's (see Figure 3)

1.1.11 He has explained that he double-checked that pitot heat was on. He also flicked up the selector for alternate static air and left it open for about five seconds a couple of times in the hope that it would revive the speed indicator, but nothing changed.

1.1.12 The pilot has furthermore explained that he concentrated on regaining flying speed and making the aircraft "carry itself" again towards Sola. The artificial horizon was still on the screen. The pilot knew he had to monitor this, and that it was necessary to lower the nose of the aircraft to build up speed again after the stall. He tried to listen to the sound of the wind to estimate the speed, and he had direction and ground speed information from the GPS.

1.1.13 Furthermore, the pilot has described that it was impossible for him to feel the aircraft attitude related to the horizon. He manoeuvred using the side stick until the wings were horizontal. The aircraft stalled anew when he tried to pull it out of the dive, and the aircraft flicked to an estimated 90° bank. Before the next attempt, he extended the flaps halfway. However, the aircraft stalled again, and he retracted the flaps. On the compass, he could see the course changing all the time. While manoeuvring, he at times registered increased g-loads on his body. He did not adjust the engine controls, which were set at 85% engine power.

1.1.14 According to the pilot, the passengers sat still, waiting for him to regain control of the aircraft. He hoped that they would descend to warmer air which would make the ice melt, but the temperature remained below zero as they plunged out below the cloud layer. The front window was completely covered in ice, but the pilot spotted the ground through the side windows. He understood that they were as low as to be almost in the partly snow-covered mountainous terrain. The speed was high, and he raised the nose of the aircraft. Without forward visibility and with the risk of stalling again, he realised that continuing was too dangerous. He believed that the speed at the time was 150-160 kt. He then pulled back on the throttle and mixture, flicked off the velcro-attached lid in the roof, grabbed a solid hold of the T-handle of the rescue parachute and pulled it firmly.

1.1.15 The rescue parachute opened as intended, and the nose of the aircraft rose and the speed dropped off. According to the pilot, one of the passengers on the right side has stated that he saw a cliff wall in front of them when the parachute opened. He has described that the aircraft at that moment twisted and swung back on a course that took them away from the terrain. When the aircraft had stabilised hanging from the rescue parachute, the pilot called *"MAYDAY-MAYDAY-MAYDAY"* on the radio and then asked if anyone could hear LN-BCD. He heared no response to these calls.

2 Electrical heating of the system section that records the air speed

1.1.16 The pilot estimated that they descended under the parachute for about 30 seconds before hitting the ground. The impact took place at 1908 hrs in a rough hollow in a ravine, see Figure 2. The impact was not particularly hard, estimated at 2 g, and no one was injured. The airbags built into the seat belts were not triggered. The three passengers quickly exited through the aircraft's right door. The pilot remained on board for a short time, trying to establish radio contact without success. There was a smell of fuel, and he turned off various switches and left the aircraft.

1.1.17 One of the passengers called emergency services and established contact with the AMK centre (medical emergency communication centre) on a mobile phone. 45 minutes after the accident, a Sea King rescue helicopter landed on a round hill about 5 minutes' walk from the crash site. All four were flown back to Sola where they landed at 2016 hrs.

1.1.18 The air traffic controller of sector South has explained that he observed on the radar that LN-BCD was making a series of course changes and was flying towards Sola before the accident. He commented on the flying to a colleague in sector north, but concluded that they were probably taking pictures. There were also a lot of thunderclouds (cumulonimbi, CB) in the area, so some turns were not unexpected. Suddenly, he saw that the altitude indication for the aircraft (Mode C) changed to 5 500 ft, with a high rate of descent. On the next update, only the call sign remained on the radar, and ELT signals could be heard on the emergency frequency.

1.1.19 Recordings of the radio correspondence show that just after this, at 19:07:30 hrs, the distress call *"MAYDAY-MAYDAY-MAYDAY"* was heard on the Sola Approach frequency. The air traffic controller immediately responded *"LCD, go ahead"*, followed by a silence of 10 seconds before LN-BCD called *"Can anyone hear us?"* The air traffic controller immediately confirmed that he could hear LN-BCD, but did not receive any reply. Nor did the air traffic controller receive any response to two subsequent calls to LN-BCD made at about 10 second intervals.

1.1.20 The planner and supervisor air traffic controllers were immediately notified of the situation. They notified the Joint Rescue Coordination Centre and secured the final radar position. The controller in sector South remained at his work position. The crew of an SAS aircraft that had taken off from Sola assisted in the attempts to call for LN-BCD, but did not receive any reply. There were clear signals from an emergency locator transmitter in the area, and the air traffic controller in position sector South has explained that he was convinced that a fatal accident had occurred.

1.1.21 About 10 minutes after the distress call, a message came in to Sola Approach that those on board had called the NOTAM office, and it became clear that they were all ok. Approximately at the same time, one of the air traffic controllers found advertising footage on the internet showing a Cirrus aircraft hanging from a rescue parachute. The whole chain of events became clearer when they realised that LN-BCD had such equipment.

Figure 2: LN-BCD at the crash site on the day following the accident.
(Photo: The Police)

1.2 Injuries to persons

Table 1: Injuries

Injuries	Crew	Passengers	Others
Fatal			
Serious			
Minor/none	1	3	

1.2.1 No injuries were reported except for short-lived back pain for the pilot and a bump on the forehead of one of the passengers.

1.3 Damage to aircraft

The aircraft sustained substantial damage, see 1.12 for details.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 The pilot, male, age 41, commenced private pilot training in 2001 and received his licence in 2002. His private pilot's licence PPL(A) was valid until 30 June 2011, with a class 2 medical certificate without restrictions. He was the co-owner of the LN-BCD, which was bought new from the manufacturer in 2008. He had previously flown Piper PA-28 Archer II and Cessna 172. The pilot had started, but not completed night flight qualification training, and his experience in manoeuvring the aircraft based on instruments was minimal. He had been an active sky diver and had completed about 150 jumps.

Table 2: Flying experience

Flying time	All types	On type
Last 24 hours	0:30	0:30
Last 3 days	0:30	0:30
Last 30 days	5:20	5:20
Last 90 days	8:20	8:20
Total	251	Approximately 80

1.5.2 Routine tests taken by the Police on the night of the accident showed no traces of alcohol influence or other factors that could have affected the pilot's judgment. The pilot has stated to the Accident Investigation Board that he had eaten three meals that day, and that he felt rested and healthy before departure.

1.6 Aircraft

1.6.1 General information

Manufacturer and model: Cirrus Design Corp. SR20

Serial No. 1888

Year: 2008

Airworthiness Review Certificate (ARC) valid until 24 august 2010

Engine: Teledyne Continental IO-360 ES21

Fuel: Avgas 100LL

Maximum take-off mass: 1 386 kg

Number of seats: 4

According to the pilot's calculations, the actual take-off mass for LN-BCD was 1 343 kg, with the centre of gravity at 146.77 inches, which is within the applicable limits.

Cirrus SR20 is known to be the first aircraft in the “factory-built light aircraft" that is equipped with a rescue parachute.

LN-BCD had neither a pressurised cabin nor a de-icing system.

1.6.2 Cockpit instrumentation

1.6.2.1 LN-BCD was the VFR version of Cirrus SR20, and had therefore not the most sophisticated equipment on the market. The aircraft was equipped with Avidyne FlightMax Entegra Integrated Flight Deck (glass cockpit) with two large LCD displays; Primary Flight Display (PFD) and Multi-Function Display (MFD), as well as a Garmin GPS satellite receiver. The PFD shows standard instrumentation such as artificial horizon, compass (HSI), altimeter and vertical speed indicator. The MFD includes checklists and a moving map with terrain, flight plan and the aircraft's position.

1.6.2.2 Should the PFD lose access to "air data" from pilot /static system, a red X will be shown on the screen instead of values for air speed, altitude and vertical speed, cf. Figure 3.In such cases, the pilot is assumed to refer to back-up instruments (conventional air speed indicator and altimeter)[3].

