Statens haverikommission
Swedish Accident Investigation Authority

Interim statement SRL 2016:01e

Accident in Oajevágge, Norrbotten County, Sweden, the 8 January 2016 involving the aircraft SE-DUX of the model CL-600-2B19, operated by West Atlantic AB.

File no. L-01/16

09/03/2016

SHK investigates accidents and incidents from a safety perspective. Its investigations are aimed at preventing a similar event from occurring again, or limiting the effects of such an event. The investigations do not deal with issues of guilt, blame or liability for damages.

The report is also available on SHK´s web site: www.havkom.se

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This document is a translation of the original Swedish report. In case of discrepancies between this translation and the Swedish original text, the Swedish text shall prevail in the interpretation of the report.

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Content

General observations

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is a state authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended to clarify, as far as possible, the sequence of events and their causes, as well as damages and other consequences. The results of an investigation shall provide the basis for decisions aiming at preventing a similar event from occurring again, or limiting the effects of such an event. The investigation shall also provide a basis for assessment of the performance of rescue services and, when appropriate, for improvements to these rescue services.

SHK accident investigations thus aim to answer three questions: What happened? Why did it happen? How can a similar event be avoided in the future?

SHK does not have any supervisory role and its investigations do not deal with issues of guilt, blame or liability for damages. Therefore, accidents and incidents are neither investigated nor described in the report from any such perspective. These issues are, when appropriate, dealt with by judicial authorities or e.g., by insurance companies.

Nor does the task of SHK include investigating how persons affected by an accident or incident have been cared for by hospital services, once an emergency operation has been concluded. Nor are measures in support of such individuals by the social services, for example in the form of post crisis management, the subject of the investigation.

Investigations of aviation incidents are governed mainly by Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation and by the Accident Investigation Act (1990:712). The investigation is carried out in accordance with Annex 13 of the Chicago Convention.

The result of the investigation will be published in a final report. Such a report shall, if possible, be published within twelve month after the accident. SHK has however decided to publish an interim statement at an earlier date. The statement contains – besides a report of the sequence of events – information on the progress of the investigation and relevant parts of the factual material gathered in the case. Publication of the interim statement takes place during a phase where the investigation has not yet been completed, for which reason the content of the material now presented may come to be supplemented, amended or omitted in the final report.

The interim statement has not undergone the consultation process that precedes the publication of a final report. Hence, SHK cannot guarantee that everything presented in this interim statement will be part of – or be identical to – the content in the final report on the event subsequently published.

The investigation

SHK was informed on 08/01/2016 that an accident involving an aircraft with the registration SE-DUX had occurred in Oajevágge, Norrbotten County, Sweden, on the same day at 00:20 hrs.

The accident is investigated by SHK represented by Mr Jonas Bäckstrand, Chairperson, Mr Nicolas Seger, Investigator in Charge, Mr Sakari Havbrandt, Technical-operational Investigator Mr Johan Nikolaou, Operations Investigator, Mr Tony Arvidsson, Mr Christer Jeleborg and Mr Ola Olsson, Technical Investigators, Mr Jens Olsson, Investigator Behavioural Science. Mr Jonas Bäckstrand is also supervising the rescue services part of the investigation.

The investigation is assisted by Ms Annika Wallengren as expert in the rescue services, Mr Kristoffer Danèl as an expert in aviation mechanics and Ms Liselotte Yregård as an expert in aviation medicine.

Accredited representatives from Canada, France, Norway and the United States participate in the investigation.

The Swedish Transport Agency and EASA is continuously informed about the investigation progress.

The investigative material

The aircraft's CVR[1] and FDR[2] and approximately 3.5 tons of debris and 1 000 kg of mail have been recovered.

Analysis of fuel from the fuel supplier at Oslo/Gardermoen airport has been completed.

Reports have been received regarding de-icing fluids used for de-icing before take-off.

Five films from surveillance cameras at Oslo/Gardermoen airport have been collected and analysed.

Interviews have been conducted with loading staff, refuelling staff, as well as with the operator's management and pilots.

Radar data from Norwegian and Swedish civil and military radar stations have been collected.

Recordings of radio communication between air traffic control and the crew have been collected.

[1] CVR – Cockpit Voice Recorder.
[2] FDR – Flight Data Recorder.

Interim statement SRL 2016:01e

Aircraft:	
Registration, type	SE-DUX, CRJ200
Model	CL-600-2B19
Class, Airworthiness	Normal, Certificate of Airworthiness and Valid Airworthiness Review Certificate (ARC)[3]
Serial number	7010
Operator	West Atlantic Sweden AB
Time of occurrence	08/01/2016, 00:20 hrs during darkness Note: All times are given in Swedish standard time (UTC[4] + 1 hour
Place	Oajevágge, Norrbottens county, Sweden (position 6743N 01654E, 2 370 feet above mean sea level)
Type of flight	Commercial Air Transport
Weather	According to SMHI's analysis: At FL330: wind northwest 30 knots, visibility >10 kilometers, no clouds, temperature -60 to -63°C At the crash site: wind light and variable, visibility >10 kilometers, no clouds, temperature -20 to -25°C, dewpoint -30°C, QNH[5] 1010 hPa
Persons on board:	2
crew members including cabin crew	2
passengers	None
Injuries to persons	2 fatally injured
Damage to aircraft	Destroyed

[3] ARC (Airworthiness Review Certificate).
[4] UTC (Coordinated Universal Time).
[5] QNH (Barometric pressure at mean sea level).

