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Swiss Transportation Safety Investigation Board STSB

Final Report No. 2438 by the Swiss Transportation Safety Investigation Board

concerning the serious incident involving the commercial aircraft Dornier D328, D-CSUE,

on 20 April 2024

Pfannenstiel, Municipality of Meilen (ZH)

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General information on this report

The sole purpose of an investigation of an aircraft accident or serious incident is to prevent further accidents or serious incidents from occurring. It is expressly not the purpose of the safety investigation and this report to establish blame or determine liability.[1]

Should this report be used for purposes other than those of accident prevention, this statement should be given due consideration.

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

All information, unless otherwise indicated, relates to the time of the serious incident.

All times in this report, unless otherwise indicated, are stated in Coordinated Universal Time (UTC). At the time of the serious incident, Central European Time (CET) applied as Local Time (LT). The relation between LT, CET and UTC is:
LT = CET = UTC + 2 hour.

[1] Article 3.1 of the 13th edition of annex 13, effective as of 28 November 2024 to the Convention on International Civil Aviation of 7 December 1944 which came into force for Switzerland on 4 April 1947, as amended on 27 November 2025 (SR *0.748.0*)

Article 24 of the Federal Act on Civil Aviation of 21 December 1948, as amended on 1 January 2026 (CAA, SR *748.0*)

Article 1, point 1 of Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC, which came into force for Switzerland on 1 February 2012 pursuant to a decision of the Joint Committee of the Swiss Confederation and the European Union (EU) and based on the agreement of 21 June 1999 on air transport between Switzerland and the EU (Air Transport Agreement)

Article 2, paragraph 1 of the Ordinance of 17 December 2014 on the Safety Investigation of Transportation Incidents, as amended on 1 January 2025 (OSITI, SR *742.161*)

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Summary

Overview

Operator	Private Wings Flugcharter GmbH, Georg-Wulf-Strasse 2, 12529 Schönefeld, Germany
Owner	TEC Aircraft Leasing GmbH + Co. KG, Innsbrucker Bundesstrasse 105, 5020 Salzburg Flughafen, Austria
Manufacturer	Dornier Luftfahrt GmbH
Aircraft type	Dornier D328
Country of registration	Germany
Registration	D-CSUE
Location	Pfannenstiel, approximately 20 kilometres south-southeast of Zurich Airport
Date and time	20 April 2024, 05:35 UTC
Type of operation	Charter
Flight rules	Instrument Flight Rules (IFR)
Point of departure	Stuttgart (EDDS), Germany
Destination	Zurich (LSZH)
Flight phase	Approach
Type of serious incident	Controlled Flight towards Terrain

Investigation

The serious incident occurred at 05:35 UTC on 20 April 2024. The Swiss Transportation Safety Investigation Board (STSB) was notified at 07:42 UTC the same day and, after preliminary clarifications, the STSB opened the investigation on 24 May 2024. The STSB informed the following states about the serious incident: Federal Republic of Germany, Republic of Austria and the United States of America. Germany and the United States of America supported the investigation.

The following elements were available for the investigation:

- flight data recorder;
- Radio communications and radar data recordings;
- Information provided by the flight crew;
- Simulator tests.

This final report is published by the STSB.

Synopsis

On the morning of 20 April 2024, the Dornier D328-100 commercial aircraft, registered as D-CSUE, coming from Stuttgart (EDDS), was guided by radar from the approach control centre east of Zurich Airport (LSZH) via the right-hand downwind leg to the final approach to runway 34. The cleared altitude of 5000 ft was passed through just under a minute before reaching the final approach point MILNI, to be passed at 5000 ft, with the autopilot engaged and a low descent rate of a few hundred feet per minute. Shortly afterwards, the rate of descent increased rapidly and suddenly.

A few seconds later, the ground-based Minimum Safe Altitude Warning system triggered an alarm. The Enhanced Ground Proximity Warning System on board triggered a warning 35 s after passing through 5000 ft. The flight crew subsequently switched off the autopilot and initiated a go-around. The lowest recorded height above ground was 300 ft.

Causes

The serious incident, in which the commercial aircraft flew through the intermediate approach altitude before the final approach point and subsequently entered a steep descent and approached the terrain dangerously, was most likely caused by a software anomaly affecting the aircraft's vertical navigation and the late intervention of the flight crew.

Safety recommendations and safety advice

This final report provides 2 safety recommendations.

1 Factual information

1.1 Flight preparations and history of flight

1.1.1 General and pre-flight history

On the morning of 20 April 2024, the Dornier D328-100 commercial aircraft with registration D-CSUE was on a charter flight from Stuttgart (EDDS) to Zurich (LSZH). The crew of the turboprop aircraft consisted of three people, two pilots as flight crew and one cabin crew member; there were no passengers on board. Instrument weather conditions prevailed at Zurich Airport; the temperature was around freezing (see chapter 1.7.2).

1.1.2 History of flight

After an uneventful climb and cruise, the flight crew of D-CSUE, approaching waypoint RILAX from the north, reported to Approach Control Unit Zurich shortly before 05:30 UTC. The Approach Control Unit informed the flight crew that the aircraft would be guided by radar onto the RNP[2] approach to runway 34 (see chapter 1.8 and annex 1). The flight path led over the right downwind leg east of Zurich Airport. The aircraft was then guided with altitude, heading and speed instructions approximately 2 NM before the Final Approach Fix (FAF), which was the MILNI waypoint. At 05:33:10 UTC, the flight crew was assigned a speed of 180 kt by final approach control (Final) and was cleared at 05:33:31 UTC for descent to the intermediate approach altitude of 5000 ft (see figure 1). At 05:33:38 UTC, final approach control gave clearance for the RNP approach as follows: 'Private Wings One Zero One, turn right heading Two Niner Zero, cleared RNP approach runway Three Four, report established.' This meant that the aircraft was to turn right to a heading of 290°, was cleared for the RNP approach runway 34, and the flight crew was to report when the aircraft was established on the final approach.

The aircraft was in a clean configuration with flaps and landing gear retracted when, at 05:34:52 UTC, controlled by the autopilot, it passed through the intermediate approach altitude of 5000 ft QNH[3] with a low descent rate of a few hundred feet per minute. Waypoint ZH492 (framed in red in figure 1), which was 2 NM before MILNI and had to be passed at a minimum altitude of 5000 ft QNH, was passed 7 seconds later, at 05:34:59 UTC, at an altitude of approximately 4600 ft QNH. Two seconds later, the flight crew was instructed to maintain a speed of 160 kt or more until 5 NM before the runway threshold.

Shortly before passing over waypoint ZH492, the descent rate began to increase. As a result, there was a rapid increase in the descent rate, and the aircraft began to accelerate (see chapter 1.11.1 and annex 2).