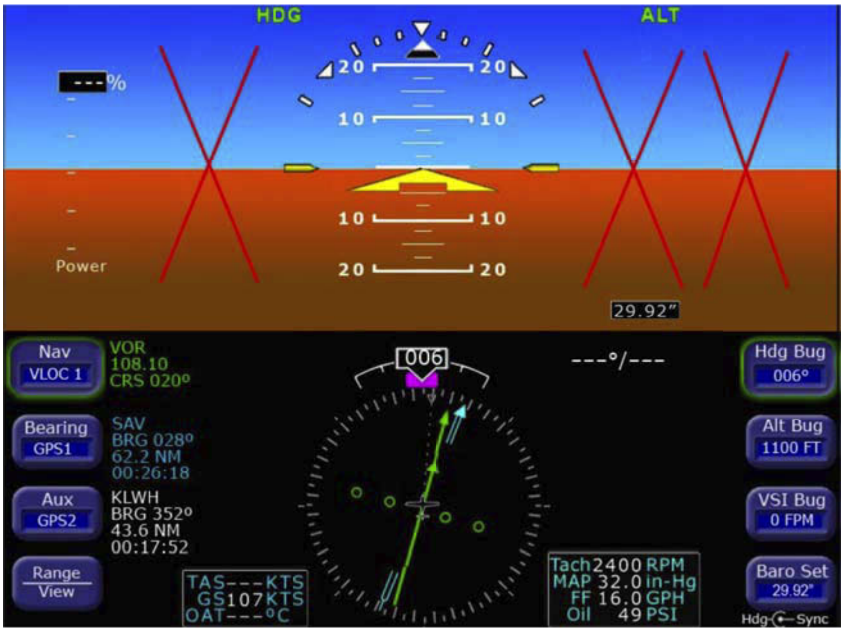

Figure 3: Illustration of how PFD may look in the event of loss of air data.
(Source: Entegra Cirrus EXP5000 Pilot's Guide)

1.6.3 Autopilot

The autopilot on LN-BCD was an S-TEC55X type. This drives roll and pitch trim servos and is operated by buttons on the control panel. In addition, the autopilot receives control signals from the control wheel steering switch. The relevant model did not have a button to resume normal flying position (straight and level button), something the most recent digital autopilots have. The autopilot is disconnected by either the pilot turning it off or trimming the aircraft manually. It will also disconnect if the stall warning is triggered, or if there is an error in one of the data sources used by the autopilot (for example the turn co-ordinator).

1.6.4 Pitot static system

1.6.4.1 The instrumentation on Cirrus SR20 receives air data from a pitot-static system which is common for the Primary Flight Display (PFD) and the back-up instruments. Considering the need for pitot heat is an item on the pre-take-off checklist.

1.6.4.2 The EASA edition of the manufacturer's flight manual is available on Cirrus' web site (http://servicecenters.cirrusdesign.com/techpubs/pdf/POH/SR20-03E/pdf/Online11934-003E.pdf) Section 4, Normal Procedures, pre-take-off checklist (P/N 11934-003, Revision A9), contains a note stating that the pitot heat must be on when flying in IMC, when there is visible moisture and *always when the surrounding temperature is 5°C or lower*:

[3] *The supplier Avidyne has later further developed this system so that altitude and vertical speed indication are not lost automatically if air speed shows an invalid value*

15. Voltage .... CHECK
16. Pitot Heat .... AS REQUIRED

• Note •

Pitot Heat should be turned ON for flight into IMC, flight into visible moisture, or whenever ambient temperatures are 41° F (5° C) or less.

Earlier versions of the checklist stated that the pitot heat must be on before flying into visible moisture when the temperature is 4°C or lower:

15. Voltage .... CHECK
16. Pitot Heat .... AS REQUIRED

• Note •

Pitot heat should be turned ON prior to flight into IMC or flight into visible moisture and OAT of 40° F (4° C) or less.

4-14 P/N 11934-002
Revision A5

1.6.4.3 The checklist on board the LN-BCD was not identical to the official POH version. It did not contain the note with guidelines for what pitot heat "as required" meant.

1.6.4.4 Cirrus has stated that the change in the aircraft flight manual was introduced as a result of the US aviation authority FAA demanding that aircraft approved for instrument flying in known icing conditions had to meet the pitot heat indication system requirements (14 CFR part 23, § 23). Cirrus complied with the requirements for the relevant aircraft, and chose to introduce the most conservative wording in all flight manuals.

1.6.5 <u>Procedures for unintended operation in icing and/or instrument conditions</u>

1.6.6 The manufacturer's flight manual for LN-BCD emphasises that flying in known icing conditions is prohibited, and has the following supplement describing situations where icing conditions can be encountered and what should be done:

Operations in Icing Conditions

• WARNING •

Flight into known icing is prohibited.

A pilot should not take off in an aircraft that has frost, snow, or ice adhering to any external surface.

A pilot can expect icing when flying in visible moisture, such as rain, snow or clouds, and the temperature of the aircraft is below freezing. If icing is detected a pilot should turn on all available anti-icing equipment and do one of two things to exit the icing conditions; get out of the area of visible moisture or go to an altitude where the temperature is above freezing. The warmer altitude may not always be a lower altitude. Proper preflight action includes obtaining information on the freezing level. Report icing to ATC, and if operating IFR, request new routing or altitude if icing is encountered.

The following checklist is available from the manufacturer:

Flight Environment

Inadvertent Icing Encounter

1. Pitot Heat .... ON
2. Exit icing conditions. Turn back or change altitude.
3. Cabin Heat .... MAXIMUM
4. Windshield Defrost..FULL OPEN
5. Alternate Induction Air.. ON

Amplification

Flight into known icing conditions is prohibited.

Inadvertent IMC Encounter

1. Airplane Control ....ESTABLISH straight and level flight
2. Autopilot .... ENGAGE to hold heading and altitude
3. Heading..RESET to initiate 180° turn

Amplification

Upon entering IMC, a pilot who is not completely proficient in instrument flying should rely upon the autopilot to execute a 180° turn to exit the conditions. Immediate action should be made to turn back as described above:

1.6.7 Rescue parachute

1.6.7.1 LN-BCD was equipped with a Cirrus Aircraft Parachute System (CAPS) designed to save the aircraft and those on board from life-threatening emergency situations. The system consists of an activation handle, a parachute harness built into the aircraft fuselage, a rocket engine and a parachute package.

1.6.7.2 Pulling the handle down activates the rocket and tightens the harness. The parachute opens gradually and controlled, and the aircraft's forward speed decreases. When everything has stabilised, the aircraft will hang flat under a 2 400 ft^2 (223 m^2) large dome parachute and drift with the wind (see Figure 4). According to the flight manual, the descent rate will be less than 1 700 ft/minute, and the impact can be compared with falling from a height of 10 ft (3 m).

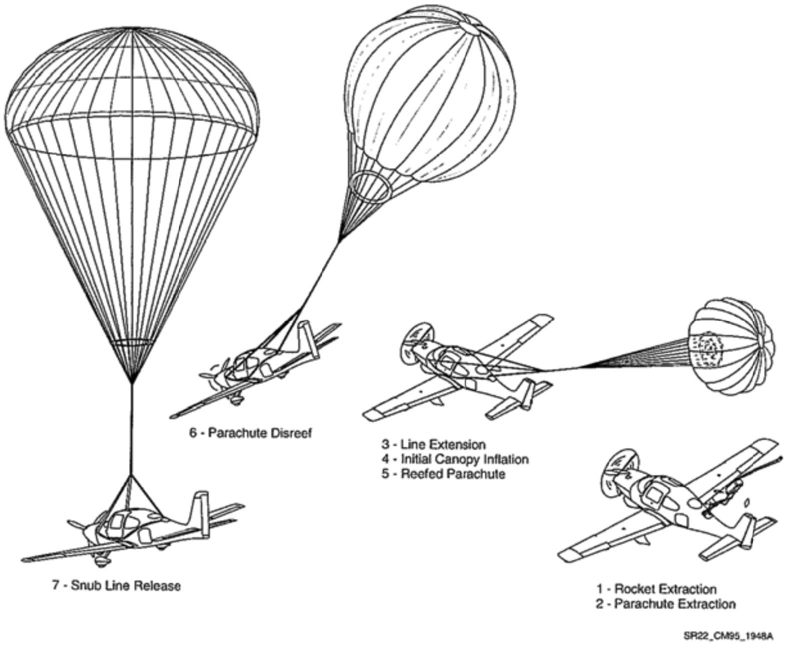

Figure 4: Illustration of rescue parachute deployment (Source: Cirrus Component Maintenance Manual)

1.6.7.3 The emergency procedures include reducing the air speed as much as possible and preferably stopping the engine by cutting the fuel supply before deploying the rescue parachute (mixture cut-off). The system has been demonstrated in use for air speeds up to 135 kt.

