Summary Report

A summary investigation, in accordance with article 45 of the Ordinance on the Safety Investigation of Transport Incidents from 17 December 2014 (OSITI), as of 1 February 2015 (SR 742.161), was carried out with regards to the following serious incident. This report was prepared to ensure that lessons can be learned from the incident in question.

**Aircraft**  
Airbus A320-214 B4 EC-HTD

**Operator**  
Vueling Airlines S.A., Barcelona, Spain

**Owner**  
Vueling Airlines S.A., Barcelona, Spain

**Commander**  
Italian citizen, born 1963  
Licence: Airline Transport Pilot Licence Aeroplane (ATPL(A)) in accordance with European Aviation Safety Agency (EASA) standards

**Copilot**  
Spanish citizen, born 1975  
Licence: ATPL(A) according to EASA

**Location**  
8 NM west of Zurich Airport

**Coordinates**  
668 270 / 248 760 (SwissGrid)  
N 47°23'10'' / E 008°20'34'' (WGS 84)

**Date and time**  
20 September 2017, 18:44:58 UTC

**Type of operation**  
Scheduled flight

**Flight rules**  
Instrument Flight Rules (IFR)

**Departure point**  
Zurich (LSZH)

**Destination point**  
Barcelona (LEBL)

**Flight phase**  
Climb

**Type of serious incident**  
Loss of Navigation instruments

**Injuries to persons**  

<table>
<thead>
<tr>
<th></th>
<th>Crew</th>
<th>Passengers</th>
<th>Others</th>
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</thead>
<tbody>
<tr>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Uninjured</td>
<td>6</td>
<td>126</td>
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**Damage to aircraft**  
No damage

**Other damage**  
None

1 UTC: Universal Time Coordinated
Factual information

Background

On the day before the serious incident, the warning NAV IR 2 FAULT (see section entitled «Brief description of the navigation system») was displayed during a flight involving the Airbus A320-214 commercial aircraft, registration EC-HTD. A corresponding ground test could not confirm the fault. On 20 September 2017, a total of five more flights were performed before the flight involved in the serious incident. No technical problems occurred during any of these flights.

History of the flight

At 18:41:23 UTC on 20 September 2017, EC-HTD took off from Runway 28 in Zurich (LSZH) with the flight plan call sign VY6249 on a scheduled flight to Barcelona (LEBL). For the flight, the commander was pilot flying (PF) and the copilot was pilot monitoring (PM). Shortly after lift-off, the flight crew contacted Zurich Departure on the 125.950 MHz frequency and received clearance from the air traffic controller for a climb to Flight Level (FL) 120. At 18:44:56 UTC, the flight crew was instructed by the air traffic controller to switch to the 135.675 MHz frequency of Zurich Radar.

At 18:44:58 UTC, while the air traffic controller was still transmitting the new frequency, the autopilot and autothrust automatically disengaged. The master warning was activated and the beep known as the cavalry charge sounded to indicate that the autopilot was disengaged. This beep continued to sound for the next 21 seconds. The air traffic controller again transmitted his instruction to change frequency, to which the commander replied as follows: «we have a small issue, standby please».

At 18:45:52 UTC the copilot mentioned a computer reset, which was acknowledged by the commander with «OK». The flight crew’s report stated, among other things, that a computer reset had been performed. The description of the steps performed corresponds to the procedure for resetting the Flight Management Guidance Computers (FMGC, see Figure 6). The recordings show that the Circuit Breakers (CB) of both FMGCs were pulled practically simultaneously.

At 18:46:15 UTC the aircraft passed FL 118 and the commander asked the copilot to confirm the cleared flight level of FL 120. The copilot answered with «correctos» and reported «maintaining 120, Vueling 6249» to the air traffic controller, whereupon the air traffic controller issued clearance for FL 230. Shortly afterwards the aircraft continued its climb. At 18:46:32 UTC, the copilot said: «Autoflight, autothrust off» and just under a minute later he reported: «Both MCDU, flight directors off.» At 18:47:27 UTC the commander requested a heading instruction from the air traffic controller.