At 05:35:11 UTC (see red section of the radar track in figure 1), the ground-based Minimum Safe Altitude Warning System (MSAW)[4] of the air traffic control system triggered an alarm. The flight crew was immediately notified of the warning and instructed to check their altitude and climb to 5000 ft immediately, with the words *'Private Wings One Zero One, Low Altitude Warning, check your altitude immediately, QNH One Zero One Six, climb to five thousand feet.'* The instruction to climb immediately was repeated at 05:35:26 UTC, together with the cancellation of the

[2] RNP: required navigation performance, a concept that defines the navigation performance required of aircraft for flight in the Area Navigation (RNAV) for the purpose of standardisation for certain airspaces and flight procedures.

[3] QNH: Pressure reduced to sea level, calculated using the values of the ICAO standard atmosphere; ICAO: International Civil Aviation Organisation

[4] MSAW: a frequently used safety net that warns air traffic controllers of controlled flight into terrain (CFIT) by issuing a timely warning of an aircraft's approach to terrain or obstacles.

approach clearance. From 05:35:27 UTC, at an altitude of around 3500 ft QNH, a warning was triggered in the cockpit of the D-CSUE by the Enhanced Ground Proximity Warning System (EGPWS), warning of a dangerous approach to the terrain (see section 1.6.3). The flight crew subsequently disengaged the autopilot and initiated a go-around. The aircraft passed the Final Approach Fix MILNI, from which it was permitted to depart from the 5000 ft QNH altitude on the profile, at 05:35:31 UTC at an altitude of approximately 3000 ft QNH and a speed of nearly 210 KIAS[5]. The highest obstacle in this area had an altitude of approximately 2800 ft AMSL[6].

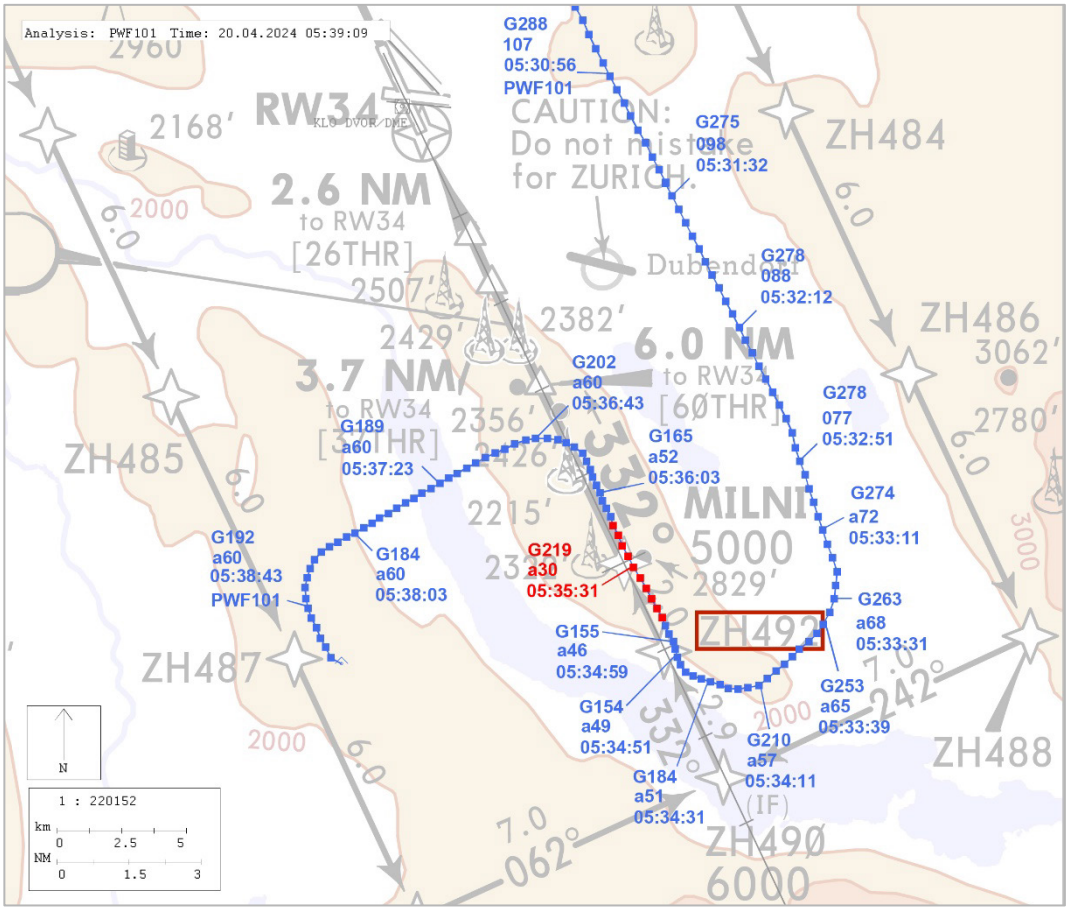


Figure 1: Flight path of D-CSUE (blue) according to radar records with positions every four seconds, indicating ground speed (G) in knots, flight level or barometric altitude (a) in hundreds of feet and time in UTC. The red dots represent the period during which a warning was issued by the Minimum Safe Altitude Warning System (MSAW). The lowest height above the terrain was recorded at 05:35:44 UTC and was 300 ft. Source of the base map: Federal Office of Topography Swisstopo.

The lowest height recorded by the radio altimeter was 300 ft above ground level at 05:35:44 UTC; the corresponding flight altitude was 3048 ft QNH at a speed of 221 KIAS (see annex 2).

Final approach control again directed the aircraft to perform an RNP approach to runway 34. The subsequent approach and landing proceeded without incident.

[5] KIAS: Knots Indicated Air Speed

[6] AMSL: Above Mean Sea Level

1.1.3 Location and time of the serious incident

Date and time	20 April 2024, 05:35 UTC
Lighting conditions	Day
Coordinates	692 842 / 238 716 (*Swiss Grid* 1903) N 47° 17' 34" E 008° 39' 57" (WGS[7] 84)
Altitude	3048 ft QNH resp. 300 ft AGL[8]

1.2 Injuries to persons

Injuries	Crew members	Passengers	Total of occupants	Other
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	3	0	3	Not applicable
Total	3	0	3	0

1.3 Aircraft damage

The aircraft was not damaged.

1.4 Other damage

None

1.5 Personnel information

1.5.1 Flight crew

1.5.1.1 Commander

Person	German citizen, born in 1980	
Licence	Airline Transport Pilot Licence Aeroplane (ATPL(A)) in accordance with the European Union Aviation Safety Agency (EASA), issued by the German Federal Aviation Authority (LBA)	
Flying experience	Total	5248 h
	On type	5038 h
	During the last 90 days	86 h
	On type	86 h
Approaches	Overall, in Zurich (LSZH)	91
	During the last 90 days	0
	RNP approaches during the last 90 days	14

[7] WGS: *World Geodetic System*, The WGS 84 standard was adopted for aviation by resolution of the International Civil Aviation Organisation (ICAO) in 1989.