1. FACTUAL INFORMATION

1.1 History of the flight

1.1.1 Preconditions

The accident occurred in Sweden during a commercial cargo flight with mail from Oslo / Gardermoen airport (ENGM) to Tromsø Airport (ENTC).

The aircraft was assigned the call sign SWN294 (Air Sweden 294). The flight was conducted under the ATS[6] flight plan as an IFR[7] flight. The requested altitude enroute was flight level 330 (FL330). The flight planned route was via NUVSA, T311, EGAGO, N150, MAVIP, T65, GILEN, P600 and LURAP. The route went more or less the shortest way to LURAP. The route left Norway and entered Sweden, but still within airspace controlled by Norwegian ATC.

The planned take-off time was 23:00 hrs local time with a scheduled flight time of one hour and 43 minutes. The fuel endurance was two hours and 46 minutes.

SHK has received the flight planning documentation from the operator. The documentation consisted of weather information, NOTAM[8], operational flight plan and performance data.

According to the significant weather charts for the weather enroute (SWC), there was no significant weather which meant that there was no forecasted risk of icing, turbulence, precipitation or lee waves.

Interviews and information from surveillance cameras showed that loading, refuelling and de-icing was carried out according to standard procedures. Load was routinely anchored in sections. Each section was surrounded by vertical nets that are designed to withstand a longitudinal load of 9G.

1.1.2 The flight and the accident

According to voice and flight recorders (CVR and FDR) and information from ATC[9] the aircraft took off in a northerly direction from runway 01 Left at Oslo / Gardermoen airport. The take-off, departure and climb to cruising altitude, flight level 330, were performed according to normal procedures.

Nothing indicates other than that everything was normal until one minute and 20 seconds before the impact.

[6] ATS – Air Traffic Service.
[7] IFR – Instrument Flight Rules.
[8] NOTAM – Notice to Airmen.
[9] ATC – Air Traffic Control.

After one hour and ten minutes of flight, during the pilots approach briefing, the pilot in command, who was seated in the left seat, exclaimed a strong expression. Immediately thereafter the aural warning for autopilot disconnect (named Cavalry Charge) was activated. The disconnection was also confirmed by FDR data. The warning sounded continuously during the following 18 seconds.

After the autopilot disengagement FDR data indicates that both left and right elevators moved towards aircraft nose down position. Left and right side angle of attack went towards negative values. The aircraft entered a descent with vertical acceleration values that reached a negative load corresponding to -1G.

After a few seconds of negative G-load the aircraft's warning system was activated by a so-called Triple Chime[10] followed by an aural warning (synthetic voice) for low engine oil pressure on both engines.

FDR data shows that the trim to the movable horizontal stabilizer was activated manually and the trim position went from -0.9 degrees nose up to 1.7 degrees nose down. An aural signal of the stabilizer trim movement (Stab trim clacker), signifying a manual input longer than three seconds, was activated in connection with this. Immediately thereafter a warning for high bank angle was activated.

After 17 seconds from the start of the event, the maximum speed (VMO), 315 knots was exceeded. The over speed warning was activated and the vertical acceleration turned to positive values.

Another 16 seconds later, the first officer transmitted a “MAYDAY” message that was confirmed by the air traffic control. The indicated airspeed then exceeded 400 knots and the stabilizer trim was reactivated and dropped to 0.3 degrees nose down. The Pilot in Command called "Mach trim"[11] after which engine power was reduced to idle.

During the further event the last valid FDR value shows that the speed continued to increase up to 508 knots while the vertical acceleration values were positive, with maximum values of approximately +3G. FDR data shows that the aircraft's ailerons and spoilerons mainly were deflected to the left during the event.

Radar data and the accident site position indicate that the track was changed about 75 degrees to the right during the event.

The crew was active during the entire event. The dialogue between the pilots consisted mainly of different perceptions regarding turn directions. They also expressed the need to climb. The aircraft

[10] Chime – Aural signal used for different cautions and warnings.
[11] Mach trim – Denotes an adjustment of the horizontal stabilizer to compensate for the airplane tendency to pitch down at increasing Mach numbers.

collided with the ground one minute and twenty seconds after the initial height loss.

1.2 Injuries to persons

	Crew members	Passengers	Total on-board	Others
Fatal	2	-	2	-
Serious	-	-	0	-
Minor	-	-	0	N/A
None	-	-	0	N/A
Total	2	0	2	-

1.3 Damage to aircraft

Destroyed.

1.4 Other damage

1.4.1 Environmental impact

Ground damage, fuel and oil spill.

1.5 Personnel information

Pilot in command

The pilot in command was 42 years old and had a valid ATPL(A)[12] with flight operational and medical eligibility. At the time the commander was PF[13]. The pilot in command had 2 016 flight hours on the type.

The co-pilot

The co-pilot was 33 years old and had a valid CPL(A)[14] with flight operational and medical eligibility. At the time the co-pilot was PM[15]. The co-pilot had 900 flight hours on the type.