At 18:47:45 UTC the air traffic controller instructed the flight crew to continue on a heading of 240°. The commander read the instruction back and added that they were busy with troubleshooting. Recordings show that the autopilot and autothrust were engaged and disengaged several times shortly afterwards.

At 18:48:40 UTC the air traffic controller said: «You are well out of my airspace, are you able to switch over to next sector on the heading or do you need further assistance from me?» The commander replied, without this being broadcast by radio by saying «yes, we would like to come back to the airport, but we do not have navigation indication. So we like to vector to landing on Runway 14.»

2 MCDU: Multipurpose Control and Display Unit (see section entitled «Navigational information and interfaces»).
At 18:50:08 UTC the commander stated: «No FMGC, no MCDU» and then: «Vueling 6249?» He immediately noticed that this message had not been transmitted on the radio, and transmitted «Vueling 6249?» again. This time the message was transmitted. The commander replied to the air traffic controller remark of «go ahead» by saying: «Yes, are you switched me on the next frequency, or we come back to your airfield?» The air traffic controller, still unaware of the commander’s intention to return to Zurich, asked: «Vueling 6249, do you wish to continue?» The commander answered: «Yes, if possible we would like to come back, but we have right now no navigation indication available.» Shortly afterwards, at 18:50:59 UTC, the air traffic controller gave the instruction: «Left turn heading 050 degrees, radar vectors to Zurich.» Shortly afterwards the instruction followed to maintain the altitude that the aircraft had just attained.

At 18:51:50 UTC the air traffic controller asked whether the crew could fly an instrument approach or whether they wanted radar vectors for a visual approach. The captain answered: «Vectoring [...] long final for a visual», which was not transmitted, and shortly afterwards «Vectoring for a long approach to Runway 14», which was transmitted. The air traffic controller said: «ILS approach runway 14 or visual approach, if you prefer that later on» and gave clearance for a descent to FL 150. The commander read back this clearance twice. The communication was only transmitted the second time.

During the ongoing discussion with the copilot, the commander said the following at 18:52:59 UTC: «[...] double FMGC failure.» At 18:53:50 UTC the air traffic controller gave the instruction to turn onto a heading of 020°. Clearance for FL 130 followed just over a minute later. At 18:56:03 UTC the air traffic controller said: «Just for my confirmation, you have got no primary and secondary flight display, or just no navigational system behind?», to which the commander answered «No navigation system, as I told you before, both navigation systems.» The air traffic controller thanked him and gave clearance for FL 110. The commander read back «one», which was not transmitted, followed by the transmission «one zero, six two fo...».

At 18:57:08 UTC, the air traffic controller stated that he estimated there were another 47 miles before the aircraft would land on Runway 14 and repeated his offer of an instrument approach or visual approach. The captain said: «We cannot follow any instrument approach, so we prefer visual», after which a visual approach was agreed upon.

During the discussion with the copilot, the commander repeated the following at 18:57:37 UTC: «Nada, nada, dual FMGC, dual MCDU [...]»

The air traffic controller gave clearance for FL 70 at 18:58:27 UTC. The commander read back the clearance and asked the air traffic controller to report to the maintenance company. At 19:01:16 UTC clearance was given to descend to 6000 ft at a QNH³ of 1022 hPa (see the section entitled «Meteorological information»). The flight crew worked through the approach checklist. The commander requested a level off at 4000 ft to configure the aircraft. Again, this was only transmitted on the second attempt. The air traffic controller confirmed this, saying: «You will get now minimum 10 nautical miles final, and I will vector you with a heading onto the extended centreline of Runway 14, that you can continue the last portion in VMC and visual conditions.»

At 19:03:40 UTC clearance was given for 4000 ft. The flight crew’s discussion continued and the computer reset was discussed. At 19:05:04 UTC an instruction was given for a heading of 090°, together with the information: «I take you slightly through the extended centreline, in order for you to maintain 4000 ft for some time to configure.»

At 19:06:10 UTC the air traffic controller gave the instruction for a heading of 180°, followed by an instruction for a heading of 200° some 30 seconds later. The landing flaps were extended to Setting 2. This was followed by an instruction to turn onto a heading of 230°.