1.6.7.4 The rocket engine of rescue parachutes that were not released during an accident can pose a risk to rescue personnel or other arriving at a crash site. For such instances, Cirrus has prepared a DVD with important information that has been made available on the internet (http://www.cirrusaircraft.com/flash/firstresponder *Username: cirrus Password: CAPS*).

1.7 Meteorological information

1.7.1 General

1.7.1.1 The weather situation during the climb-out and during the flight is to some extent documented by the passengers' pictures (see Figure 1). The passenger also took pictures at the crash site showing that there was no precipitation just after the crash, but a heavy snow shower followed a few minutes later. The rescue service reported difficult flying conditions as a result of low cloud cover, sleet and snow showers in the area.

1.7.1.2 The Norwegian Meteorological Institute (DNMI) has assessed the weather conditions in the area in the relevant time period. The weather situation was characterised by a large low-pressure area with unstable air over southern Scandinavia. There were cumulonimbi and scattered lightning in the area. Wind conditions varied, with wind speeds ranging between 5 and 15 kt at elevations up to 10 000 ft. Forecast rises indicated the likelihood of cloud peaks up to 25 000 ft. The two-hour forecast for Sola, issued at 1620, showed that temporary thunder and rain with broken cloud cover consisting of cumulonimbi 1 500 ft above the ground could be expected. Cumulonimbi were also observed and forecast at Sandefjord airport Torp (ENTO), 6 NM south-west of Jarlsberg.

1.7.1.3 The Norwegian Meteorological Institute has also contributed with a description of what characterises a towering cumulus (TCU). It is a form of cloud that is formed in humid, unstable air masses. It starts as a small, innocent nice-weather cumulus, but develops into a thundercloud (CB, cumulonimbus) due to atmospheric conditions. TCU is the final phase before CB. Below the vertical growth, water vapours are condensed in the air coming from the lower air layers, releasing latent energy. This gives the cloud energy to grow further, which will often not stop until it hits the tropopause, and the cumulus has developed into a cumulonimbus. The following quote is from the description given by the Norwegian Meteorological Institute:

> *"In a CB, the top of the cloud has reached altitudes where the precipitation process is efficient, .i.e. more than about -20C, and precipitation falls from the CB. The top of the CB contains mostly ice particles. Within the CB, there are both rising and descending air flows, and usually heavy turbulence. There is also a fair bit of icing.*
>
> *TCU is a cloud without much precipitation, but much of the moisture that later precipitates from the CB is already present. Icing in TCU is therefore more severe as in a CB (where some of the moisture has simply precipitated). TCU generally has only rising air flows and the turbulence is not as heavy as in a CB.*
>
> *The air outside of CB/TCU is often descending, compensating for the air rising inside the clouds. As long as the amount of TCU/CB is not too large and the distance between them too small, flying conditions between TCU/CB are mostly fine. This can often be the case inland on summer days, where isolated TCU/CB occurs (in particular in the afternoon).*
>
> *A TCU is often, as stated, in the process of becoming a CB. Clouds grow quickly. The rising air flows inside the cloud typically have speeds of 5-10 m/s, but can in cases exceed 20 m/s."* [more than 3 900 ft/minute].

1.7.2 METAR (routine weather observations for aviation purposes, times in UTC)[4]

1.7.2.1 *Stavanger airport Sola (ENZV) with two-hour forecast (TRENDS)*

1220Z 20010KT 9999 -SHRA SCT030TCU BKN059 12/06 Q1007 TEMPO SHRA SCT020CB=
1250Z 20009KT 9999 VCSH SCT030TCU BKN059 14/07 Q1007 TEMPO SHRA SCT020CB=
1320Z 18011KT 150V220 9999 VCSH SCT020CB BKN034 12/06 Q1007 TEMPO SHRA=
1350Z 03010KT 350V070 9999 -SHRA SCT020CB BKN040 10/06 Q1007 TEMPO SHRA=
1420Z 34009KT 310V030 9999 -SHRA SCT020CB BKN036 10/06 Q1008 TEMPO TSRA BKN015CB=
1450Z 33011KT 9999 VCTS SCT025CB BKN040 10/06 Q1008 TEMPO TSRA BKN015CB=
1520Z 30009KT 9999 VCTS SCT025CB BKN060 11/07 Q1008 TEMPO TSRA BKN015CB=
1550Z 26008KT 9999 -SHRA SCT025CB BKN032 09/07 Q1008 TEMPO TSRA BKN015CB=
1620Z VRB02KT 9999 -SHRA SCT025CB BKN030 08/07 Q1008 TEMPO TSRA BKN015CB=
1650Z 24007KT 9999 -SHRA SCT015CB BKN030 08/07 Q1008 TEMPO TSRA BKN015CB=
1720Z 22003KT 180V260 9999 -SHRA FEW010 SCT015CB BKN040 09/08 Q1008 NOSIG=

1.7.2.2 *Skien airport Geiteryggen (ENS)*

1450Z 15011KT 9999 SCT027TCU 10/03 Q1008=
1550Z 15010KT CAVOK 11/04 Q1008=
1650Z 16005KT CAVOK 11/03 Q1007=
1750Z 15005KT CAVOK 10/03 Q1007=

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[4] *Decoding of meteorological abbreviations, see: https://www.ippc.no/ippc/help_met.jsp and https://www.ippc.no/ippc/help_metabbreviations.jsp*

1.7.2.3 *Sandefjord airport Torp (ENTO)*

1420Z 18014KT 9999 SCT028TCU 11/05 Q1008=
1450Z 18013KT 9999 SCT027TCU 11/04 Q1008=
1520Z 17014KT 9999 SCT028TCU 10/04 Q1008=
1550Z 15013KT 9999 BKN023 10/05 Q1008=
1620Z 16012KT 9999 SCT019 SCT110 10/05 Q1008=
1650Z 16011KT 9999 FEW020 SCT035 09/05 Q1008=
1720Z 16008KT 9999 FEW010 BKN030TCU 09/06 Q1008=
1750Z 14005KT 9999 FEW011 BKN030TCU 08/06 Q1008=
1820Z 13003KT 090V160 9999 FEW010 BKN035 09/06 Q1008=

1.7.2.4 *Kristiansand airport Kjevik (ENCN)*

1420Z 20007KT 9999 BKN015 10/06 Q1008=
1450Z 19009KT 9999 BKN018 10/06 Q1008=
1520Z 19009KT 9999 FEW015TCU SCT018 SCT030 10/06 Q1008=
1550Z 19009KT 9999 FEW016TCU BKN018 10/06 Q1008=
1620Z 19008KT 9999 FEW018TCU SCT020 10/05 Q1008=
1650Z 18008KT 150V210 9999 FEW018TCU SCT020 SCT040 10/05 Q1008=
1720Z 18008KT 9999 FEW018CB SCT020 SCT040 10/06 Q1008=

1.7.3 TAF (airport forecast, times in UTC)

The following forecast for the coming 24-hour period was issued on that day:

1.7.3.1 *Stavanger airport Sola (ENZV)*

ENZV 281400Z 2815/2915 34010KT 9999 SCT030 BKN050 TEMPO 2815/2818 SHRA SCT020CB BKN030 PROB40 2815/2818 TS BECMG 2821/2824 VRB05KT PROB30 2900/2906 1500 BCFG BKN002=

1.7.3.2 *Kristiansand airport Kjevik (ENCN)*

ENCN 281400Z 2815/2823 20007KT 9999 FEW003 SCT020TCU BKN030 TEMPO 2815/2818 BKN014=

1.7.3.3 *Sandefjord airport Torp (ENTO)*

ENTO 281100Z 2812/2821 20012KT 9999 SCT030TCU TEMPO 2812/2821 SHRA SCT020CB BKN030=

ENTO 281400Z 2815/2822 20012KT 9999 SCT030TCU TEMPO 2815/2821 SHRA SCT020CB BKN030=

ENTO 281700Z 2818/2822 VRB05KT 9999 SCT030 TEMPO 2818/2821 SHRA FEW020CB BKN030=

1.7.4 IGA forecasts

1.7.4.1 The following area forecast, prepared especially for VFR flights for coastal and fjord areas in the Stavanger region, was issued for the period time 1700 to time 0200:

IGA PROG 281500-282400 UTC May 10 STAVANGER AOR COASTAL AND FJORD AREAS.