1.5.2 Duty schedule of the crew

The pilot in command and the co-pilot were working on the fifth day of their working roster. The event occurred during the third flight of the shift. The cumulative duty time for the pilots was 32.5 hours.

[12] ATPL(A) (Airline Transport Pilot License Aeroplane).
[13] PF (Pilot Flying).
[14] CPL(A) (Commercial Pilot License Aeroplane)
[15] PM (Pilot Monitoring).

1.6 Aircraft information

The aircraft model CL-600-2B19 is a twin-engine regional jet with the marketing name CRJ 200PF (Canadair Regional Jet 200 Package Freighter). The aircraft is intended for the transport of cargo on short and medium range. The aircraft has a length of 26.77 meters, a wingspan of 21.21 meters and is pressurized.

Figure 1. The aircraft SE-DUX. (Photo: West Atlantic Sweden AB).

The aircraft features two turbofan engines manufactured by General Electric. The aircraft is mainly made of aluminium and is divided into cockpit and cargo sections.

1.6.1 Airplane

TC-holder	Bombardier Inc.
Model	CL-600-2B19
Engines	2 General Electric CF34-3B1
Year of manufacture	1993
Gross mass, kg	Max authorised start/landing mass 23 995/21 200, current 19 912
Center of Gravity	Within allowable limits, 16 % MAC[16] (Min 9 Max 32).

The airplane had a Certificate of Airworthiness and a valid ARC[17].

[16] MAC – Mean Aerodynamic Chord.
[17] ARC – Airworthiness Review Certificate.

1.6.2 Description of parts or systems of importance for the event

Flight Controls

The airplane's control system is of conventional type with control wheels, control columns and rudder pedals. Control surfaces are actuated either hydraulically or electrically. The flight control systems include major control surfaces, components and subsystems that control the aircraft's attitude during flight. The flight controls are divided into a primary and a secondary system.

The primary flight controls include:

- Elevators (pitch control)
- Ailerons (roll control)
- Spoilerons (roll assist)
- Rudder (yaw control)

The primary flight controls are controlled by a network of cables, pulleys, push/pull rods and levers that transmit control and pedal inputs to hydraulic power control units.

The airplane is equipped with three independent hydraulic systems. Each aileron and spoileron is powered by two hydraulic systems. The rudder and elevators are powered from all three hydraulic systems.

To allow the pilots to feel aerodynamic loads on the control surfaces there is an artificial feel system that applies control feel resistance.

The left and right elevator and aileron control systems can be disconnected in the event of a blockage in the control system on one side.

Spoilerons, flight spoilers and ground spoilers are electrically controlled and hydraulically actuated.

Flight control status and surfaces positions are displayed on the EICAS[18] primary page, status page and flight controls synoptic page.

A protection system warns for and prevents stall.

The secondary flight controls include:

- Flaps
- Flight spoilers
- Ground spoilers
- Aileron and rudder trim
- Horizontal stabilizer trim

[18] EICAS – Engine Indication and Crew Alerting System.

Attitude and Direction Systems

Attitude and direction systems include the following:

- Inertial Reference System (IRS)
- Electronic Flight Instrument System (EFIS)

There are two IRS installed in the airplane, IRS 1 and IRS 2. Each IRS includes an IRU (Inertial Reference Unit) and a MSU (Mode Selector Unit). Each IRU has three Ring Laser Gyros (RLG) and a three axis accelerometer.

The systems generate the following information:

- Attitude (pitch roll, and yaw)
- Angular rates (pitch, roll and yaw)
- Linear accelerations (normal, longitudinal, lateral)
- True heading
- Magnetic heading (synthetic)
- Present position
- Track (true and magnetic)

Electronic flight instruments consist of a primary flight display (PFD) and a Multifunctional Display (MFD) for each pilot.

The flight instruments provide the following basic information to the flight crew:

- Altitude (barometric/radio)
- True airspeed (TAS)
- Airspeed (MACH / KIAS)
- Temperature
- Airspeed Trend
- Airplane Attitude
- Vertical Speed
- Heading Information
- Overspeed Warning
- Navigation Information

Normally, PFD 1 displays information from IRU 1 and PFD 2 from IRU 2.

PFD 1 is installed in front of the left pilot and PFD 2 in front of the right pilot. The information displayed on each PFD is monitored by a comparator system. If there is a discrepancy in the displayed data between PFD 1 and PFD 2 an amber caution message EFIS COMP MON is activated on EICAS display. At the same time the relevant warning is displayed on the PFD.

Regarding pitch, roll and heading the applicable indicator PIT, ROL and HDG show in a yellow box on each PFD, in addition to the EFIS COMP MON message together with an aural warning.

If there is a failure in the attitude information to a PFD there is a flag warning on the PFD with the failed attitude source with the letters ATT in a red box and attitude information is removed.

Standby instruments provide attitude, altitude and airspeed information to the flight crew. An independent standby compass provides airplane magnetic heading.

Independent Position Determining

Independent position determining incorporates airplane navigation systems that generate navigation information without using signals from ground based navigation stations or navigation satellites.