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³ QNH: Pressure reduced to sea level, calculated using the values of standard atmosphere
At 19:07:36 UTC, the air traffic controller gave the flight crew the following information: «The runway is now at your about 9 to 10 o'clock position, and intensity is now on 100 % of the lighting, report the runway in sight.» The copilot reported «runway in sight». The air traffic controller cleared a «visual straight-in approach to Runway 14».

At 19:08:20 UTC, the landing gear was extended. The landing flaps were extended to setting 3. The air traffic controller informed the flight crew: «You are now 10 miles from touchdown, showing 3900 ft and mode Sierra shows indicated speed of 160 knots.» The copilot replied, «fully established», after which the air traffic controller issued landing clearance and provided information that the wind was at 2 knots from 260 degrees.

At 19:13:11 UTC the automatic callout «fifty - forty - thirty - twenty - retard, retard - ten» was recorded. Touchdown took place at 19:13:23 UTC. During the landing roll, the Enhanced Ground Proximity Warning System (EGPWS) gave the warning «terrain ahead, pull up!» eight times. After the flight crew had established visual contact with the marshaller, they contacted Zurich Apron on the frequency 121.850 MHz and taxied to the stand. The passengers disembarked the aircraft as normal.

**Meteorological information**

The approach on Runway 14 took place with no cloud and little wind. The following aerodrome meteorological report was valid for Zurich Airport:

201850Z VRB01KT CAVOK 09/07 Q1022 NOSIG

This message indicates that the following weather conditions had been observed shortly before its release time of 18:50 UTC:

- **Wind**: 1 kt from variable direction
- **Visibility**: 10 km or more
- **Weather**: No significant weather phenomena
- **Cloud**: No cloud below 8000 ft above ground level
- **Temperature/dewpoint**: 9 °C / 7 °C
- **Atmospheric pressure (QNH)**: 1022 hPa
- **Trend**: No significant change expected within the next two hours

**Communications**

Radio communication between the pilots and air traffic control took place in English. Communication between the pilots took place in Spanish.

The commander's radio communications were repeatedly transmitted only partially or not at all. It was not possible to determine the reason for this on the basis of the available flight data recorder recordings. It can be assumed that the push to talk switch was not depressed.

The aircraft was in contact with Zurich Departure on the 125.950 MHz frequency at the time of the serious incident and remained on this frequency until the landing. The air traffic controller worked in a safety-conscious manner and offered the flight crew support that was appropriate to the situation.

**Brief description of the navigation system**

Navigational information and interfaces

The Air Data Inertial Reference System (ADIRS) is an essential provider of navigation data. It consists of three Air Data Inertial Reference Units (ADIRU). These provide temperature, barometric and acceleration parameters (e.g. flight attitude and position) for the various systems including the Flight Management Guidance Computer (FMGC), the Full Authority Digital Engine Control (FADEC) and the Ground Proximity Warning System (GPWS).
The aircraft EC-HTD has two FMGCs, which are part of the Flight Management and Guidance System (FMGS). Both FMGCs provide (independently of one another) the command signals for the Autopilot (AP), the Flight Director (FD) and for the Autothrust (A/THR). They also provide information about the estimated flight time, distances, speed and about the economic profiles and altitudes. The Multipurpose Control and Display Unit (MCDU, see Figure 4) is used to enter a planned route from departure point to destination point into the FMGS during flight preparations, among other things.

The three identical ADIRUs then constantly calculate (independently of one another) the aircraft position. During flight preparations, the exact position at the stand (present position) must be entered into the ADIRU via the MCDU as the starting point for determining the position. When the aircraft moves, the rotary movements around the vertical, lateral and longitudinal axes of the aircraft, as well as the accelerations along these axes, are determined by means of relevant sensors. The ADIRU then calculates the aircraft position, track, heading and groundspeed using these values.

Each ADIRU also independently selects a GPS source to ensure maximum availability of GPS data. The ADIRU uses this to calculate the mixed GPS/IRS position (also known as the GPIRS position).