WIND SFC: VRB AND COT LCA N-NW/05-10KT
WIND 2000FT: AS SFC
WIND/TEMP FL050: VRB/05-10KT, LCA 280-340/10-15KT. TEMP: MS02-PS03
WIND/TEMP FL100: VRB/05-10KT, LCA 120-160/10-20KT. TEMP: MS12-MS10
WX: SCT SHRA, RISK TS

VIS: MAINLY+10KM
CLD: SCT-BKN 3000-9000FT, TEMPO SCT-BKN 1500-3000FT ASSW SH, LCA TCU/CB
0-ISOTHERM: 3500FT-FL055
ICE: NIL/FBL, LCA MOD ASSW TCU/CB
TURB: NIL/FBL, LCA MOD ASSW CB/SH
OUTLOOK FOR TOMORROW: S-PART:
VRB/05-10KT, NW/ 10-15KT NEAR LISTA EARLY,
LATE SE/10-15KT S OF ENZV.
SCT SHRA, LATE WX NIL.
N-PART:
SW/10-15KT, VRB/05-10KT FJORDS EARLY.
SW/20-25KT NEAR STAD.
SCT SHRA, LATE WX NIL.

1.7.4.2 Area forecast for southern and south-eastern parts of eastern Norway:

IGAPROG 281500-282400 UTC May 10 OSLO AOR S/SE DISTR.

WIND SFC: S-SW/05-15KT, STRONGEST COT, BECMG W/05-l5KT SW-MOST PART LATE
WIND 2000FT: S-SW/05-l5KT, BECMG W-NW/05-10 SW-MOST PART LATE
WIND/TEMP FL050: 180-240/05-15KT, BECMG 270-310/10-15KT SW PART / MS01-PS02
WIND/TEMP FL100: VRB/05-15KT, BECMG 270-300/10-20KT SW PART LATE / MS12-MS10
WX: SCT SHRA AND RISK TSRA, MAINLY S-AND W-PART
VIS: +l0KM, RISK 4-8KM IN SHRA
CLD: FEW/SCT/BKN 2000-6000FT, OCNL TCU/CB 2000-FL050
0-ISOTHERM: 4000FT-FL050
ICE: RISK LCA MOD/SEV IN TCU/CB, ELSE FBL/NIL
TURB: RISK LCA MOD/SEV ASSW CB, ELSE NIL
OUTLOOK FOR TOMORROW:
N-PART VRB/05-10KT, ELSE NW-SW/05-10KT, W-SW/15-25KT COT, BECMG SE/ 10-15KT SW-MOST PART LATE. LCA FG/BCFG EARLY, LCA SHRA, MAINLY E PART =

1.8 Aids to navigation

The navigation took place using visual references supported by the moving map on the multi-function display and the GPS receiver.

1.9 Communication

The pilot of LN-BCD had established radio contact with Stavanger radar on frequency 120.65 MHz. Radio transmission recordings show that no messages were exchanged between LN-BCD and Stavanger between 1901 hrs, when LN-BCD asked for and received clearance to climb to FL090, and the distress call at 19:07:30 hrs.

1.10 Aerodrome information

Not relevant.

1.11 Flight recorders

1.11.1 Flight recorders are not mandatory for this type of aircraft, but LN-BCD was equipped with an early version of recoverable data module (RDM), primary flight display (PFD) and multi-function display (MFD) with built-in memory which records values such as altitude, speed, course, aircraft attitude, engine parameters, electricity consumption and alarm status. The data units were sent to the US National Transportation Safety Board (NTSB) for downloading. It must be taken into account that the registered values may be inaccurate. Time references diverge, and parameter sampling rate is not particularly frequent. A selection of the parameters can be found in Appendix B.

1.11.2 Avidyne and Cirrus have assisted the AIBN with interpretation and analysis of data. It was registered that the aircraft started a turn to the left about one minute after making a course adjustment of about 30 degrees to the left in relation to the original compass heading of 80 degrees. Before the turn had been completed, the air speed started to drop, and the indication disappeared completely after 15 seconds. In this period, the aircraft went into a fairly tight right turn and pitched the nose downwards. The pitch and roll varied to an abnormal degree in the following seconds, with increasing amplitudes.

1.11.3 About 20 seconds after the speed indication was lost, a fault warning was generated for air data, altitude and climb speed. About 10 seconds later, a peak was registered in the bus current (increased power consumption). After an additional approximately 20 seconds, the fault warning for air data disappeared from the registrations. The values for indicated air speed returned, with considerable variations as a result of extreme pitch variations.

1.11.4 About one minute after the speed indication disappeared, the stall warning was triggered and the autopilot disengaged. The large variations in the aircraft's nose pitch increased further, while the banking changed frequently and considerable variation was registered in the vertical acceleration (g-load). The banking went from 60 degrees and back to zero over a few seconds, and then increased immediately again. This was repeated several times with somewhat varying fluctuations, every time to the right. The registered extreme was a 120-degree bank, while the nose pitch during the same period varied between more than 50 degrees pitch up and 70 degrees pitch down. The most extreme registered speed exceeded 250 kt (V_{NE} is 200 kt). The registrations indicate that the aircraft made about four revolutions in a right-turning spiral.

1.11.5 Pressure height registrations with apparently reliable values were available throughout the entire period when the aircraft was out of control (see Appendix B). The altitude varied from slightly less than 9 000 ft and up to 10 000 ft twice before a marked loss of altitude occurred. According to the registrations, the aircraft lost about 5 800 ft over the course of 20 seconds (corresponds to an average vertical speed of 17 400 ft/min). The ground speed from the GPS was registered throughout the incident, and the indicated/true air speed deviated only as expected taking into account the wind force, with the exception of the most extreme flight attitudes.

1.11.6 Registered engine parameters clearly show when the fuel supply to the engine was cut. There were several indications that the rescue parachute was triggered directly afterwards, for example a sudden deviation in the longitudinal acceleration which indicated a sudden reduction of speed. Other parameters changed at the same time, such as the altitude which started falling slowly, continuing until it stabilised at slightly less than 3 000 ft for a few seconds before the registrations stopped.

1.11.7 The registered air speed and pressure height were rapidly changing when the parachute was deployed, and it is not possible to determine exactly the speed and altitude when the parachute was deployed. The time was approximately 19:06:23, and Cirrus has estimated the speed to 121 kt and the altitude to 3 250 ft.

1.12 Wreckage and impact information

1.12.1 The crash site

The crash site is situated in the Ørnefjell area in Sirdalsheiane, about 7 km north of Ådneram tourist cabin. The mountains in the area peak at 950-1 200 metres above sea level. (3 100 - 3 900 ft). The aircraft came down in a ravine where the ground was at about 770 AMSL (2 550 ft), see Figure 2 and Figure 5.

Figure 5: The area northeast of the crash site. The rescue parachute is visible in the bottom right of the picture.

1.12.2 The aircraft wreckage

1.12.2.1 When the Accident Investigation Board examined the wreckage on the day after the accident, it was established that the fuselage (tail boom) had broken off behind the rescue parachute. The nose leg had broken, the propeller had hit the ground and the left wheel fairing was damaged. The lower cowling, left flaps and underside of the left wing were damaged. There were holes in the left fuel tank.