[8] AGL: Above Ground Level

All the evidence available suggests that the commander started his duty in good health. There is no evidence that fatigue played a role at the time of the serious incident.

1.5.1.2 First Officer

Person	Austrian citizen, born in 1982	
Licence	Commercial Pilot Licence Aeroplane – CPL(A)) in accordance with EASA, issued by the LBA	
Flying experience	Total	1780 h
	On type	1490 h
	During the last 90 days	63 h
	On type	63 h
Approaches	Overall, in Zurich (LSZH)	7
	During the last 90 days	0
	RNP approaches during the last 90 days	11

All the evidence available suggests that the first officer started his duty in good health. There is no evidence that fatigue played a role at the time of the serious incident.

1.6 Aircraft information

1.6.1 General

Registration	D-CSUE	
Aircraft type	Dornier D328-100	
Characteristics	Twin-engine regional aircraft with propeller turbine propulsion, designed as a cantilever high-wing aircraft in all-metal construction with retractable landing gear in nose wheel configuration.	
Manufacturer	Dornier Luftfahrt GmbH	
Operator	Private Wings Flugcharter GmbH, Georg-Wulf-Strasse 2, 12529 Schönefeld, Germany	
Owner	TEC Aircraft Leasing GmbH + Co. KG, Innsbrucker Bundesstrasse 105, 5020 Salzburg Flughafen, Austria	
Relevant speeds:		
Maximum flap extended speed for specific landing flap positions	Flaps 12°	200 KIAS
	Flaps 20°	180 KIAS
	Flaps 32°	160 KIAS
Maximum landing gear extended speed (V_{LE})	200 KIAS	
Mass and center of gravity	Both the mass and centre of gravity were within the limits according to the Aircraft Flight Manual (AFM).	

1.6.2 Selected aircraft systems and equipment

1.6.2.1 General

The following sections only briefly describe systems that bear any significance with regards to this serious incident.

1.6.2.2 Flight Management System

The Flight Management System (FMS) of the D-CSUE was the Honeywell Legacy FMZ 2000 model. This is part of the Honeywell Primus 2000 Avionics System IC-800 (P/N: 7017300-11010) and was equipped with software version NZ4.8[9]. The FMS met the lateral performance criteria for enroute flight and for navigation in the terminal control area.

According to the Aircraft Flight Manual (AFM), the FMS was certified for use in the following RNAV environments:

- B-RNAV[10] (RNP 5) in accordance with JAA[11];
- P-RNAV[12] (RNP 1) in accordance with JAA and approved for navigation in designated European airspaces.

The database used for P-RNAV must come from an approved provider. Use of the FMS requires that the database has been validated for the intended use.

With the GPS[13] sensor on board, the commercial aircraft had EASA certification for RNAV non-precision instrument approaches (2D approach). To fly such an approach, the AFM provides for the following modes:

- LNAV (lateral navigation): lateral guidance along the waypoints relevant for the approach;
- VNAV (vertical navigation): vertical guidance according to the angle stored in the database, taking into account the minimum crossing altitudes stored in the FMS database[14].

According to the AFM, the use of LNAV mode for lateral flight guidance in combination with a selected descent rate or glide angle for vertical flight guidance is not intended.

According to the AFM specifications, 2D approaches are flown using LNAV/VNAV mode and the following requirements:

- The higher LNAV minimum is used as the Decision Altitude[15];

[9] In a Safety Information Bulletin (SIB N°: 2008-73 dated 11 August 2008), EASA advises the following: With the FMZ-2000 FMS, VNAV mode can lead to premature descent and incorrect vertical deviation being displayed. The flight crew must strictly monitor all published minimum altitudes.

[10] Basic Area Navigation: in aviation, this refers to a navigation procedure for instrument flights in which the route is determined via freely selectable waypoints without the need to fly to ground beacons. RNP 5 means that an aircraft must remain within ± 5 NM of its intended position for at least 95% of the flight time.

[11] JAA: Joint Aviation Authorities

[12] Precision Area Navigation: RNAV application in the terminal control area and further development of B-RNAV, in which an aircraft must remain within ± 1 NM of its intended position for at least 95% of the flight time.

[13] GPS: Global Positioning System

[14] The use of this vertical mode is only certified up to the higher LNAV minimum.

[15] At the Decision Altitude, the approach to landing is continued if visibility conditions are sufficient, otherwise a go-around must be initiated.

- To check the vertical guidance, the altitudes shown on the approach chart in relation to the distance to the runway threshold are used (see figure 4 in annex 1).
- The Minimum Decision Altitude MDA/H is set using the knob for the preselected altitude, in accordance with the operator's specifications.

1.6.3 Warning devices to prevent collision with the terrain

The Enhanced Ground Proximity Warning System (EGPWS) built into the D-CSUE monitors the aircraft's flight profile at low heights to avoid dangerous flight paths and ultimately prevent collisions with the ground.

The system uses various aircraft data from the PRIMUS 2000 system, processes it using special warning algorithms and, if necessary, alerts the flight crew with audible warnings, visual displays and images on the cockpit screens.

Warnings are triggered in particular when the barometric descent rate or the approach speed to the terrain exceed certain limits. The acoustic warnings 'SINKRATE – SINKRATE' and 'TERRAIN – TERRAIN' are issued.

According to the flight data recordings, an EGPWS warning was issued between 05:35:27 UTC and 05:35:42 UTC (see annex 2). It was not possible to determine retrospectively which EGPWS warning was actually issued, as the detailed EGPWS warnings are not recorded individually by the flight data recorder (see chapter 1.11.1).

1.7 Meteorological information

1.7.1 General weather conditions

Between a high-pressure system centred over the British Isles and a low-pressure system over northern Italy, moist air flowed from the north into the Alpine region.

1.7.2 Weather at the time and location of the serious incident

The following information on the weather at the time and location of the incident (minimum flight altitude approx. 3000 ft AMSL) is based on various data sources.