Each of the two FMGCs independently calculates the aircraft position (known as the FMS position). This consists of the average of the IRS positions supplied by the three ADIRUs, the MIX IRS position and the GPS position. If one of the three IRS positions differs significantly from the other two, its influence on the MIX IRS position is reduced using an algorithm.

Normally the FMGC works in IRS/GPS mode. This mode monitors accuracy and integrity criteria. If these are fulfilled, GPS PRIMARY is displayed on the progress page. If one of these criteria is lost, GPS PRIMARY LOST will be displayed on both MCDUs and on both navigation displays (NDs). This was the case at 18:44:58 UTC. At the same time the FDR recorded invalid position data.

Figure 1 shows the interfaces between the individual systems and their components. Data entry for the FMGCs is achieved via the MCDUs. The FMGCs in turn supply data to the MCDUs and information for display on the NDs in the flight deck.

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4 GPS: Global Positioning System
Flight deck displays

**Figure 2:** Cockpit arrangement (source: aviation operator’s FCOM)

The six screens (PFD 1 and 2, ND 1 and 2, E/WD, SD) are primarily for the following displays:

- **PFD** These two screens (PFD 1 and 2) are the primary flight data displays (PFD) for the commander and copilot. The PFDs are primarily used to display flight attitude, flight level, airspeed and heading.

- **ND** These two screens (ND 1 and 2) are primarily used for navigation display (ND). They show maps and flight plan information. A wide range of additional information can also be displayed, e.g. traffic displays, weather radar, terrain, approach charts and waypoint information.

- **E/WD** This screen (engine/warning display – E/WD) primarily displays the engine data (engine primary indication), flap/slat position and warning & caution messages. This screen is part of the electronic centralized aircraft monitor (ECAM).

- **SD** This screen is used for displaying aircraft systems (System Display – SD). The systems are displayed in simplified diagrams (system synoptic diagrams). The various system displays can be selected on the ECAM Control Panel (ECP). The status of the different systems (aircraft status) is also displayed.
Data entry by the flight crew

The pilots each have one MCDU (multi-purpose control and display unit) in the centre pedestal (see Figure 5). These are used to enter practically all data relevant to a flight.

![Diagram of center pedestal with two MCDUs](image)

**Figure 3**: Centre pedestal with the two MCDU (marked red - source: aviation operator’s FCOM)

The two MCDUs are the interface to the two Flight Management Guidance Computers (FMGCs) (see Figure 1). The MCDUs provide them with information on vertical and horizontal flight guidance, as well as speed profiles. The flight crew can also use the MCDU to modify pre-selected flight paths, change performance data or select special functions via the flight management system. Additional data from peripheral systems such as the Centralized Fault Display System (CFDS), the communication addressing and reporting system (ARINC), the Air Traffic Service (ATSU) etc. can be displayed on the MCDU. If data is entered on the MCDU that is illogical or exceeds the aircraft capabilities, this data is not taken into account or an advisory message is displayed.
The radio navigation aids are normally selected automatically by the FMGC software. However, they can also be selected by the flight crew via the NAV/RAD page on the MCDU. If this is not possible, as was the case in the present serious incident, the flight crew can select the frequency of the appropriate radio navigation aid via the Radio Management Panel (RMP, see Figure 6 - Backup tuning).

Figure 4: Radio Management Panel (RMP - source: aviation operator's FCOM)

The backup tuning is described in the flight crew operating manual (FCOM) as follows:

«If both FMGCs fail, the flight crew can use the RMPs (Radio Management Panels 1 and 2) for backup tuning. Either RMP controls ILS. Prior to select an ILS frequency on one of the RMPs, the flight crew has to select “NAV” button from RMP 1 and RMP 2. If the ILS has a DME, the PFD will not display the DME distance. In this situation, the flight crew will fly without DME information. If necessary, increase the Decision Height (DH) accordingly.»

According to the flight crew’s statement, backup tuning was not possible. It was not possible to determine whether this was due to the copilot pressing the NAV button only on one RMP, or the back-up tuning function being blocked by an FMGC during the flight.