1.12.2.2 There was nothing to indicate that the accident was caused by irregularities, malfunctions or deficiencies with the aircraft, and the Accident Investigation Board has not examined the wreckage in any more detail.

1.13 Medical and pathological information

Not relevant.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 The persons on board were strapped in four-point seatbelts and were not exposed to loads that could result in physical injuries as long as the aircraft was airborne.

1.15.2 The rescue parachute functioned as intended. The impact was not especially hard. The seat belts in front were equipped with AmSafe Seatbelt Airbag. None of them were activated in the crash.

1.15.3 The seats in the aircraft are designed to dampen collision forces, and according to the pilot, some of the honeycomb structure under one seat had collapsed.

1.15.4 The pilot has explained that the ELT was triggered automatically when the rescue parachute was deployed. He could hear the signal as interference in his headset. According to the manufacturer Cirrus, automatic triggering of the ELT is not a built-in function, and Cirrus does not know of any instances where the impact of the deployment of the rescue parachute has caused activation of the ELT. Switching on the ELT manually is one of the emergency checklist items when deploying the rescue parachute, but the pilot is certain that he did not do this. The ELT switch was in the "ARM" position when the AIBN arrived.

1.15.5 The signals from the emergency locator transmitter were heard by both the Air Traffic Control, aircraft in the area and the Joint Rescue Coordination Centre (JRCC). Stavanger Air Traffic Control Centre (ATCC) notified search and rescue immediately after receiving the distress call. The last observed position on the radar was recreated and communicated to the JRCC. The descent rate on the radar was registered at 6 300 ft/minute before the aircraft disappeared.

1.15.6 Neither those on duty at the Air Traffic Control Centre on Sola or JRCC knew that LN-BCD had a rescue parachute. There is no code for this in the flight plan form. The pilot has stated that he used to mention the parachute or state this in the remark field when submitting his flight plan.

1.15.7 The JRCC lost the ELT-signals on the emergency frequency and first assumed that it was a test[5]. When they received the notification from Air Traffic Control, they immediately initiated a search with a Sea King rescue helicopter. The signals from the ELT were later detected by the COSPAS-SARSAT satellite system.

1.16 Tests and research

None.

1.17 Organisational and management information

Not relevant.

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5 According to the applicable provisions, ELT must not be turned on for more than 5 seconds during testing, and the test must take place at 0-5 minutes past the hour.

1.18 Additional information

1.18.1 Experience with rescue parachutes

1.18.1.1 The "Ballistic Recovery System" has been on the market since the Eighties. According to the manufacturer BRS Aviation's website, the rescue parachutes have been installed in more than 30 000 aircraft, and have, as of 8 December 2011, saved 266 lives.

1.18.1.2 The UK Air Accidents Investigation Branch (AAIB) recently published a report of an accident where the pilot of a Cirrus SR20 lost control while programming the GPS to avoid clouds (AAIB Bulletin 7/2011). The pilot chose to deploy the rescue parachute, and the two on board walked away from the accident without injuries. The report states that the aviation authority (CAA) will publish suitable information as it turned out that many UK air traffic controllers were not familiar with the fact that aircraft with rescue parachutes existed.

1.18.2 Observations related to glass cockpits in general aviation aircraft

1.18.2.1 Glass cockpits were only widely introduced in general aviation in 2003, when Cirrus Aircraft chose to deliver SR20 with Avidyne FlightMax Entegra as standard equipment. The President and CEO of Cirrus, Alan Klapmeier, stated the following:

> *"PFDs have long been available in very high-end corporate, commercial and military aircraft. We believe that all pilots deserve to fly with the same advanced technology,"* […] *"We recognize that 21st Century technology in the form of a 10.4" Primary Function Display supported by another 10.4" Multi-Function Display makes flying safer and more intuitive by improving situational awareness."*
>
> *(Avidyne press release dated 24 July 2003).*

1.18.2.2 Now that some years have passed, experience is beginning to accrue concerning the effect of modern glass cockpits as regards safety in general aviation. NTSB has carried out a study and issued a press release on 9 March 2010 (SB-10-07) titled *"NTSB study shows introduction of 'glass cockpits' in general aviation airplanes has not led to expected safety improvements"*. The report from the study (NTSB/SS-01-10) refers to the fact that aircraft with glass cockpits have a different area of use than conventional aircraft. They are more frequently used for instrument flying and less for school flying. In its study, NTSB concluded that the findings indicated that there were no safety gains in the period comprised by the study. Aircraft with glass cockpits were, for instance, more often involved in loss of control in the air, collision with the terrain and weather-related accidents.

1.18.2.3 The Norwegian magazine "Flynytt" No. 2/2011 contains an article about glass cockpits and safety effects written by human factor specialist Justin Caird-Daley. The article focuses on automation and training, and questions are raised of whether the most advanced functions can have a negative effect as regards influencing the private pilots' willingness to take risks. Encouraging VFR flying in IMC is mentioned specifically, and the author reminds us that accidents as a result of this still top the accidents statistics for private flying.

1.18.3 Risk factors in weather-related accidents in general aviation

1.18.3.1 AOPA (Aircraft Owners and Pilot Association) Air Safety Foundation issues an annual *NALL report*, analysing the trends in GA accidents in the US. The 2009 report establishes again that most aircraft are damaged in connection with landing accidents that are almost never fatal, while more than two-thirds of all weather-related accidents have fatal outcomes. AOPA only registered one weather-related accident with a so-called technologically advanced aircraft[6]" (TAA) in 2008.

1.18.3.2 AOPA has also issued a report titled *Technologically Advanced Aircraft – Safety and Training*. The report analyses TAA Cirrus accidents and makes a comparison with the total accident situation for general aviation. It emerges that in comparison with the overall fleet, a considerably larger share of these accidents are weather-related. The report mentions several accidents where a rescue parachute was used and cases where it definitely should have been used. The report also mentions a fatal accident with loss of control in icing where the rescue parachute was used, but the speed was too high, making the rescue parachute tear away from the aircraft with no noticeable braking effect.

1.18.3.3 Over the years, NTSB has conducted several studies of weather-related accidents in general aviation. The report *"Safety Study – Risk Factors Associated with Weather-Related General Aviation Accidents"* issued in 2005 (NTSB/SS-05/01), discusses factors such as sources of weather information, pilot age, experience level and exam results, aircraft equipment, the purpose of the flight, etc. The report concluded with six recommendations to the US Federal Aviation Administration. The recommendations included giving pilots better training in recognising critical weather situations both from the ground and in the air, mandatory training in aircraft handling based on instruments, stricter requirements as regards theoretical knowledge and optimisation of weather presentations.

1.18.3.4 SKYBrary[7] has gathered extensive material regarding VFR into IMC on its website (http://www.skybrary.aero/index.php/VFR_Flight_Into_IMC).

1.18.4 Relevant provisions

1.18.4.1 The Norwegian operations regulations for non-commercial aviation with aircraft (private flying)(BSL D 3-1) state the following about weather reports and flight planning in Item 4.4.1:

"A flight must not commence before the pilot in command has familiarised herself/himself 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 method if the flight cannot be carried out as planned due to weather conditions

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[6] *Aircraft with modern avionics; minimum "moving map", IFR-approved GPS and autopilot according to FAA.*

[7] *SKYbrary is stated to be "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 organizations - regulators, service providers, industry". (SKYbrary Content Management).*

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."

1.18.4.2 Operational restrictions as a result of weather conditions state the following:

"4.5.1 For VFR flight

Note: Visibility and cloud height as indicated in items 4.5.1.1, 4.5.1.2 and 4.5.1.3 below applies to flight planning. The worst-case scenario for the available weather observations/information as regards estimated passing/time of arrival must be used as a basis. When flying, the minimum requirements for flight visibility and cloud distance that appear in the air traffic regulations apply, BSL F [...]

4.5.1.1 A VFR flight that is planned to take place below cloud more than 50 NM from the departure airport, must not commence if the available weather observations/information along the route that will be flown under VFR state that visibility and cloud base height will be less than 5 km and 1000 feet.

4.5.1.2 A VFR flight on top 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 of a nature making flying under VFR 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 over.

c) At the destination or in the area around the landing site, the visibility and cloud base height must not be less than 5 km respectively 1000 feet."