Independent position determining includes the following systems:

- Inertial Reference System (IRS)
- Weather Radar System (WXR)
- Enhanced Ground Proximity Warning System (EGPWS)
- Traffic Alert and Collision Avoidance System (TCAS)
- Radio Altimeter (RAD ALT)

Dependent Position Determining

The dependent position determining incorporates airplane navigation systems that generate navigation information by using signals from ground based navigation stations or from navigation satellites.

Dependent position determining includes the following systems:

- VHF Navigation (VOR)
- Automatic Direction Finder (ADF)
- Distance Measuring Equipment (DME)
- Air Traffic Control Transponder (ATC)
- Global Positioning System (GPS)

Flight Management System (FMS)

The flight management system (FMS) is an integrated navigation system that provides worldwide point-to-point and great circle route navigation.

The system includes, among other, the following functions:

- Lateral navigation with advisory vertical guidance
- Flight plan creation and monitoring
- Enroute map display

- Autopilot steering commands
- Radio navigation

Automatic Flight Control System (AFCS)

The Automatic Flight Control System (AFCS) provides integration of the autopilot and flight director systems. The system consists of two interlinked Flight Control Computers (FCC).

The FCCs receive the following data:

- Flight control panel
- Air data system
- Navigation systems
- Inertial Reference System (IRS)
- Radio Altimeter (RA)
- Surface position sensors

The flight control computer provides the control signals to drive the aileron and elevator servos as well as the horizontal stabilizer trim.

The flight director provides visual guidance using a command bar on the attitude director indicator portion of the primary flight displays.

The autopilot can be disengaged manually or automatically. A disconnection causes a warning signal called “Cavalry Charge”.

The warning will be automatically silenced after a few seconds at manual disconnection or earlier if the disconnect pushbutton is pressed a second time.

Automatic disconnection will activate the warning continuously until the disconnect pushbutton is pressed.

Indication and recording systems

The indication and recording systems consist of the following sub-systems:

- Clock
- Recorder (DFDR)
- Engine Indicating and Crew Alerting System (EICAS)
- Other warning systems

The systems provide visual indications of system operation and record flight and operating parameters.

Data from the airplane systems is received and processed by two Data Concentrator Units (DCU). The DCUs provide data information to the Engine Indication and Crew Alerting System (EICAS) displays.

Master Warning and Master Caution lights on the glare shield draw crew attention to the system malfunctions. Audio signals are also generated within DCUs and are heard through the cockpit speakers.

The DCUs also provide interface with the Flight Data Recorder System (FDR) and Maintenance Diagnostic Computer (MDC) via the Integrated Avionics Processor System (IAPS).

During normal conditions the DFDR is provided with attitude information from IRU 1 via the DCU 1.

1.7 Meteorological information

According to SMHI's analysis:

At flight level 330:
Wind northwest 30 knots, visibility >10 kilometres, no clouds, temperature -60 to -63°C.

At the accident site:
Light variable wind, visibility> 10 km, no clouds, temperature -20 to -25°C, dewpoint -30°C, QNH 1010 hPa.

The accident occurred in darkness without any moonlight.

1.8 Aids to navigation

On the route there were several VOR and NDB beacons within the aircraft's range.

1.9 Communications

In connection with the accident the crew was in contact with Norway Control. Emergency messages were sent out during the accident and were acknowledged by ATC.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

The airplane was equipped with a flight data recorder (DFDR, Digital Flight Data Recorder) and a CVR (Cockpit Voice Recorder). The units were heavily demolished and have been recovered. The memory unit had separated from the CVR chassis. Both units including the CVR memory unit were transported by SHK's staff to the French Accident Investigation Authority, BEA, for readout.

Figure 2. DFDR-unit.

Figure 3. CVR chassis.