Information on the procedures of the aviation operator

The procedures specified by the aviation operator are stipulated in the relevant operations manuals. The generally applicable procedures can be found in Operating Manual (OM) A and the aircraft-specific procedures in OM B. There are also two identical Quick Reference Handbooks (QRH) on the flight deck, which include procedures for abnormal and emergency situations, among other things. The following refers only to procedures that are important for flight crew cooperation and the course of the flight.

In OM A, the section entitled «Flight procedures» stipulates that the existing checklists should be used:

«Vueling establishes a system of checklists for use by crew members in all phases of operation of the airplane under normal, abnormal and emergency procedures, as appropriate, to ensure that procedures follow the OM.»
The Section of OM B entitled «Operating Philosophy» stipulates the following:

- «The PF responds to the PM’s challenge only after checking the current status of the aircraft. If the configuration does not agree with the checklist response, corrective action shall be taken before answering.
- If corrective action is not possible, the PF must modify the response to reflect the real situation (with a specific answer). When necessary, the PM must crosscheck the validity of the response. The PM waits for the response, before proceeding with the checklist.»

With regard to task sharing and crew coordination, the section on «Task Sharing» contains the following information for normal operation:

- «All the callout is performed in English or what the checklists specify.
- Standard callouts and phraseology are essential to ensure effective crew communications during all phases of the operations. All crew members are required to strict adherence to the standard phraseology applicable to the relevant phase of flight, which is described in OM B. Whenever a crew member makes a callout, another crew member shall verify and respond.»

The use of the standard phraseology is stipulated as follows in the section entitled «Use of Standard Calls»:

- «Standard Calls are defined to be alerting, in order to be clearly identified by the PF or PM; and, distinguished from other intra-cockpit or ATC communications.
- Command and response calls should be performed in accordance with the defined PF / PM task sharing (i.e., task sharing for hand flying and for autopilot operation, task sharing for normal operation and for abnormal / emergency condition). Nevertheless, if a call is omitted by one crew member, the other crew member should perform the call, per good crew resource management (CRM) practice.
- The other crew member should accomplish the requested command or verify the requested condition and respond accordingly.
- Vueling recommends restricting the callouts in the cockpit to remain standard AIRBUS, thus Spanish substitutes are not allowed.»

The available recordings show that these guidelines were not consistently followed. Communication was almost exclusively in Spanish and standard phraseology was not used.

For abnormal and emergency situations, task sharing is defined in OM B as follows:

«PF Pilot Flying – Responsible for the:
- Thrust leavers.
- Flight path and airspeed control.
- Aircraft configuration (request configuration change).
- Navigation.
- Communications.

PM – Pilot Monitoring – Responsible for the:
- Monitoring and reading aloud the ECAM and checklists.
- Performing required actions or actions requested by the PF, if applicable.
- Using engine master switches, IR and guarded switches with PF’s confirmation.»

The recordings of the cockpit conversations show that this task sharing was not consistently applied by the flight crew.

If both FMGCs fail, as was the case in the present serious incident, the flight crew may attempt to reset the Flight Management Guidance Computer (FMGC). The corresponding procedure for flight crews is published in the QRH. It should be noted that the procedure essentially con-
sists of two parts. The first part provides information on the general considerations for a computer reset (see Figure 5), while the procedure for the respective computer is published in the second part (see Figure 6).

**COMPUTER RESET - GENERAL**

Ident.: ABN-80-E-00010905.0001001 / 19 AUG 10
Applicable to: ALL

When a digital computer behaves abnormally, as a result of an electrical transient, for example, the Operator can stop the abnormal behavior by briefly interrupting the power supply to its processor. The flight crew can reset most of the computers in this aircraft with a normal cockpit control (selector or pushbutton). However, for some systems, the only way to cut off electrical power is to pull the associated circuit breaker.

Ident.: ABN-80-E-00010906.0001001 / 06 DEC 16
Applicable to: ALL

To perform a computer reset:
- Select the related normal cockpit control OFF, or pull the corresponding circuit breaker.
- Wait 3 s if a normal cockpit control is used, or 5 s if a circuit breaker is used (unless a different time is indicated)
- Select the related normal cockpit control ON, or push the corresponding circuit breaker
- Wait 3 s for the end of the reset.