1.18.4.3 In accordance with Section 2-37 of the Rules of the Air (BSL F) *minimum requirements for flight visibility and distance to clouds for VMC*, the flight visibility in cases such as this, when flying under FL100 in Class G air space, must be at least 5 km when the flight altitude is higher than 300 m above the ground or water. The distance to clouds must be 1.5 km horizontally and 300 m (1 000 ft) vertically.

1.19 Useful or effective investigation techniques

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

2. ANALYSIS

2.1 Introduction

What is special about this weather-related accident is that it involved a technologically advanced aircraft, and that the rescue parachute was used. As far as the AIBN knows, this is the first parachute rescue for this aviation category in the Nordic countries. Analyses conducted by AOPA, NTSB and others show which factors are the most frequent in general aviation in general, and how the situation seems to be changing as new, well-equipped aircraft make up an increasingly larger share of the fleet in the coming years.

2.2 Flight planning

2.2.1 The pilot's description of how he planned the trip shows that he used several sources to obtain weather information, but that he had not studied the area forecast for VFR flights (IGA prognosis) or called an aviation meteorologist prior to departure. This in spite of being aware of cumulonimbi in the area and heavy thunder in Egersund. The Accident Investigation Board's impression based on the pilot statement is that he believed it would be possible to get around on the north side, but that he did nothing to actively confirm this.

2.2.2 The Accident Investigation Board believes that the pilot should have taken the fact that there were unstable air masses in the area where he was planning to fly more into account. The aircraft was not equipped to fly in icing conditions, and he was not qualified to fly under instrument conditions. He did not know the cloud extent and layers along the route, and could therefore not comply with the planning requirements that apply for VFR on top (cf. 1.18.4). A telephone call to a meteorologist would probably have made the pilot realise that it was inadvisable to fly VFR in the area on the afternoon in question. Instead, he adopted the approach that it was worth an attempt.

2.2.3 The pilot expressed that he found the IPPC radar images very useful. In this connection, the Accident Investigation Board would like to emphasise that it is important to know that the radar does not detect clouds, only precipitation particles. As described in 1.7.1.3, clouds will not be visible on the radar until approaching the CB stage. New aids such as radar images of precipitation that are easily accessible on the internet and smart phones that help you decode weather forecasts, are useful. The AIBN believes it is important that all pilots who use these aids in their planning understand that a radar image showing an area without precipitation must not be interpreted as an area without clouds where VFR flying is unproblematic. It is also important to remember that icing is a real threat when flying over mountainous terrain and the 0 isotherm is so low as it was in this case, even if you are not planning on flying in clouds or in precipitation.

2.2.4 The pilot on LN-BCD had plenty of experience from flying this route, and the automatic systems in the aircraft were reliable and provided good assistance. From the literature we know that there is a risk of complacency when you are used to everything going ok. The Accident Investigation Board’s impression is that the pilot had excessive confidence in his smartphone, with updated and already decoded weather observations, providing him with the necessary information, and that the autopilot would take him safely through a cloud peak. The AIBN believes the pilot on LN-BCD should have made a greater effort in planning the trip and preparing alternative plans if the flight could not take place as planned.

2.2.5 Previous experience has shown that there is often external pressure in the form of a desire to meet expectations involved when VFR pilots push the margins and fly in too bad weather. According to the pilot on LN-BCD, this issue was not relevant in this case, as they could easily postpone the flight to the next day without any consequences of significance. The AIBN believes that this should have made it even easier to postpone the flight until the weather conditions had improved, and the impression of overconfident behaviour on part of the pilot is strengthened.

2.3 The en route phase

2.3.1 The Accident Investigation Board believes the pilot's choice of route above and between heaped-up cumuli shows that he lacked knowledge of the risk factor that such clouds constitute. With the stated estimate of about 500 ft vertical distance to the clouds, it would also appear that the operative regulatory requirements were not met (cf. 1.18.4). Manoeuvring around individual cumulonimbi, or flying at 1 000 ft above a stable cloud layer with known extent, can be safe. Passing over and between clouds in an extensive clouded area which, at worst, can grow far quicker than any light aircraft can climb, is highly risky.

2.3.2 The safety regulations have been prepared to provide a certain safety margin and are often based on painful experience. The AIBN believes that showing good pilot judgment includes considering whether you, in certain situations, need wider margins than the regulations' minimum requirements. The part of the route where LN-BCD was to fly on top could be expected to amount to an estimated 20 minutes of flying. With unstable air masses up to 25 000 ft, it was unlikely that they could keep clear of the clouds by flying at the altitudes within reach of LN-BCD. It also quickly turned out that the cloud valley was not a stable formation, and that turning back was problematic.

2.3.3 As the clouds came dangerously close and the pilot decided to turn back, he let the autopilot perform the turn. This is in accordance with the manufacturer's recommendations, and the Accident Investigation Board believes that this was a sensible plan. He expected only a short stay in the cloud top and was not prepared for the icing conditions in the cloud creating such fundamental problems.

2.3.4 The pilot’s desire to get out of the cloud by increasing the speed in the turn, had the opposite effect. The shallow descent took the aircraft into the cloud layer below, and higher speed increased the turn radius and the time it would take to get out of the clouds.

2.4 Loss of speed indication and autopilot

2.4.1 The loss of air speed indication suggests that the pitot tube had frozen. The three red X’s on the screen were an expected indication with the equipment LN-BCD had. It is probable that pitot heat was only turned on after the speed indication was lost, registered as a marked change in the bus current (cf. 1.11.3).

2.4.2 If the pitot heat had been on when the aircraft entered a surrounding temperature of 5 °C as Cirrus now recommends, the speed indication had probably remained normal throughout the turn. The situation would, however, still have been difficult for the pilot, and AIBN believes the outcome would probably have been the same. The loss of control and the handling of this are discussed in more detail in Chapter 2.5.

2.4.3 The pilot knew how the pitot system worked and was familiar with the procedure of opening alternate static if problems occurred. He was not in the habit of using pitot heat, as he only flew in VFR conditions, and did not know of Cirrus’ more conservative guideline.

2.4.4 The fact that the air data returned while the aircraft was in the clouds in temperatures below zero shows that the pitot heat functioned as intended. The Accident Investigation Board believes the change in recommended use of pitot heat is a safety improvement, and an example of a latent factor that only creates problems when several unfortunate factors occur simultaneously.

2.4.5 The autopilot remained engaged for some time after the speed indication disappeared. It has been established that it disengaged as a result of a stall warning. However, registered parameters do not indicate that the aircraft was about to stall when this happened. Avidyne has stated to the AIBN that, in their experience, ice in the static port can cause a false stall warning, and Avidyne believes that this was the case here.

2.5 Loss of control and handling thereof

2.5.1 The pilot experienced problems with maintaining control of the aircraft the moment they entered clouds. The transition from a left turn to a steep right turn in the cloud took place before the speed indication was lost and the autopilot disengaged. This indicates that the pilot either gave input on the control wheel steering or that the ice that formed on the aerodynamic surfaces influenced the flying characteristics in this phase. AIBN believes that the aircraft may have stalled or come close to stalling on several occasions in the sequence as a result of ice forming on aerodynamic surfaces. However, the movement path indicates that the aircraft mainly flew in a spiral (so-called graveyard spiral) and did not enter a spin.

2.5.2 The situation was complicated by the fact that the aircraft was in a turn when the visual references were lost. Icing, loss of air data and the autopilot disengaging made the situation even worse. It is known that a VFR pilot without training in instrument flying will quickly lose his/her orientation inside a cloud. The pilot's description of how he experienced the situation shows that he was exposed to vertigo, a sensory illusion where the brain's perception of up and down and movements does not correspond with reality.

2.5.3 In cases where one unintentionally ends up in IMC, the recommended course of actions is to make small stick/control wheel movements and careful adjustments to level out the aircraft and maintain control. Turning and changing altitude at the same time should be avoided, and this requires considerable instrument experience.