Weather/clouds (see chapter 1.7.5)	Overall, 8/8 at various heights; the lowest clouds were over the Pfannenstiel.
Visibility (see chapter 1.7.5)	At minimum flight altitude, partly in clouds; outside clouds up to 9 km
Wind	At minimum flight altitude, level 8 kt from 300 degrees; gusts 15 kt
Temperature / dew point	At 1132 m/M -1.4 °C / -1.4 °C At 2900 ft AMSL around 0 °C / -1 °C
Atmospheric pressure	QNH LSZH: 1016 hPa (with ISA[16] -10 °C, the true altitude was around 60 ft lower than the indicated altitude of 3000 ft AMSL)

[16] International Standard Atmosphere

	Hazards	Summit in the clouds and icing above 3000 ft AMSL (light according to ADWICE[17]; up to moderate according to LL-SWC[18])

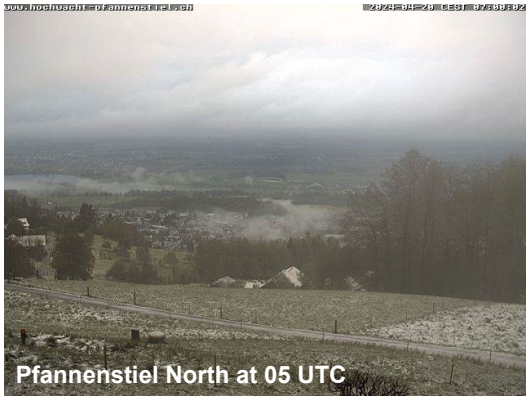
1.7.3 Astronomical information

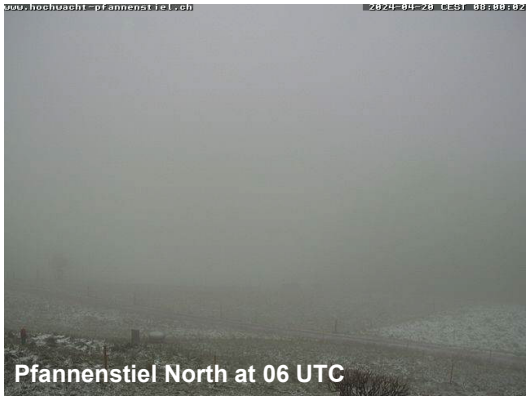
Position of the sun	Azimuth: 84°	Elevation: 10°
Light conditions	Day	

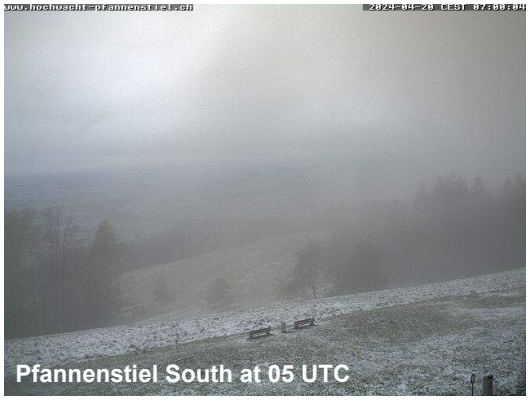
1.7.4 Weather according to the flight crew

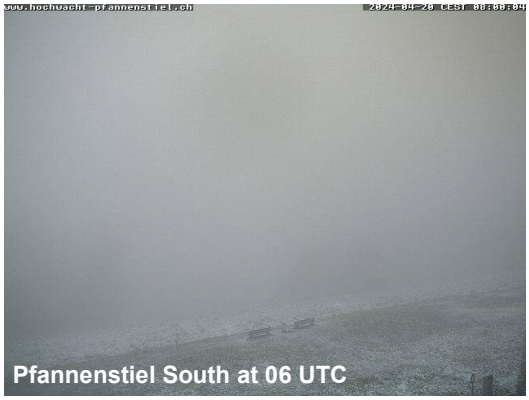
According to their own statements, the flight crew never had visual contact with the ground during the first approach or the missed approach.

1.7.5 Webcams









[17] ADWICE: Icing forecast by the German Weather Service, as published, for example, in the self-briefing system https://www.flugwetter.de

[18] LL-SWC: Low Level Significant Weather Chart

Figure 2: A selection of various webcam recordings around the time of the serious incident

1.8 Aids to navigation

The RNP approach to runway 34 was implemented at the beginning of 2024 and was approved for use in VNAV mode at temperatures down to -20 °C at the time of the serious incident (see annex 1). Due to a requirement by the air traffic control Skyguide, the design ensured that there was a straight, 2 NM long segment before the Final Approach Fix (FAF). Three RNAV transitions were implemented from the initial approach fix (IAF) GIPOL, RILAX and AMIKI to waypoint ZH490. The stored glide angle for the final approach was 3.3°. The procedure included a deviation from the PANS-OPS[19] design standards, which was accepted during validation in September 2023; it played no role in the serious incident under investigation.

1.9 Communications

Radio communications between the flight crew and the air traffic controllers at the approach control centre and final approach control proceeded normally and without difficulty until the time of the serious incident.

1.10 Aerodrome information

1.10.1 General

The reference altitude of the airport is 1417 ft AMSL, and the reference temperature is set at 27.0 °C.

[19] PANS-OPS: ICAO regulations that define globally uniform criteria for the safe creation of instrument flight procedures for arrivals and departures with the aim of ensuring obstacle clearance and flight safety.

1.10.2 Runway equipment

Zurich Airport is characterised by a system of three runways. Runways 14 and 16 are equipped with a Category III instrument landing system (ILS), while runway 34 has a Category I ILS. Runway 28 is equipped with an uncategorised ILS, which has a higher minimum than Category I. The runways are therefore suitable for precision approaches.

The runways at Zurich Airport have the following dimensions:

Runway	Dimensions	Threshold elevation
10/28	2500 × 60 m	1391/1416 ft AMSL
14/32	3300 × 60 m	1402/1402 ft AMSL
16/34	3700 × 60 m	1390/1388 ft AMSL

At the time of the serious incident, all three runways were available for landings along their entire length.

At the time of the serious incident, the ILS approach to runway 34 was not available due to maintenance work, according to NOTAM[20], but the RNP and LOC approaches were available (see annex 1).

1.11 Flight recorders

1.11.1 Flight data recorder

Type	Model F1000
Manufacturer	Fairchild (currently: L3Harris)
Year of manufacture	06/96
Number of parameters	46
recording rate	64 words per second (WPS)
Recording medium	SSFDR
Recording time	≥ 25 h

The flight data recorder's data frame contained only 46 parameters (see annex 2); there were no recordings that would allow conclusions to be drawn about the flight crew's handling of the Flight Control System (FCS) or the autopilot. In particular, the preselected altitude, the FMS target altitude stored in the FMS and the vertical speed were not recorded.

It should also be noted that the pressure altitudes recorded by the FDR correspond to standard pressure (see annex 2) and therefore do not correspond to the barometric altitude according to QNH, as displayed to the pilots on the display (indicated altitude). In this approach, the difference was approximately 90 ft, i.e. the recorded pressure altitude of 4910 ft corresponds to an indicated altitude of approximately 5000 ft QNH.

The most important events according to the flight data recorder (see figure 5 in annex 2) and the mode changes of the vertical guidance (vertical modes) are recorded below:

[20] NOTAM: Notice To Airmen, daily updated reports on operational restrictions or changes to published procedures, which are consulted by the flight crew before commencing a flight.