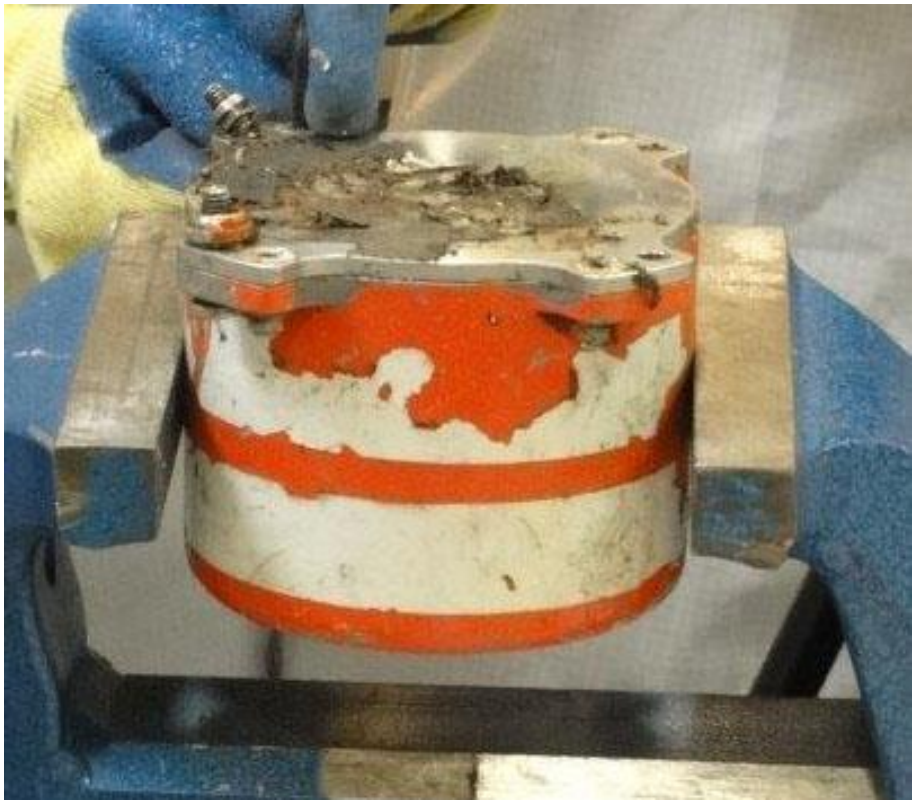


Figure 4. CVR memory module.

1.11.1 DFDR

The DFDR from L-3 Communications Aviation Recorders, Inc. had the part number S800-2000-00 and serial number 01038.

The DFDR was opened up to extract the memory module. The module was connected to a reference frame to be able to download data. Binary Data was downloaded and converted to engineering units via the aircraft's parameter list.

The list contains 137 parameters. All parameters could be read out. The validation of the parameters showed that four of the parameters could not be compatible with the aircraft's actual movement. The concerned parameters were pitch angle, roll angle, magnetic heading and ground speed. Those parameters emanate from the airplane’s IRU units and are described in section 1.16.2.

Selected parameters are presented in appendix 1.

1.11.2 CVR

The CVR from the same manufacturer had the part number 2100-1020-00 and serial number 570736.

The unit was opened to extract the memory module. The module was connected to a reference frame in order to download data from four channels.

The channels consist of one public address channel, two channels for left and right pilot position and one channel for cockpit area sound.

The four channels were downloaded successfully and resulted in four sound files of two hours and four minutes with high quality.

Information about the dialog between the pilots is included in paragraph 1.1.2.

A CVR transcript for the last 75 seconds of the event is presented in appendix 2.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

The accident site is located in an almost flat part of a valley in mountainous terrain. In connection with the accident, a crater was formed. The crater is approximately 6 meters deep and 20 meters in diameter. The bottom of the crater was filled with about 1.5 cubic meters of fluid consisting of aviation fuel and water.

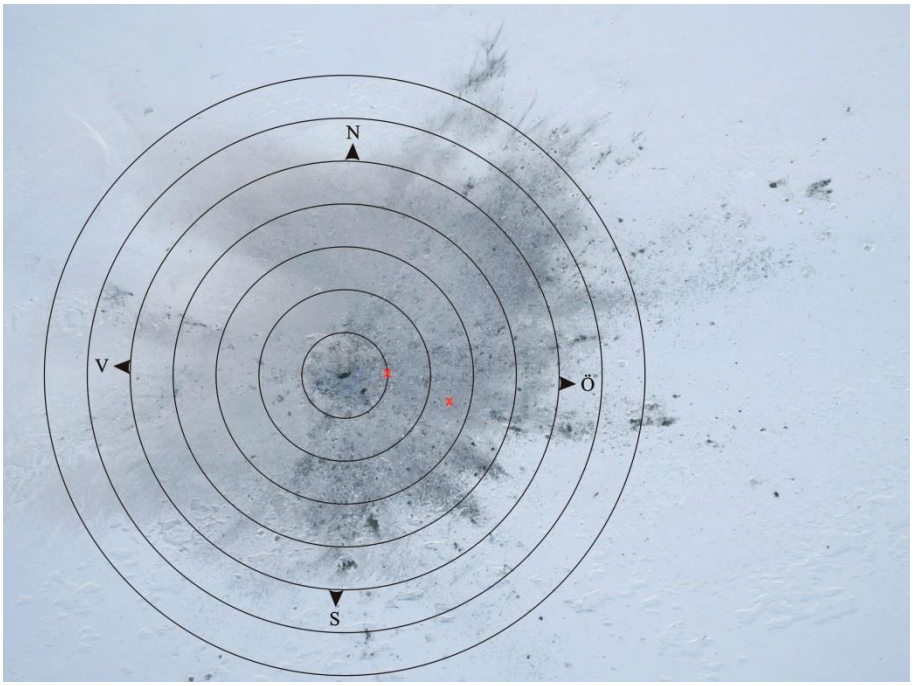


Figure 5. Accident site with 10 meter distance circles. CVR was found at the red cross closest to the center, FDR at the second cross. (Photo: Swedish Police).

1.12.2 Aircraft wreckage

The aircraft was destroyed. Debris was found about 150 meters from the crater. Most parts were found in the crater and to the east of it (see Figure 5 above). Mapping of the wreckage was made according to the polar method, which means that one starts from the centre of the crash site and specify distance and direction.

About 3.5 tons of debris, equivalent to more than 25 percent of the basic empty mass of the airplane was recovered from the crash site and stored by SHK for further investigation.

1.13 Medical and pathological information

To be presented later.

1.14 Fire

There was no evidence of fire or explosion.

1.15 Survival aspects

The accident was not survivable.

