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Aircraft accident investigation bureau

# **Final Report No. 1821 by the Aircraft Accident Investigation Bureau**

concerning the serious incident  
to the aircraft Cessna Citation 501 SP, VP-CCD,  
on 22 March 2001  
at Zurich-Kloten Airport

## Ursache

Der schwere Vorfall ist auf eine Treibstoffplanung zurückzuführen, die auf einer Flugzeit basierte, welche unrealistisch war.

Die folgenden Faktoren haben die Entstehung des Vorfalls begünstigt:

- Die Durchführung des ersten Anfluges war unzweckmässig und führte zu einem Durchstart.
- Die Kommunikation über die sich anbahnende Treibstoffknappheit geschah spät und war nicht zweckmässig.
- Nach dem Erklären der Luftnotlage legte die Maschine einen langen Flugweg bis zur Landung zurück.

**General remarks to this report**

In accordance with the agreement on International Civil Aviation (ICAO Annex 13) the sole objective of the investigation of an accident or incident shall be the prevention of accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

According to art. 24 of the Swiss Air Navigation Law the legal assessment of accident/incident causes and circumstances is no concern of the investigation.

The masculine form is used exclusively in this report regardless of gender for reasons of data protection.

If not otherwise stated, all times in this report are indicated in universal time coordinated (UTC). At the time of the accident, the Central European Time (CET) was valid for the area of Switzerland. This CET was equal to the local time (LT). The relation between LT, CET and UTC is:  $LT = CET = UTC + 1 \text{ h}$ .

The german-language version of this report is authoritative.

The Aircraft Accident Investigation Bureau (AAIB) of Switzerland would like to thank the authorities and other organizations for the given support throughout the investigation

## Final Report

<b>Aircraft</b>	Cessna Citation 501 SP	VP-CCD		
<b>Operator</b>	Xecu Air, P.O. Box 1111 GT, Grand Cayman, Cayman Islands			
<b>Owner</b>	Xecu Air, P.O. Box 1111 GT, Grand Cayman, Cayman Islands			
<b>Pilot</b>	German citizen, born 1948			
<b>Licence</b>	Private Pilot's Licence (PPL), issued by the Federal Aviation Authority of the United States of America, validated by the Civil Aviation Authority Cayman Islands, valid till 30 November 2001			
<b>Flying hours</b>	<b>total</b>	1211	<b>during the last 90 days</b>	5:36
	<b>on aircraft involved in the serious incident</b>	745	<b>during the last 90 days</b>	5:36
<b>Location</b>	Zurich-Kloten Airport			
<b>Date and time</b>	22 March 2001, 09:42 UTC			
<b>Type of operation</b>	IFR private flight			
<b>Flight phase</b>	Approach and landing			
<b>Type of incident</b>	Inflight emergency due to fuel shortage			
<b>Damage to persons</b>				
		<b>Crew</b>	<b>Passengers</b>	<b>Third parties</b>
	<b>Fatally injured</b>	---	---	---
	<b>Seriously injured</b>	---	---	---
	<b>Slightly injured or uninjured</b>	1	---	---
<b>Damage to the aircraft</b>	None			
<b>Material damage to third parties</b>	None			

## History

On 14 March 2001 the pilot was flying with aircraft VP-CCD from Finthen/Mainz to Munich. According to his statement he fully refuelled the aircraft there before flying back to Finthen/Mainz. No kerosene was available at the Finthen/Mainz aerodrome. According to the pilot's logbook the return flight from Munich to Finthen took 48 minutes. According to the pilot's statements, 2000 lbs of kerosene were still on board the aircraft before the flight to Zurich. As a basis for fuel consumption during the flight to Zurich, the pilot calculated a flying time of 40 minutes plus 15 minutes holding time. St. Gallen-Altentrhein was specified as the alternate airport. The pilot calculated 15 minutes for the flight from Zurich to the alternate airport. Expressed in amounts of fuel, the plan comprised trip fuel of 950 lbs, holding fuel of 350 lbs, alternate fuel of 250 lbs and taxi fuel of 100 lbs. Thus according to the pilot's plan at least 1650 lbs of fuel was needed for the flight.