- At 05:34:38 UTC, the aircraft was at a pressure altitude (PA) of 5128 ft (corresponding to 5218 ft QNH) when the vertical mode of the automatic Flight Control System changed from V/S to Altitude Select Capture (ASEL CAP).
- At 05:34:44 UTC, the lateral mode LNAV was captured.
- At 05:34:48 UTC, the Flight Control System switched back from ASEL CAP mode[21] to V/S mode.
- At 05:34:52 UTC, the aircraft passed through an altitude of 5000 ft QNH with a shallow descent rate of a few hundred feet per minute.
- Another 4 seconds later, at 05:34:56 UTC, vertical mode VNAV was engaged at an altitude of approximately 4950 ft QNH. As a result, the descent rate increased significantly.
- Within 20 seconds, the descent rate increased to a calculated value of just over 4000 ft/min.
- From 05:35:27 UTC to 05:35:42 UTC, the flight data record shows an EGPWS warning.
- The autopilot was switched off at 05:35:32 UTC and a go-around was initiated.

1.11.2 Cockpit Voice Recorder

Recordings from the Cockpit Voice Recorder (CVR) were no longer available.

1.12 Wreckage and impact information

Not applicable

1.13 Medical and pathological information

Not applicable

1.14 Fire

Not applicable

1.15 Survical aspects

Not applicable

1.16 Tests and research

On 4 and 5 March 2025, various tests were carried out in the DO-328 simulator in Velbert (Germany). These involved four selected scenarios for an RNAV approach to runway 34 at Zurich Airport (LSZH), which were carried out under conditions that were largely identical to those of the incident flight. The results were then evaluated together with the manufacturer.

The tests carried out did not provide evidence of the behaviour observed during the incident flight regarding the mode change of the vertical guidance. However, a plausible scenario for how the rapid increase in descent rate could have occurred in the serious incident under investigation was successfully and repeatedly reproduced: This scenario can be triggered under certain conditions if the knob for the

[21] The flight control logic provides for a change from ASEL CAP mode to ALT HOLD mode, i.e. the preselected flight altitude is captured and maintained.

preselected altitude is turned to set a lower altitude during the brief ASEL CAP phase; as a result, the Flight Control System switched back to V/S mode. A renewed change from V/S to VNAV ALT HOLD (VALT)[22] could only be reproduced if VNAV was first engaged via the autopilot's flight guidance panel.

1.17 Organisational and management information

The flight operations company Private Wings Flugcharter GmbH operates in the field of on-demand aviation. It transports customers from the fields of industry, sport and events to their production facilities, competitions and event venues. Private Wings also offers its Dornier 328-100 and Beech 1900 D aircraft to other airlines for ACMI[23] and provides consulting services in the field of aircraft management.

1.18 Additional information

1.18.1 International Civil Aviation Organisation requirements

According to the specifications of the International Civil Aviation Organization (ICAO) regarding PBN[24] approaches, the relevant manual (ICAO Doc 9613) states that Air Navigation Service Provider (ANSP) clearances to fly directly to the Final Approach Fix (FAF) are not permitted (bold type in the original).

"5.3.4.3.6 ATC tactical interventions in the terminal area may include radar headings, "direct to" clearances which bypass the initial legs of an approach, interception of an initial or intermediate segment of an approach, or the insertion of waypoints loaded from the database. In complying with ATC instructions, the flight crew should be aware of the implications for the RNP system:

a) the manual entry of coordinates into the RNAV system by the flight crew for operation within the terminal area is not permitted; and

b) "direct to" clearances may be accepted to the intermediate fix (IF) provided that the resulting track change at the IF does not exceed 45 degrees.

Note.— "Direct to" clearance to FAF is not acceptable."

1.19 Useful or effective investigation technique

Not applicable

[22] VALT: Vertical Altitude Hold, this submode operates identically to altitude hold (ALT HOLD) to maintain a barometric altitude reference and engages automatically after the target altitude has been captured. VALT will also engage whenever the VNAV button is pressed and the airplane is within 250 ft of the FMS target altitude; the mode is annunciated on the Primary Flight Display (PFD) by a green "VALT" (Source: Airplane Operating Manual, Vol. 2).

[23] ACMI: Aircraft, Crew, Maintenance and Insurance, type of aircraft leasing

[24] PBN: Performance Based Navigation

2 Analysis

2.1 Technical aspects

After clearance for the RNP approach to runway 34, the flight crew had to update the flight plan in the FMS (sequencing) during the turn-in phase to the final approach track and select the Final Approach Fix MILNI as the direct-to waypoint before the mode for lateral flight guidance (LNAV) mode could be engaged at 05:34:44 UTC. This meant that the conditions for subsequently engaging VNAV mode for the final approach from the MILNI waypoint in accordance with operational requirements were met (see chapter 1.6.2.2).

The FDR data (see chapter 1.11.1) showed a change from Vertical Speed (V/S) to Altitude Select Capture (ASEL CAP) in the vertical guidance mode of the approach at 05:34:38 UTC, i.e. the phase in which the aircraft transitions from descent to horizontal flight at the preselected altitude of 5000 ft. Around 10 s later, there was another change back to Vertical Speed (V/S). A few seconds later, the aircraft passed through the cleared and preselected Intermediate Approach Altitude of 5000 ft in the FMS with a low descent rate of a few hundred feet per minute (see annex 2).

The scenarios flown in the simulator tests (see chapter 1.16) allow no other conclusion than that, during this brief ASEL CAP phase, the preselected altitude was set by the flight crew to the LNAV Decision Altitude of 1990 ft in accordance with operational specifications using LNAV/VNAV mode (see chapter 1.6.2.2). This led to a reversion to Vertical Speed (V/S) mode at 05:34:48 UTC. The flight crew must then have switched to VNAV mode at 05:34:56 UTC to transfer the aircraft to vertical flight guidance along the profile (VPATH) after the Final Approach Fix MILNI (see figure 3).

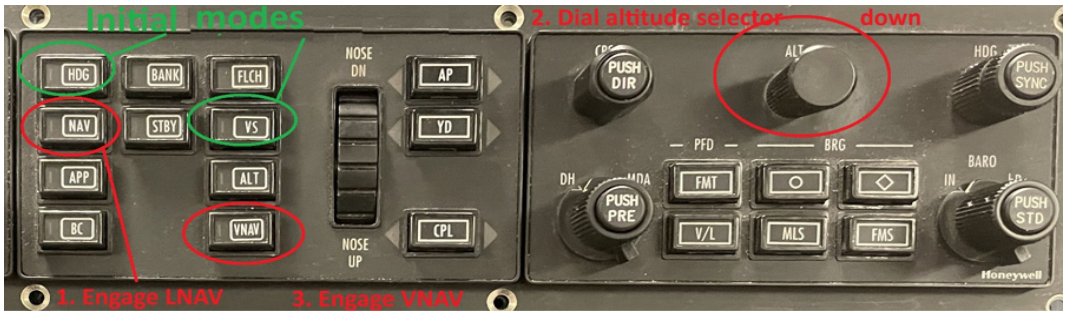


Figure 3: Flight guidance panel of the autopilot showing the most probable sequence of mode changes selected by the flight crew when approaching the Final Approach Fix MILNI in the initial modes with heading (HDG) and vertical speed (VS). Then 'NAV' (①) was selected, the lower altitude value was set on the preselected flight altitude knob "ALT" (②), followed by switching on the 'VNAV' mode (③).