1.15.1 Rescue efforts

Air traffic control in Norway (Norway Control) perceived an emergency call (Mayday) from the aircraft crew at 00:19 hrs local time. Norway Control responded to the call and tried to get additional information but did not get any response. The aircraft disappeared from radar screens at Flight Level 088. Hovedredningscentralen Northern Norway (JRCC-Bodø) informed the Joint Rescue Coordination Center in Sweden (JRCC) about the situation and left at 00:26 hrs information about the presumed location of the accident. At 00:27 hrs JRCC decided to alert the mountain rescue services and all appropriate helicopter resources in the area.

Norwegian authorities offered assistance in the search efforts with e.g. an ambulance helicopter from Evenes and two F-16 aircraft from the Royal Norwegian Air Forces. At 03:09 hrs the Norwegian F-16 planes had located the crash site. At 03:10 hrs the ambulance helicopter from Gällivare which participated in the operation had located the crash site.

1.16 Tests and research

1.16.1 Radar data

Selected radar data was converted to KML format and inserted in Google Earth map. The track in figure 6 below is derived by straight lines between the few radar positions that were recorded.

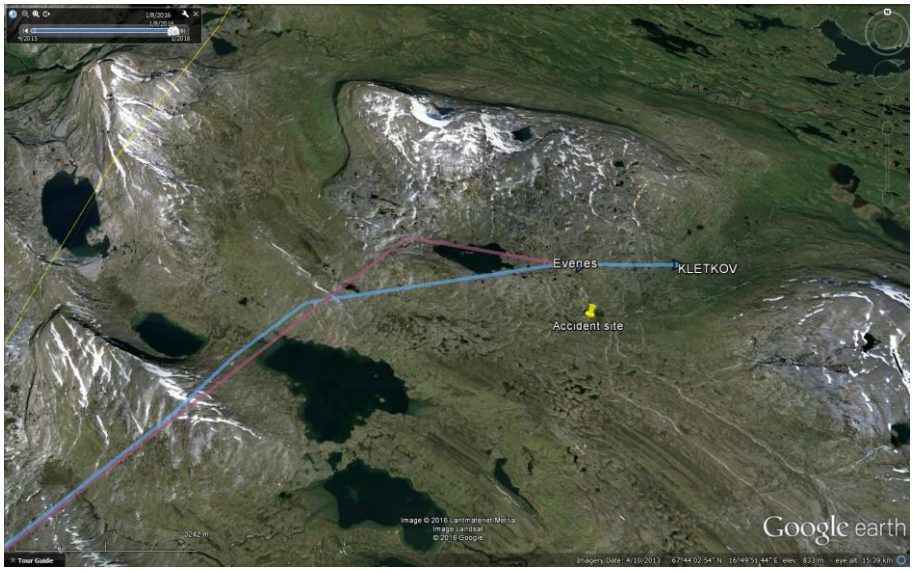


Figure 6. Radar data from Evenes and Kletkov radar in magenta and blue. (Picture Google Earth).

1.16.2 Preliminary validation of non-compatible FDR parameters

SHK have initiated research in order to validate the pitch angle that is not compatible with the motion of the aircraft.

The Pitch Angle has been recalculated based on true airspeed (TAS), altitude information and angle of attack. As the bank angle is not known and the angle of attack is used for the calculation there might be an error of a few degrees in case of large bank angles.

The chart below shows the physically probable values for the aircraft's Pitch Angle with a green line.

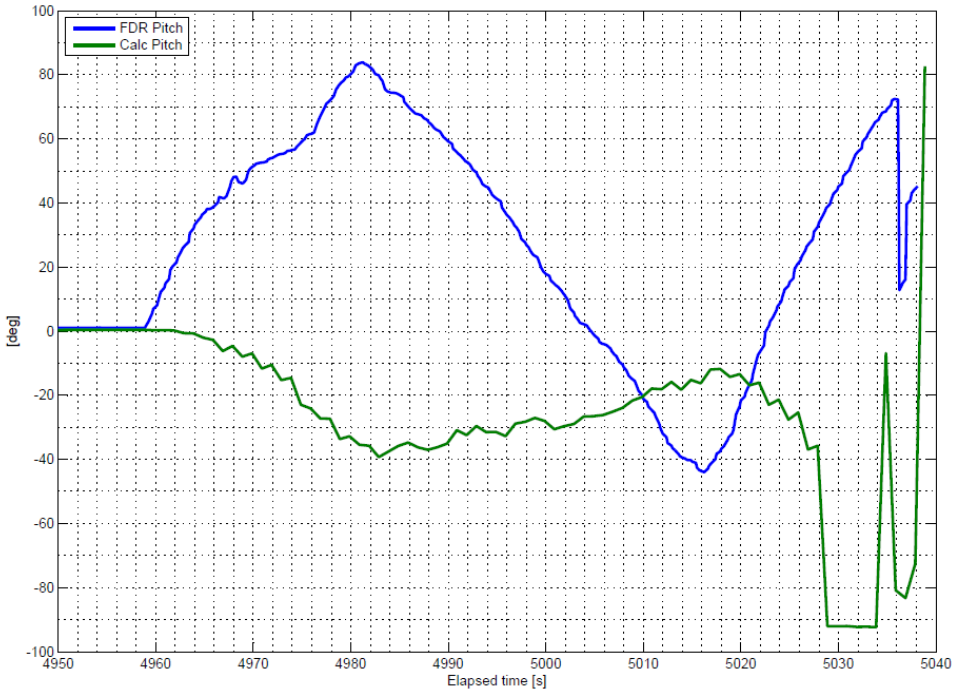


Figure 7. FDR Pitch Angle (blue) and preliminary calculated Pitch Angle (green).