The pilot took off, alone on board, from Finthen/Mainz at 08:10 UTC. After about 36 minutes flying time, he called the Air Traffic Control Center "Zurich Arrival East" while descending to flight level (FL) 130. At 08:46:38 UTC he was ordered to join RILAX holding. Nearly seven minutes later, at 08:53:19 UTC he was instructed to turn onto heading 210 degrees and he was told that the first part of the approach would take place using radar vectors. At the same time he was allowed to descend to FL 110. VP-CCD was subsequently cleared at 08:55:23 UTC for a descent to FL 80 and at 08:58:08 UTC for a descent to 6000 ft QNH. At 08:59:50 UTC the pilot received clearance for a standard VOR/DME approach on runway 28, which was to be carried out under his own navigation.

At 09:01 UTC the hand-over to the "Zurich Approach" frequency took place. In the meantime the aircraft had reached an altitude of 6000 ft QNH, which it maintained for the next six minutes. Shortly after 09:04 UTC VP-CCD overflew the Zurich East VHF omnidirectional range (VOR). When, about two minutes later, the aircraft deviated somewhat to the east from the prescribed flight path, the air traffic controller instructed VP-CCD at 09:06:40 UTC to intercept the final approach base line, constituted by VOR Kloten radial 095: "VCD, start right turn to intercept final radial 095 Kloten for final approach." The pilot answered: "Turning to inbound radial, say again radial", to which the air traffic controller replied: "VCD, according to the chart, radial 095 Kloten." After the pilot had confirmed this information with "095 Kloten, CD", he steered the aircraft to a heading of approximately 275 degrees and for a short time flew approximately two nautical miles north of the extended runway centre-line, parallel to the latter in a westerly direction. At 09:07:02 UTC the air traffic controller instructed him to turn left onto a heading of 230 degrees: "VCD, turn now left, left heading 230". The pilot acknowledged with "Turning left, heading 3...230, VCD". A short time later the air traffic controller again ordered a left turn, emphatically: "VCD, start left turn immediately, please." A few seconds later VP-CCD began to turn left, adopted a heading of approximately 230 degrees and now approached the extended runway 28 centre-line from the north.

At 09:07:35 UTC the air traffic controller instructed the pilot to descend to 5000 ft QNH. At this time the aircraft was at a distance of about 9 NM from VOR KLO and about one nautical mile north of the extended runway centre-line, still at an altitude of 6000 ft QNH. The air traffic controller's instruction to descend to 4000 ft QNH was given twenty seconds later. At this time VP-CCD was at a distance of less than 8 NM from VOR Kloten and was at an altitude above 5000 ft QNH. The initial approach altitude for the standard VOR/DME approach 28 is 4000 ft QNH. According to the approach profile, the descent for the final approach should be commenced from this initial approach altitude at a distance of 8 NM to the VOR KLO.

The aircraft crossed the extended runway centre-line on a heading of approximately 230 degrees to the south and was descending to 4000 ft QNH. When the aircraft had reached this altitude it was at a distance of approximately 5 NM from VOR Kloten, just under 2 nautical miles to the south of the extended runway centre-line and was still flying on a south-westerly heading. At 09:09:41 UTC the air traffic controller cancelled the approach clearance and instructed the pilot to turn onto a heading of 270 degrees: "VCD, approach clearance cancelled, fly heading 270, climb to 6000 feet." The pilot confirmed this instruction, adopted a heading of approximately 270 degrees and climbed to 6000 ft. At 09:11 UTC the hand-over to the air traffic control unit "Zurich Departure" took place.