**WARNING** Do not reset more than one computer at the same time, unless instructed to do so.

*Note:*
1. In flight, before taking any action on the cockpit C/Bs, both the PF and PM must crosscheck and ensure that the C/B label corresponds to the affected system.
2. The flight crew should report any in-flight reset to the maintenance.

The computers most prone to reset are listed in the table below, along with the associated reset procedure. Specific reset procedures included in OEB or TDUs are not referenced in this table and, when issued, supersede this table.

- On ground, almost all computers can be reset and are not limited to the ones indicated in the table.
- The following computers are not allowed to be reset in specific circumstances:
  - ECU (Engine Control Unit on CFM engines), or EEC (Electronic Engine Control on IAE engines), and EIU (Engine Interface Unit) while the engine is running.
  - BSCU (Brake Steering Control Unit), if the aircraft is not stopped.
- In flight:

**WARNING** The flight crew can attempt a computer reset only when:
- An ECAM/OEB/TDU procedure requests to reset the system, or
- The Computer Reset Table permits to reset the system.

**CAUTION** Do not pull the following circuit breakers:
- SFCC (could lead to SLATS/FLAPS locked).
- ECU or EEC, EIU.

Figure 5: General information on the computer reset procedure (copy from QRH 80.17A)
Figure 6: Explicit procedure to reset the FMGC (copy from QRH 80.18C/D). In this reset procedure, the circuit is interrupted for 10 seconds using of the Circuit Breaker (CB).

According to the flight crew report, this reset procedure was applied. The recordings indicate that the CB of the second FMGC was pulled before the first FMGC was restarted and fully operational. It must therefore be assumed that the CBs of both FMGCs were pulled practically simultaneously. This is confirmed by the commander’s comment at 18:52:59 UTC: «…double FMGC failure.»

Additional information

After the incident, the crew made the following entry in the logbook: «During flight lost navigation datas both FMGC both MCDU on ECAM appear AP1-2 fault A/THR fault TERR GPWS off. After touch down appear on ECAM NAV IR 2+3 fault.»

The maintenance post-flight report which was automatically generated after the flight involved in the incident contained the following information, among other things:

18:42 UTC: The auto flight system (AFS) reported during lift-off: ADIRU1/2/3 DISAGREE. This message was repeated one minute later.

18:44 UTC: Warning AUTO FLT AP OFF
18:45 UTC: Warning AUTO FLT A/THR OFF
18:48 UTC: The AFS reported FMGC 1 and FMGC 2
18:48 UTC: Warnings ENG 1 FADEC, ENG 2 FADEC, NAV GPWS TERR DET FAULT, CAB PR LDG ELEV FAULT

These messages were the result of the loss of FMGC data.
19:06 UTC: Warning NAV IR 2 FAULT
19:13 UTC: Warning NAV IR 2+3 FAULT
19:14 UTC: After landing the message ADIRU 3 appeared

Findings
The maintenance company carried out extensive fault analysis checks. After changing ADIRU 2, the aircraft passed all subsequent tests without any problems and was released for operation again.

Technical analysis of the history of the flight and conclusions
The nose wheel lifted for a short time on several occasions between achieving a speed of 105 kt and lifting off. Vertical accelerations between 0.83 g and 1.13 g were recorded in the same period of time. As Runway 28 is generally in good condition, it is conceivable that the nose wheel ran over the runway centre lights, increasing the drift of all three ADIRUs.

At 18:41:51 UTC the aircraft took off at a speed of 144 kt. Almost simultaneously, the message ADIRU 1 2 3 DISAGREE was registered for the first time, as can be seen from the maintenance post-flight report. This message is not displayed to the crew and does not indicate which of the three Air Data Inertial Reference Unit (ADIRU) and which parameter deviated.

At 18:42:04 UTC, Autopilot 1 was switched on in SRS/NAV mode at a height of 300 ft above ground level. This was possible because at that time two ADIRUs still agreed on their position. The AFS message registered in the Post-Flight Report (PFR) reads: ADIRU 1 2 3 DISAGREE.