The Pitch Angle has also been calculated with true airspeed and longitudinal acceleration. The registered longitudinal acceleration has two components, the airspeed acceleration and the gravity. The registered acceleration been reduced by the airspeed acceleration. The result is the component of the gravity which gives the pitch angle.

This calculation corresponds mainly with the previous one.

The validation of the Pitch Angle and the three other non-compatible parameters is still in progress.

1.17 Organizational and management information

West Atlantic Sweden AB is an aviation company engaged in commercial cargo air transport under an AOC permit from the Swedish Transport Agency.

1.18 Additional information

1.18.1 Measures taken

SHK has continuously informed concerned authorities about the progress of the investigation.

1.19 Useful or effective investigation techniques

None.

Continued investigation

The investigation continues with further collection of facts and analysis work.

Four parameters recorded by the FDR have shown to be non-compatible with the aircraft's actual movement. The continued investigation will, among other subjects, focus on clarifying in which way this might have affected the airplanes instruments.

The final report is expected to be published in December 2016.

On behalf of the Swedish Accident Investigation Authority,

Jonas Bäckstrand Nicolas Seger

Appendices

Appendix 1: FDR plots.

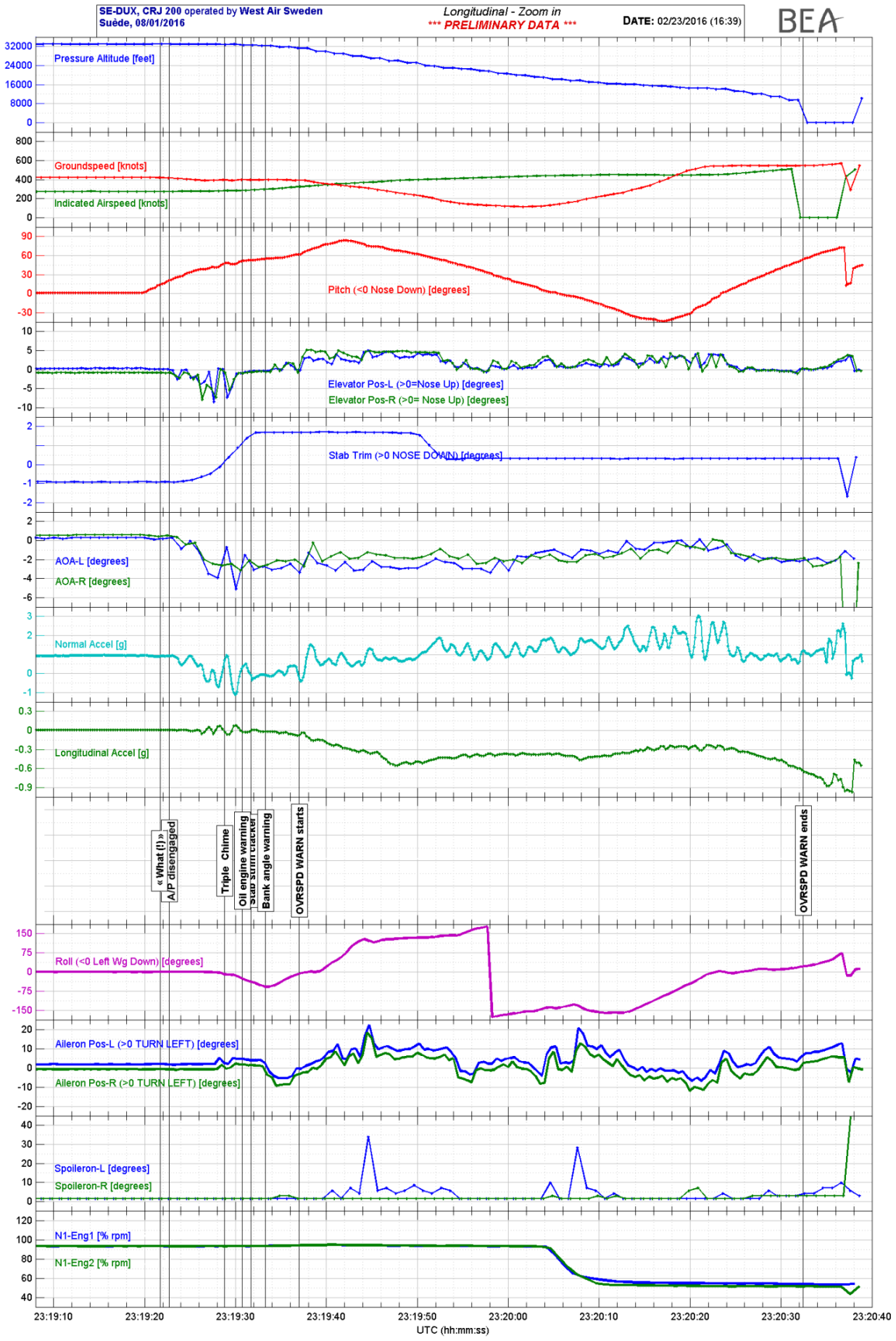
Appendix 2: CVR transcript.