At 09:12:15 UTC the pilot received the instruction to continue flying at FL 60, heading 320. Twenty-seven seconds later, he had to turn left onto heading 250. The pilot confirmed this instruction correctly, but then adopted a heading of 230 degrees. About one minute later the air traffic controller realised this discrepancy and instructed VP-CCD to adopt the specified heading of 250 degrees. At 09:15:53 UTC the air traffic controller instructed the pilot to turn direct to the EKRI approach point: "VCD, turn right direct to EKRI point, approximate track 300". The pilot answered: "Turning right, approximate heading, say heading again." The repetition by the air traffic controller was: "It's not the heading, it's the track, the approximate track is 300, the point is EKRI – Echo, Kilo, Romeo, India, Tango, the approach fix from the west". The pilot then asked for radar vectors, which he subsequently received.

At 09:19:26 UTC the air traffic controller informed the pilot that he should continue flying on heading 280 and that he could expect a standard VOR/DME approach 28. At 09:20:30 UTC the pilot again requested radar vectors and stated that he was getting low on fuel: "Arrival, VPCCD is requesting radar vectors, I am getting low of fuel now." The air traffic controller asked for this message to be repeated; however, it was not repeated. At 09:21:54 UTC the pilot received the message that he was now over EKRI and was instructed to join the holding pattern. The pilot then again requested radar vectors: "Joining the hold CD, also I'm requesting radar vectors for an approach." After the pilot had confirmed on request that he had the approach chart for the standard VOR/DME approach 28 on board, he was again instructed to fly into the holding pattern. He read back this instruction, began a holding procedure and at 09:23:40 UTC again requested radar vectors: "I am requesting again radar vectors, VCD". The air traffic controller replied with: "VCD, remain in the holding, your expected approach time is 33, in ten minutes, I call you back for vectors". The pilot then declared an emergency at 09:23:55 UTC: "CD, it's an... an emergency, I'm low of fuel now". After confirmation of this message, VP-CCD was instructed at 09:24:12 UTC to leave the holding on heading 030. A little later, at 09:25:40 UTC the air traffic controller asked the pilot whether he could accept 50 NM (93 km) to landing: "VCD, can you accept 50 track miles to touch down?" The pilot answered in the affirmative: "That's affirmative, sir" The aircraft was then controlled uneventfully via VOR Zurich East onto the extended runway centre-line of standard VOR/DME approach 28. VP-CCD landed at 09:42 UTC on runway 28 of Zurich Kloten airport after a flight time of one hour and 32 minutes.

## Findings

- The pilot envisaged a flight time of 40 minutes for the flight from Finthen/Mainz to Zurich and a holding time of 15 minutes. Fifteen minutes flying time was envisaged for the flight to the alternate airport of St. Gallen-Altenrhein.
- In the ATC flight plan the pilot specified that he had sufficient fuel for a maximum flying time (endurance) of 2 hours.
- The flight from Finthen/Mainz to Zurich until joining the RILAX holding pattern was about 37 minutes.
- After holding for about seven minutes, VP-CCD was cleared to leave the RILAX holding pattern at 08:53:19 UTC.
- At 08:59:50 UTC the pilot received clearance for a standard VOR/DME approach on runway 28.
- Standard VOR/DME approach 28 is carried out under the pilot's own navigation.
- At 09:09:41 UTC, after a flying time of approximately 60 minutes, the first standard VOR/DME approach 28 was aborted by air traffic control.
- At 09:20:30 UTC the pilot informed air traffic control that he was getting low on fuel.
- At 09:23:55 UTC the pilot declared an emergency, because he had only little fuel left.
- VP-CCD landed on runway 28 of Zurich Kloten airport at 09:42 UTC after a flight time of 1 hour 32 minutes.
- The aircraft was approved for non-commercial use and was not equipped with flight recorders.
- The serviceable tank capacity of the aircraft type Cessna Citation 501 SP is 2120 litres of kerosene.
- After the landing it was possible to refuel the tanks of VP-CCD with 2110 litres of kerosene.
- The aircraft's tank displays were checked for accuracy after the landing. It turned out that the tank displays had functioned correctly.
- The weather in Switzerland was typical of weather after the passage of a cold front, with meteorological visibility of more than 10 km. Clouds: 1-2/8 base 3000 ft AGL and 5-7/8 base 4500 ft AGL. The wind on the ground was 13 kts from 260 degrees gusting to 30 kt. Windshear warnings were in force for all Zurich airport runways.