2.5.4 The pilot of LN-BCD was correct in focusing on the artificial horizon, but he also used his mental capacity to try and get on the correct course out of the clouds. He knew that in a stall, he would have to increase speed before pulling the control stick backwards. His statement and the registered data indicate that the control movements became exaggerated. Without necessary reference to the horizon, without speed indication and with icing on an aircraft which stalled earlier than assumed upon increased wing loads, the task of regaining control became impossible.

2.5.5 The Accident Investigation Board believes the pilot did the only right thing in the situation they found themselves in. He acted resolutely and correctly as he pulled the CAPS activation handle. The fact that he achieved visual references and had time to reduce the air speed substantially by pulling the aircraft out of a dive before deploying the parachute was decisive.

2.5.6 The surroundings around the crash site suggest that it was only a matter of time before LN-BCD would have collided with the terrain had the pilot chosen to continue flying. The aircraft's wings and windshield were iced over, and the 0-isotherm was lower than the cloud base and below the terrain at the site. The people on board were in a life-threatening situation, and this is when the rescue parachute really proves its worth.

2.5.7 Although the basic rule must be to never include in your planning the aircraft's rescue parachute's ability to save your life in an emergency, it is important to be mentally prepared to use this emergency equipment in extreme situations. Fire and structural failure while airborne are examples of a scenarios where the rescue parachute can save lives. The certainty that the aircraft will be destroyed if the CAPS is used in a situation like this, when the aircraft is still intact, can inhibit the use of the parachute. The AIBN believes that the pilot's parachutist background may have contributed to his lack of hesitation when triggering the rescue parachute on LN-BCD.

2.6 Survival aspects

2.6.1 It seems clear that the rescue parachute saved the lives of the four persons on board. The seats and seat belts seem to have functioned as intended.

2.6.2 The emergency locator transmitter was located near the rescue parachute and was probably triggered by the vibrations at chute deployment. The AIBN sees several advantages of the emergency locator transmitter being triggered while still airborne. For example, the ELT can be damaged or the connection between the ELT and external antenna broken due to the forces involved in the crash, resulting in the signals not being broadcast or being broadcast with a short range. The ELT will not work if the aircraft crashes into the water and sinks, or if there is a fire. Turning on the ELT is one of the checklist items, but it would be advantageous if this happened automatically in an extreme situation.

2.7 Weather-related accidents

2.7.1 To respect the weather, knowledge about cloud phenomena and the ability to interpret weather information, is undoubtedly important for aviation safety. Examples of other investigations carried out by the AIBN in recent years where planning and/or visibility are factors, include a serious incident during VFR flying with a Sikorsky S-61 in to Bodø (SL2011/15), a fatal accident with a Eurocopter AS 350 B3 in Rostadalen in Målselv (SL2011/08), an emergency situation in connection with unintended, long-term VFR flying on top with a Piper PA-28-181 over Eastern Norway (SL2011/05), accident following loss of control in clouds with a Bell 206B (SL2009/16) at Eggemoen and two fatal accidents following loss of control in clouds with a Piper PA-28 at Sunndalsøra (SL2007/24) and a Cessna 180H at Slettefjell west of Notodden (SL2006/16).

2.7.2 In addition to the risk of losing visual references, the accident with LN-BCD is a reminder of the hazards involved in flying in clouds with high air humidity at temperatures below zero with aircraft without de-icing systems. VFR pilots can benefit from noting the altitude of the 0 isotherm. For aircraft with carburettor enginges, the risk of carburettor icing also has to be taken into consideration. For injection engines, air intakes can freeze.

2.8 Concluding remarks

2.8.1 As shown in 1.18.3, several authorities and special interest organisations are concerned with whether new technology causes private pilots to push the envelope so that potential safety gain is negated. The data basis is still limited, and the AIBN does not aim to answer this question. However, the Accident Investigation Board believes that there is a risk of new, modern aids creating a sense of false safety. Those who fly light aircraft with glass cockpits should note that there have been a high number of weather-related accidents with technologically advanced aircraft since they came on the market.

2.8.2 The AIBN recommends stating any special rescue equipment on the flight plan, as the pilot of LN-BCD was in habit of doing. ICAO's flight plan form has a separate field for this under supplementary information, Item 19 (Remarks N/). The information is stored with the unit that distributed the flight plan in the system. The existence of the rescue parachute is assumed to have been noted amongst air traffic controllers in Norway through the attention given to this accident.

3. CONCLUSION

3.1 Findings

a) The aircraft had a valid airworthiness review certificate, and there was no evidence of any defect of malfunction in the aircraft that could have contributed to the accident.

b) The pilot had a valid private pilot’s licence. He was not qualified for flight at night or in instruments meteorological conditions.

c) Necessary additional information to evaluate whether the trip could be conducted under the prevailing weather conditions was not obtained prior to departure.

d) The flight was established on top with insufficient vertical distance to growing cumulonimbi.

e) A turn back was started to avoid flying in clouds, but during the turn, nevertheless, the aircraft entered clouds with heavy icing and turbulence.

f) The pilot had no instrument flying experience and suffered from vertigo when the visual references were lost.

g) Speed, altitude and vertical speed disappeared from the screen (Primary Flight Display), and the autopilot disengaged during the turn in instrument conditions.

h) Pitot heat was most likely turned on after the speed indication disappeared, and the system worked as intended. The pilot was not aware of the manufacturer's new recommendation that pitot heat should be turned ON whenever ambient temperature is 5 °C or less.

i) The aircraft was more or less out of control for over a minute and quickly lost altitude over the last 20 seconds of this period.

j) When the pilot regained visual references, the aircraft was at terrain height, and he reduced the speed of the aircraft and deployed the aircraft's rescue parachute.

k) A probable crash with a fatal outcome was prevented by the pilot deploying the rescue parachute.

l) The rescue parachute functioned as intended and the force of the impact was moderate.

m) The aircraft was equipped with modern instruments and a recoverable data module (PFD, MFD and RDM) that contained stored data wich were useful in the investigation of this accident.

The emergency locator transmitter (ELT) was triggered unintentionally while the aircraft was airborne, and both the signals from this and the pilot's radio distress message were heard by air traffic control.

4. SAFETY RECOMMENDATIONS

The AIBN believes that the history of the flight and the issues described in this report are suitable for education purposes and as a private study subject for VFR pilots. Most aspects discussed here are well-known and do not provide a basis for specific safety recommendations. The exception is the option of automatic triggering of emergency locator transmitter when deploying the rescue parachute. The AIBN makes the following safety recommendation[8]:

Safety recommendation No. 2012/01T

If the rescue parachute is deployed during the flight, the aircraft is in a serious emergency. The probability of the emergency and position being noticed by the alarm and rescue services increases if the emergency locator transmitter (ELT) is triggered automatically at the same time.

The AIBN recommends that Cirrus Aircraft develops an automatic system that ensures that the ELT is triggered when the Cirrus Aircraft Parachute System (CAPS) is engaged.

The Accident Investigation Board Norway

Lillestrøm, 3 january 2012

[8] *The Ministry of Transport and Communications ensures that safety recommendations are presented to the aviation authorities and/or other relevant ministries for assessment and follow-up, cf. Section 17 of the Regulations relating to public investigation of aircraft accidents and incidents in civil aviation.*