Appendix 1

FDR plots with selected parameters from top to bottom in the graph as follows:

Pressure altitude, ground speed*, indicated airspeed, pitch angle*, elevator position left/right, stabilizer trim, angle of attack left/right, normal acceleration (G), longitudinal acceleration (G), rollangle*, aileron position left/right, spoileron left/right, N1 speed for left/right engine.

* Those parameters are not compatible with the airplanes movement and currently beeing validated.


SE-DUX, CRJ 200 operated by West Air Sweden
Suède, 08/01/2016
Longitudinal - Zoom in
*** PRELIMINARY DATA ***
DATE: 02/23/2016 (16:39)
BEA
Pressure Altitude [feet]
Groundspeed [knots]
Indicated Airspeed [knots]
Pitch (<0 Nose Down) [degrees]
Elevator Pos-L (>0=Nose Up) [degrees]
Elevator Pos-R (>0= Nose Up) [degrees]
Stab Trim (>0 NOSE DOWN) [degrees]
AOA-L [degrees]
AOA-R [degrees]
Normal Accel [g]
Longitudinal Accel [g]
« What (!) »
A/P disengaged
Triple Chime
Oil engine warning
Stab stuck cracker
Bank angle warning
OVRSPD WARN starts
OVRSPD WARN ends
Roll (<0 Left Wg Down) [degrees]
Aileron Pos-L (>0 TURN LEFT) [degrees]
Aileron Pos-R (>0 TURN LEFT) [degrees]
Spoileron-L [degrees]
Spoileron-R [degrees]
N1-Eng1 [% rpm]
N1-Eng2 [% rpm]
23:19:10
23:19:20
23:19:30
23:19:40
23:19:50
23:20:00
23:20:10
23:20:20
23:20:30
23:20:40
UTC (hh:mm:ss)

Appendix 2 Preliminary CVR transcript.

Legend: SV - Synthetic voice
(*) words that could not be interpreted
( ) word of uncertain interpretation
(!) strong expression
italics: communications with ATC

Time UTC	Pilot In Command	First Officer	ATC	Remarks, sounds and warnings
23.19.22	What (!)			
23.19.23				Continuous Cavalry Charge
23.19.24				Single Chime
23.19.28				Irregular sound
23.19.29				Triple Chime
23.19.29		What (!)		
23.19.30	What (!)			
23.19.30				SV: Engine oil
23.19.31				Warning: Stabilizer trim clacker
23.19.33		Come on		
23.19.33				SV: Bank angle
23.19.35	Come on, help me, help me, help me			
23.19.35		Turn right		
23.19.35				SV: Bank angle
23.19.36		What		
23.19.37				Warning: Overspeed (Clacker)
23.19.37	Help me, help me			
23.19.38		Yes, I'm trying		
23.19.40		Turn left, turn left		
23.19.40				SV: Bank angle
23.19.41				Continuous Cavalry Charge warning ends
23.19 42				SV: Bank angle
23.19 43		Turn left		
23.19.44				Single Chime
23.19.44		No		
23.19.45				Single Chime

Time UTC	Pilot In Command	First Officer	ATC	Remarks, sounds and warnings
23.19.50		*Mayday, mayday, mayday Air Sweden 294*		Transmit switch not activated
23.19.53		*Mayday, mayday, mayday*		
23.19.53			*294*	
23.19.54		*Mayday, mayday, mayday Air Sweden 294*		
23.19.55				Single Chime
23.19.57				Single Chime
23.19.57		*We turning back, mayday, mayday*		
23.19.59	Mach trim			
23.20.00			*294, mayday 294*	
23.20.00				Single chime
23.20.01		Trim, trim a lot		
23.20.04				SV: Bank Angle
23.20.06		Turn left, turn left		
23.20.06				SV: Bank Angle, Bank Angle
23.20.08			*294*	
23.20.09				SV: Bank Angle
23.20.09		*Mayday, mayday, mayday, we turning back*		
23.20.14	We need to climb, we need to climb			
23.20.15		Yeah, we need to climb		
23.20.15				SV: Bank Angle
23.20.16			*(*)*	
23.20.16		Turn left, turn left		
23.20.17				SV: Bank Angle
23.20.17	No, continue right, continue			
23.20.19				SV: Bank Angle

Time UTC	Pilot In Command	First Officer	ATC	Remarks, sounds and warnings
23.20.19	Continue right			
23.20.20		Ok, (*)		
23.20.22	No, help me, help me please			
23.20.22				SV: Bank Angle
23.20.23		I don't know, I don't see anything		
23.20.23				SV: Bank Angle
23.20.24		I think you are the right to correct		
23.20.25	Ok			
23.20.26	Ok, ok, ya			
23.20.28	(!)			
23.20.29				SV: Bank Angle
23.20.31		What (!) (*)		
23.20.32				Overspeed warning (Clacker) ends
23.20.33				SV: Bank Angle
23.20.35	(*)			
23.20.35				SV: Bank Angle
23.20.36	(*)			
23.20.37				Single Chime
23.20.37				End of recording