Due to the fact that the aircraft's altitude at this point was already less than approximately 50 ft below 5000 ft AMSL (see chapter 1.11.1 or annex 2), the FMS logic ignored the 5000 ft altitude constraint and its altitude target was changed to the preselected altitude of 1990 ft. That in combination with the FMS request VNAV ALT HOLD[25] led the internal logic of the Flight Control System to issue a command that resulted in a rapid descent rate with a calculated value of slightly over 4000 ft/min.

[25] VALT: VNAV ALT HOLD, a submode of VNAV (cf. chapter 1.16)

This software anomaly, which was repeatedly reproduced in simulator tests, most likely led to controlled flight towards terrain in this serious incident and was therefore a co-causal factor.

Due to the safety deficit identified, the STSB issues in this report a safety recommendation to the European Union Aviation Safety Agency (EASA) and a safety recommendation to the Federal Aviation Administration (FAA) (see chapter 4.1).

At 05:35:27 UTC, the FDR recorded the first activation of the EGPWS (see figure 5 in annex 2). At this point, the aircraft was at an altitude of around 3400 ft AMSL instead of the 5000 ft AMSL specified in the approach procedure. The terrain ahead of the aircraft culminated at around 2800 ft AMSL. With the rapidly increasing descent rate to just over 4000 ft/min, the flight crew had only about 10 s to prevent a collision with the terrain. Immediate action is imperative with EGPWS warnings, and flight crews practise this in drills in the simulator.

There is no evidence to suggest that the framework conditions described in the EASA Safety Information Bulletin (SIB No.: 2008-73) dated 11 August 2008 (see footnote 9 in chapter 1.6.2.2) were present in the serious incident under investigation. From the perspective of the operators concerned, it would be of interest and therefore desirable for the DO-328 aircraft type to also be mentioned in the SIB in question.

2.2 Human and operational aspects

After the initial call to the approach control centre, the flight crew of D-CSUE was guided via the right-hand downwind leg east of Zurich Airport with altitude, heading and speed instructions for the final approach to runway 34. This radar guidance was appropriate and the assigned speed of 180 kt allowed the flight crew to configure the aircraft for landing by lowering the landing gear and setting the flaps to the first position (see chapter 1.6.1).

According to ICAO specifications regarding PBN approaches (see chapter 1.18.1), it is stated that clearances or instructions from air traffic control to fly directly to the Final Approach Fix (FAF) are not permitted. This requirement was taken into consideration by Skyguide's demand that there be a straight segment 2 NM long before the FAF (see annex 1). This requirement was also taken into account in the last heading instruction to the flight crew to turn to a heading of 290 degrees and in the clearance for the RNP approach.

Seven seconds before reaching waypoint ZH492, D-CSUE passed through the intermediate approach altitude of 5000 ft and waypoint ZH492 was overflown at 05:34:59 UTC around 400 ft too low. At approximately the same time, the descent rate increased due to the internal FCS logic (see chapter 2.1). Within 20 s, this reached a calculated value of slightly more than 4000 ft/min without the flight crew taking any countermeasures to defuse the situation.

Even after two requests from final approach control to climb immediately to 5000 ft QNH, the flight crew only switched off the autopilot 5 s after the EGPWS warning and initiated a go-around.

The underlying reasons for the failure to react to the aircraft passing through the intermediate approach altitude, the failure to recognise the high descent rate and the late initiation of the go-around, which were co-causal factors for the occurrence of the serious incident, could not be conclusively clarified based on the available data.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The aircraft was certified for flight under Instrument Flight Rules (IFR).
- Both the mass and centre of gravity of the aircraft were within the limits permitted by the Aircraft Flight Manual (AFM) at the time of the serious incident.
- Simulator tests revealed an anomaly in software version NZ4.8 of the Honeywell Legacy FMZ 2000 FMS, whereby the internal logic of the Flight Control System, relating to vertical navigation, can command high descent rates under certain conditions.

3.1.2 Flight Crew

- The flight crew held the necessary licences for the flight.
- There is no evidence of health or fatigue-related adverse effects on flight crew during the serious incident.

3.1.3 History of the serious incident

- On the morning of 20 April 2024, the Dornier D328-100 commercial aircraft, registered as D-CSUE, was on a charter flight from Stuttgart (EDDS) to Zurich (LSZH); there were no passengers on board.
- After the initial call to Zurich Approach Control, the aircraft was guided from the north via the right downwind leg east of Zurich Airport with altitude, heading and speed instructions to waypoint ZH492, which was approximately 2 NM before the final approach point MILNI, on the RNP approach to runway 34.
- Following the instruction to turn to a heading of 290 degrees, the flight crew was cleared for the RNP approach at 05:33:38 UTC.
- At 05:34:44 UTC, the lateral navigation (LNAV) mode was captured.
- At 05:34:48 UTC, the Flight Control System switched from vertical mode ASEL CAP back to V/S mode when the flight crew adjusted the preselected altitude downwards to the Decision Altitude.
- Controlled by the autopilot, the aircraft passed through the intermediate approach altitude of 5000 ft AMSL in clean configuration at 05:34:52 UTC with a low descent rate of a few hundred feet per minute.
- At 05:34:56 UTC, the vertical navigation (VNAV) mode was engaged, and within 20 seconds the aircraft entered a steep descent with a calculated descent rate of just over 4000 ft/min.
- Waypoint ZH492, which was to be flown over at a minimum altitude of 5000 ft AMSL, was flown around 400 ft too low at 05:34:59 UTC.
- At 05:35:11 UTC, the ground-based Minimum Safe Altitude Warning System (MSAW) of the air traffic control triggered an alarm.
- From 05:35:27 UTC to 05:35:42 UTC, the flight data recorder shows a warning from the EGWPS, whereupon the flight crew switched off the autopilot and initiated a go-around.
- The terrain ahead of the aircraft was at approximately 2800 ft AMSL.

- The Final Approach Fix MILNI, from which the aircraft was permitted to leave the altitude of 5000 ft on the final approach profile, was flown over in descent at 05:35:31 UTC at an altitude of approximately 3000 ft AMSL.
- The lowest height above ground of 300 ft was recorded by the radio altimeter at 05:35:44 UTC.