APPENDICES

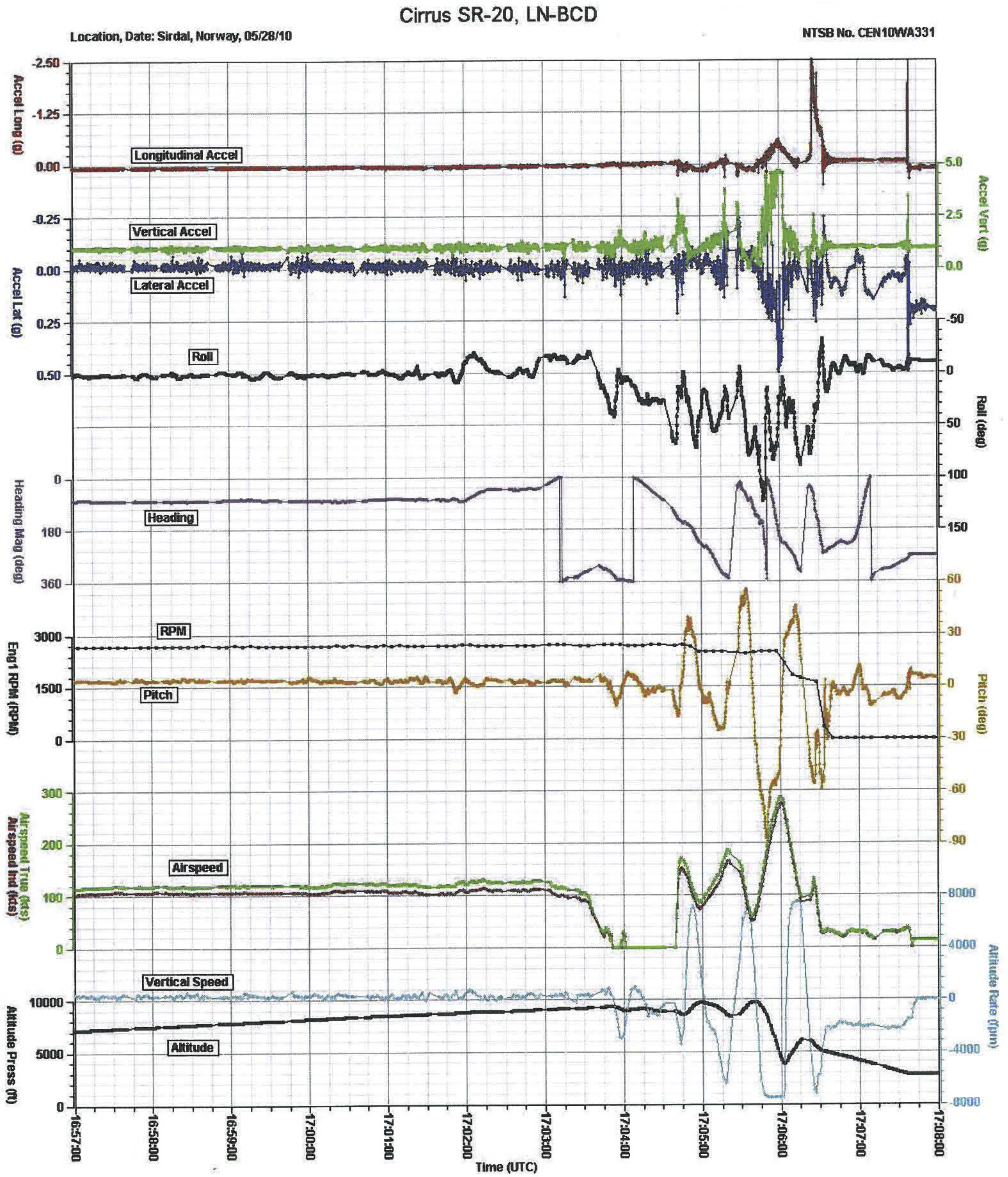
Appendix A: Relevant abbreviations

Appendix B: Various registered parameters from the aircraft's data modules

ABBREVIATIONS

AIBN	The Accident Investigation Board Norway
CAA	Civil Aviation Authority
CAPS	Cirrus Aircraft Parachute System
DNMI	The Norwegian Meteorological Institute
EASA	European Aviation Safety Agency
FAA	Federal Aviation Authority
GPS	Global Positioning System
hPa	Hectopascal
IAS	Indicated Air Speed
JRCC	Joint Rescue Coordination Centre
KIAS	Kt Indicated Air Speed
kt	Knot(s), nautical miles per hour
m.a.s.l.	Metres above sea level
METAR	Météorologie Aviation Regulière, routine weather observation for aviation (in meteorology code)
MFD	Multi-Function Display
NTSB	National Transportation Safety Board
PFD	Primary Flight Display
POH	Pilot Operating Handbook
QNH	Altimeter set to show the altitude above sea level when standing on the ground
RWY	Runway
TAF	Weather forecast for airport (MET Code)
UTC	Co-ordinated Universal Time
V_{NE}	Never Exceed Speed
Z	Zulu time

APPENDIX B



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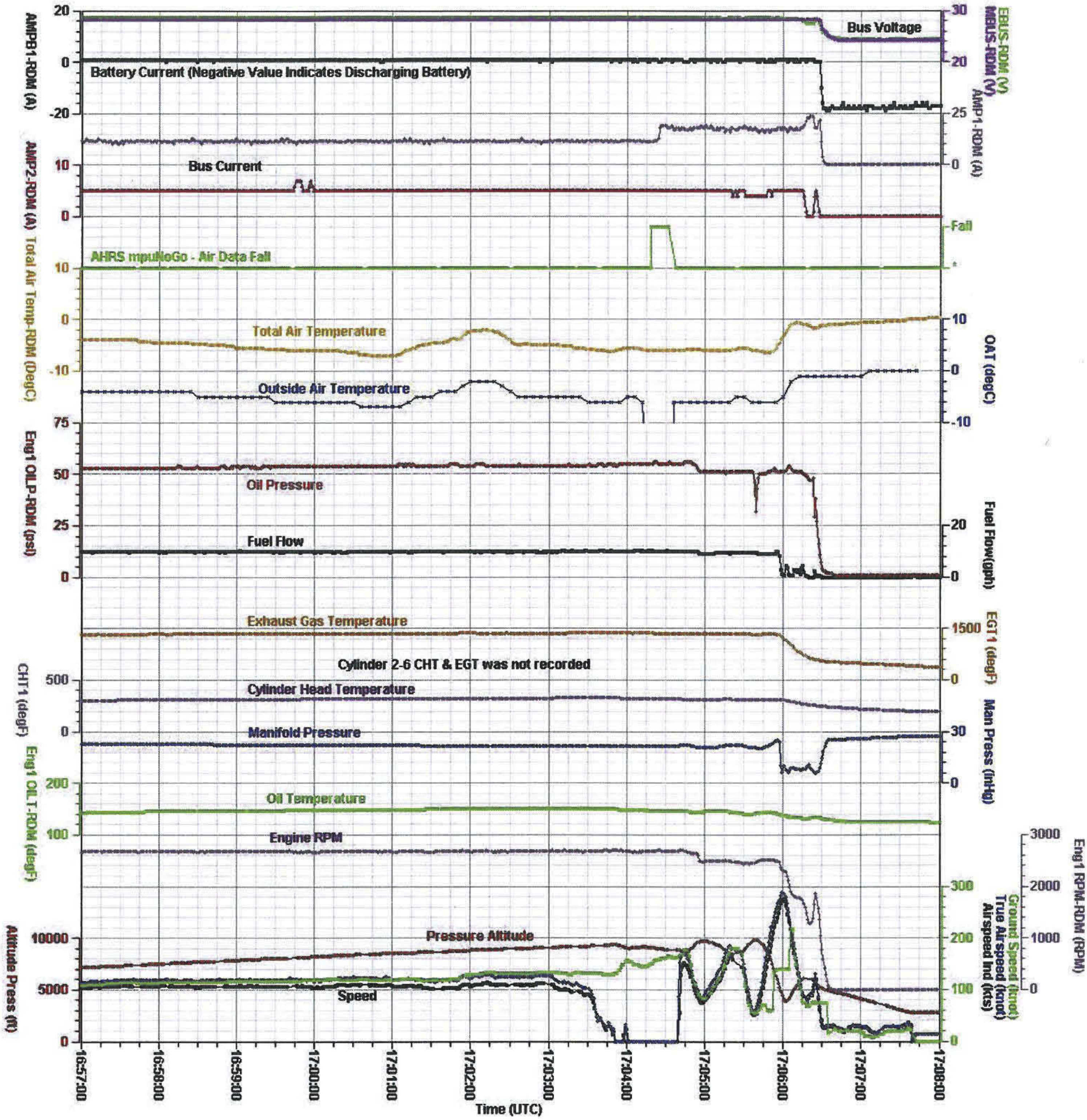
National Transportation Safety Board

Cirrus SR-20, LN-BCD

Location, Date: Sirdal, Norway, 05/28/10

NTSB No. CEN10WA331



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