At 18:44:57 UTC, Autopilot 1 and both Flight Directors (FDs) automatically disconnected at 7600 ft. The Autothrust (A/THR) disconnected one second after the autopilot. The disconnection of the above systems was due to the fact that the Flight Management Guidance Computer (FMGC) was rejecting data from at least two ADIRUs. The flight control mode was not affected by this and remained in NORMAL LAW.

At 18:45:52 UTC the copilot made reference to a computer reset, to which the commander agreed. A change in frequency of the VHF\(^5\) navigation equipment was recorded at 18:47:04 UTC. VOR\(^6\)1 remained unchanged at 114.85 MHz. VOR2, ILS\(^7\)1 / ILS2 displayed unrealistic frequencies such as 100.00 MHz. It is likely that the FMGC reset cycle began at this point in time.

Another frequency change was recorded at 18:48:00 UTC. At this time VOR1 was also displaying an unrealistic frequency. The reason for this was that the autotune function of the two FMGCs, by which the frequency of a navigation aid is automatically selected, had been lost. At 18:48 UTC the Auto Flight System (AFS) registered the error messages FMGC 1 and FMGC 2 in the PFR. This indicates that the crew had pulled both FMGC circuit breakers. Pulling the circuit breakers for the FMGC 1 and FMGC 2 systems practically simultaneously meant that the data was unavailable on either the two NDs or the two MCDUs. The flight plan, which is normally stored in both FMGCs, is irretrievably lost if both circuit breakers are pulled simultaneously.

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\(^5\) VHF: Very High Frequency
\(^6\) VOR: VHF Omnidirectional Radio range
\(^7\) ILS: Instrument Landing System
At 19:06 UTC the message NAV IR 2 FAULT was registered on the PFR (see section entitled «Additional information»). This resulted in the loss of the copilot’s heading display, so he called out «heading, heading, heading» and switched the ATT HDG selector to FO 3.

After landing, the EGPWS warning «terrain ahead, pull up» was issued several times. This was a false report due to missing or incorrect position data.

Analysis and conclusions

The procedures specified by the aviation operator are in accordance with the aircraft manufacturer’s specifications. The recordings indicate that the flight crew did not consistently adhere to these requirements. This is most evident in the fact that the circuit breakers of both FMGCs were pulled virtually simultaneously, even though the relevant procedure explicitly prohibits this (see Figure 5).

The task sharing between the two pilots for abnormal and emergency situations did not comply with the procedures. The principles of CRM and the standard phraseology were also followed inadequately. The commander’s decision to return to Zurich, for example, and his announcement to air traffic control was made without the involvement of the copilot.

In view of these findings, the Swiss Transportation Safety Investigation Board does not expect the serious incident which is the subject of the investigation to yield any findings critical to the prevention of such an incident.

For this reason, the STSB has decided, based on Art. 45 of the Ordinance on the Safety Investigation of Transport Incidents (OSITI), to refrain from further investigatory activities and to conclude the investigation with the present summary report.

The definitive version of this report is the original in the German language.

Bern, 8 July 2021

Swiss Transportation Safety Investigation Board

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8 The ATT HDG selector (attitude heading selector) is normally in the NORM (normal) position, i.e. ADIRU 1 provides data to PFD 1, ND 1, the RMI (Radio Magnetic Indicator [a combined radio and magnetic compass display]) and the VOR/DME. ADIRU 2 provides data to PFD 2 and ND 2. If ADIRU 2 fails (NAV IR 2 FAULT) the ATT HDG selector must be set to the FO 3 position so that ADR 3 or IR 3 can replace ADR 2 or IR 2 data.

9 CRM: Crew Resource Management. Based on experience of numerous accidents in which insufficient coordination between individual crew members was a causal factor, a training tool for crews, called CRM, was developed. CRM shall raise awareness of the fact that, in addition to technical knowledge on board an aircraft, human relations are also a decisive factor for flying safely.
Annex: Radar recording of the flight path

Display of the flight path excluding the final approach. The radar labels provide the following information:
Top row: groundspeed in knots; Middle row: flight level in hectofeet; Bottom row: time in UTC. The airspace structure around Zurich is indicated with grey lines. Some waypoints and navigation aids are shown. Source of base map: Federal Office of Topography.