3.1.4 General conditions

- During the approach and missed approach, the aircraft was flying in instrument flight conditions; the temperature was around freezing point.
- The PBN approach to runway 34 was approved in VNAV mode for a temperature of down to -20 °C at the time of the serious incident.

3.2 Cause

In order to achieve its objective of prevention, a safety investigation authority shall express its opinion on risks and hazards that have been identified during the investigated incident, and which should be avoided in the future. In this sense, the terms and formulations used below are to be understood exclusively from the perspective of prevention. The identification of causes and contributory factors does not, therefore, in any way imply assignment of blame or the determination of administrative, civil or criminal liability.

The serious incident, in which the commercial aircraft flew through the intermediate approach altitude before the final approach point and subsequently entered a steep descent and approached the terrain dangerously, was most likely caused by a software anomaly affecting the aircraft's vertical navigation and the late intervention of the flight crew.

4 Safety recommendations, safety advice and measures taken since the serious incident

4.1 Safety recommendations

In accordance with international[26] and national[27] legal bases, all safety recommendations are addressed to the supervisory authority of the competent state. In Switzerland, this is the Federal Office of Civil Aviation (FOCA) or the supranational European Union Aviation Safety Agency (EASA). The competent supervisory authority must decide on the extent to which these recommendations are to be implemented. Nonetheless, any agency, organisation and individual is invited to strive to improve aviation safety in the spirit of the safety recommendations expressed.

The STSB shall publish the answers of the relevant federal office or foreign supervisory authorities at http://www.sust.admin.ch to provide an overview of the current implementation status of the relevant safety recommendation.

4.1.1 Information concerning the software anomaly and its resolution

4.1.1.1 Safety deficit

On the morning of 20 April 2024, the Dornier D328-100 commercial aircraft was guided by radar onto the final approach to runway 34 at Zurich Airport. Shortly before the final approach, with the autopilot engaged, the aircraft suddenly transitioned from a descent at a low rate of a few hundred feet per minute to a steep descent. A few seconds later, the ground-based the Minimum Safe Altitude Warning system and the on-board Enhanced Ground Proximity Warning System triggered an alert. The flight crew switched off the autopilot and initiated a go-around. The lowest recorded height above ground was 300 ft.

The probable cause of the abrupt descent was determined to be a software anomaly in the Primus 2000 avionics system, specifically software version NZ4. 8 of the FMS Honeywell Legacy FMZ 2000, according to which the internal logic of the Flight Control System (FCS) relating to vertical navigation can command high descent rates under certain conditions.

4.1.1.2 Safety Recommendation No. 610

The European Union Aviation Safety Agency (EASA) should ensure that the anomaly caused by software version NZ4.8 can no longer occur in DO-328 aircraft, for example by installing the Honeywell IC-810 avionics computer with updated FMS software version NZ6.2, as enabled by Major Change Approval 10065397.

4.1.1.3 Safety Recommendation No. 611

The Federal Aviation Administration (FAA) should ensure that the manufacturer Honeywell updates the Pilot's Manual of of the Primus 2000 Avionics system based on information in Service Information Letter (SIL) D202507004836, released on 14 July 2025 to address the FCS high vertical rate issue.

[26] Annex 13 of the International Civil Aviation Organization (ICAO) and article 17 of Regulation (EU) No. 996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in civil aviation and repealing Directive 94/56/EC.

[27] Article 48 of the Swiss Ordinance on the Safety Investigation of Transport Incidents (OSITI) of 17 December 2014, as of 1 January 2025 (OSITI, SR 742.161).

4.2 Safety advice

None

4.3 Measures taken since the serious incident

The measures taken, of which the STSB is aware, are mentioned below without further comment.

4.3.1 Measures taken by Private Wings Flugcharter GmbH

"As a first safety measure, operational information was issued to all pilots to make crews aware of this specific incident.

It includes the following points:

During a non-precision approach, the aircraft must be fully configured before passing the final approach fix.

High speed clearances should not be accepted for approaches to complex or unfamiliar airports.

For flights to aerodromes that only have GPS-based approaches, the RAIM must be checked before departure for the time of the approach, with a window before and after.

Specifically for FMS-based approaches using VNAV Path mode, the sink rate and check altitudes must be monitored meticulously. In the event of deviations, the automatic mode must be deactivated, and the aircraft must be flown conventionally, matching altitudes in V/S mode.

APP mode must be displayed at the latest when passing the FAF. Both cockpit crew members must always be clear about which waypoint and altitude to fly to next. If either of them has any doubts about the correctness of this, a missed approach must be initiated immediately.

As usual, FMA changes must always be announced.

GPS-based approaches must pass at least one intermediate fix (IF) to give the system enough time to calculate a correct descent path.

The rule 'AVIATE-NAVIGATE-COMMUNICATE' always applies.

Pilot monitoring has the task of monitoring the pilot flying (PF). In situations that demand a lot of resources, both pilots must focus their priority on controlling and navigating the aircraft.

Only then does communication with ATC come into play.

In addition, a similar situation is incorporated into each simulator session as a training scenario."

4.3.2 Measures taken by Honeywell

In its Service Information Letter (SIL) D202507004836 dated 14 July 2025, Honeywell, manufacturer of the Primus 2000 avionics system, informed operators of the DO-328 with software version NZ4.8 that flight crews should not set a lower altitude with the knob for the preselected altitude when in ASEL CAP mode.

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014.

Bern, 24 mars 2026 Swiss Transportation Safety Investigation Board

Annex 1: Instrument approach chart from the aeronautical publication

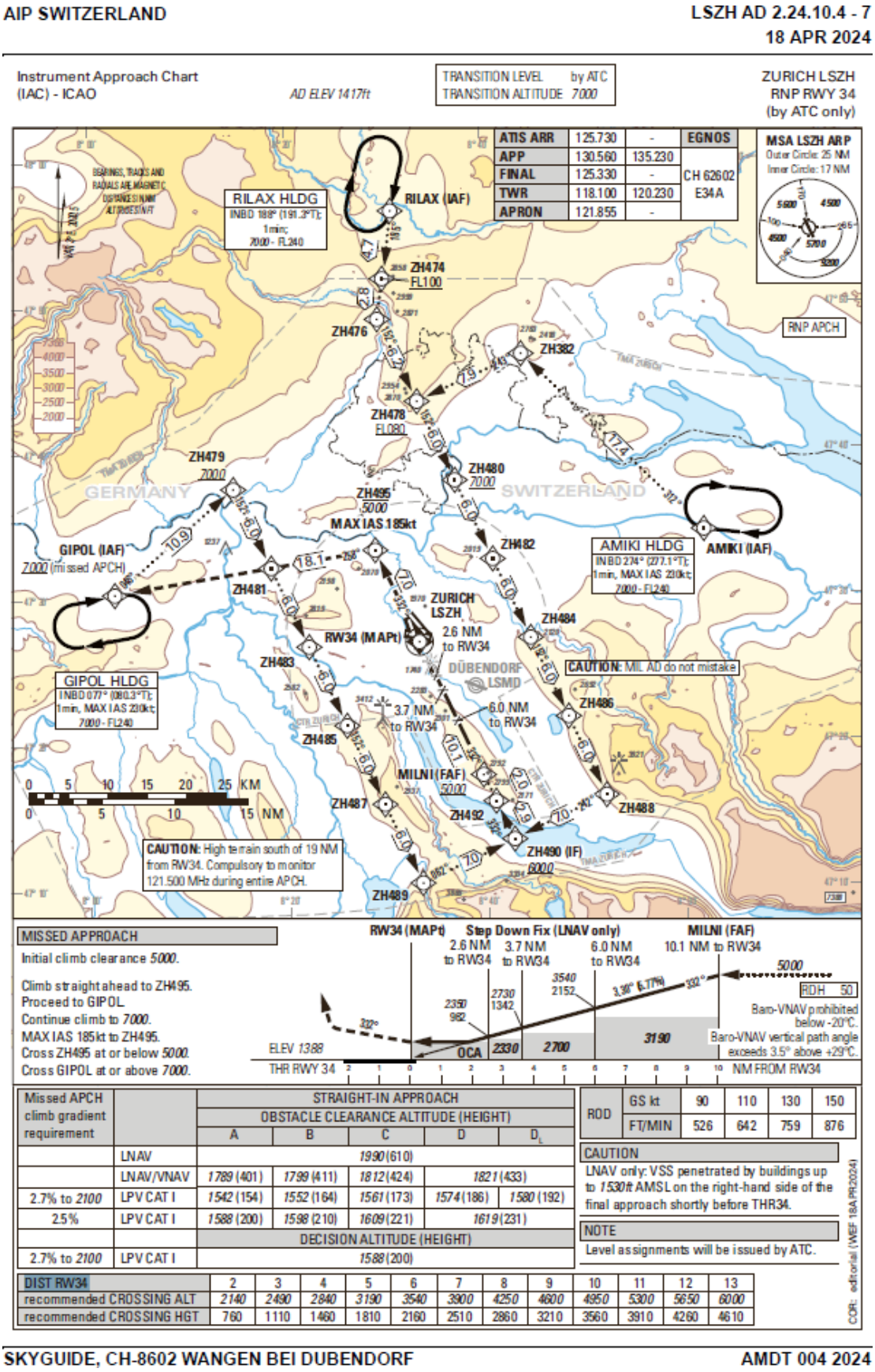


Figure 4: Approach chart for the RNP approach to runway 34 in Zurich (LSZH) as published in the Aeronautical Information Publication (AIP).

Annex 2: Recordings from the Flight Data Recorder

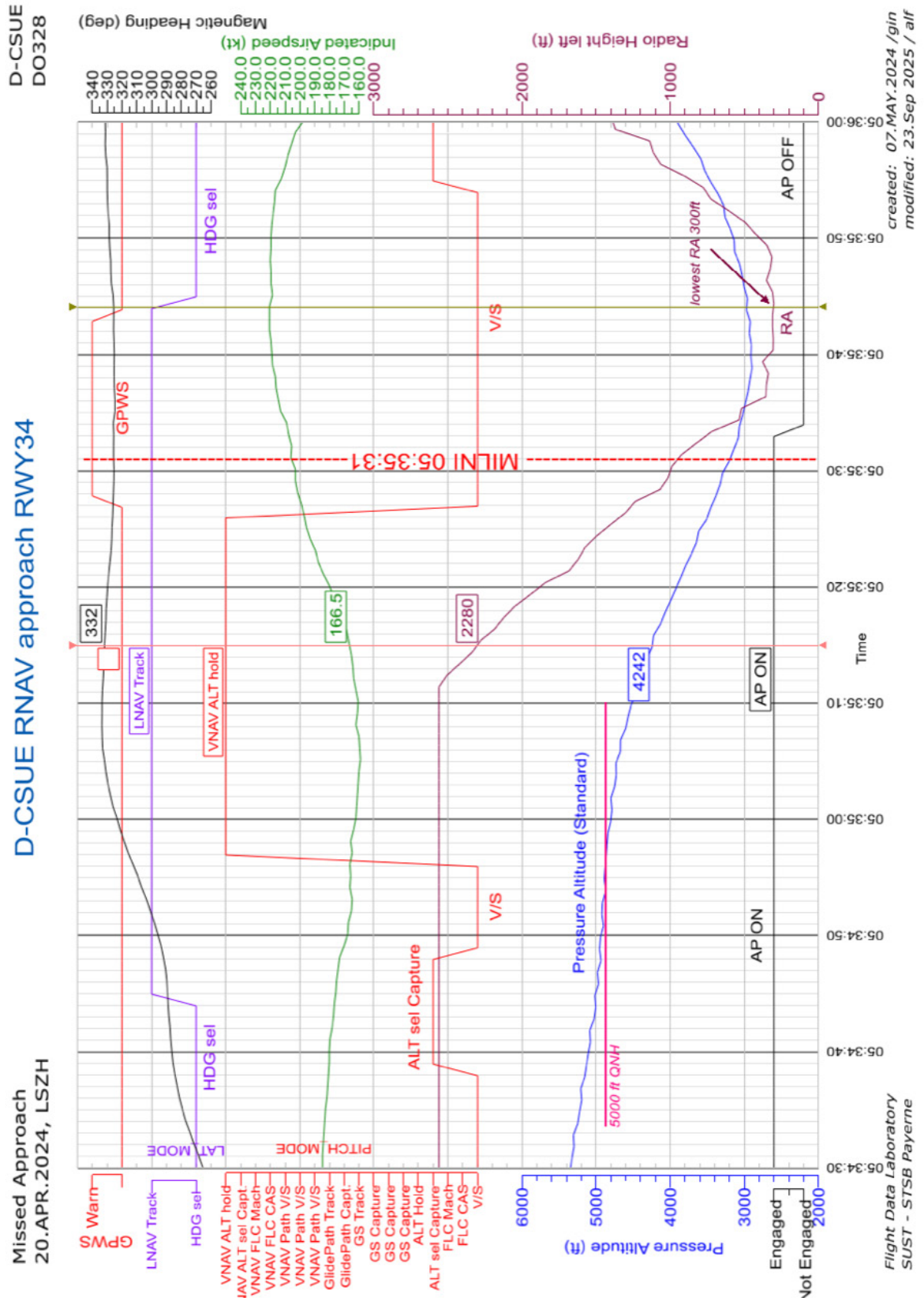


Figure 5: Extract of certain parameters from the flight data recorder during the first approach