## Analysis

The pilot's flight plan included an estimated flight time of 40 minutes for the flight from Finthen/Mainz to Zurich, holding time of 15 minutes, and an envisaged 15 minutes for the flight to the alternate airport at St. Gallen-Altenrhein. About 60 minutes had elapsed between taking-off in Finthen/Mainz and aborting the first standard VOR/DME approach 28. If one deducts the seven minutes in the RILAX holding pattern, the aircraft would have landed in Zurich after approximately 55 minutes flying time at the earliest, even without holding and a go-around. This shows that the flight time of 40 minutes entered in the plan for the flight from Finthen/Mainz to Zurich was an over-optimistic assumption.

The fuel consumption of a jet aircraft is highly dependent on altitude and power settings. A detailed calculation of consumption could not be undertaken because of missing recordings concerning altitudes and engine power settings. However, the following estimate can be made using the consumption values used by the pilot: for the entire flight, the pilot calculated a maximum fuel requirement of 1650 lbs, this amount of fuel corresponding to a flying time of 70 minutes, according to his calculations. In fact the flight lasted approximately 92 minutes. If one assumes that the aircraft – as indicated by the pilot – had approximately 2000 lbs of kerosene on board at the beginning of the flight and if one applies the consumption values used for the holding and the flight to the alternative aerodrome, one can conclude that the tanks of VP-CCD must have been empty after about one and a half hours flying time. For his fuel calculation, the pilot therefore used consumption values which reflected reality. On the other hand, it is difficult to understand that according to the ATC flight plan he was apparently expecting a maximum flight time of two hours.

At 08:59:50 UTC air traffic control cleared the pilot for a standard VOR/DME approach 28. Since this approach was to be made under the pilot's own navigation, it was the pilot's task to descend independently to the corresponding minimum altitudes according to the information in the published procedure. The radar recordings show that between 09:01 and 09:07 UTC VP-CCD maintained an altitude of 6000 ft QNH. It was not until 09:07:35 UTC, when the air traffic controller instructed the pilot to descend to 5000 ft QNH that the aircraft resumed its descent. At this time VP-CCD was at a distance of approximately 9 NM from VOR Kloten. At a distance of 8 NM from VOR Kloten, the aircraft should have been flying at 4000 ft QNH in order to be able to begin its approach. At this point the aircraft was still at approximately 5500 ft QNH and was flying at a speed of 160 KIAS. Even with correct alignment on the extended runway centre-line, the glide path to the runway threshold would have had an approach angle of 4.9 degrees. At a distance of 6 NM from VOR Kloten, the aircraft was still about 1000 ft above the nominal glide path. It appears questionable whether a touchdown from a stabilised final approach would have been possible from this starting point, in view of the necessary reduction in speed. The pilot's vertical navigation of the aircraft was inappropriate and eventually caused air traffic control to cancel the approach clearance and instruct a go-around.

The transcriptions of the radio conversations and the radar plots prove that the pilot several times experienced difficulty navigating the aircraft according to ATC instructions. Thus, for example at 09:06:40 UTC he turned onto a westerly course which ran parallel to the extended runway centre-line of the standard VOR/DME approach 28, instead of intercepting radial 095 and following it.

At 09:13 UTC he initiated a left turn which he completed on a heading of 230 degrees instead of the instructed heading of 250 degrees. He then had difficulty in flying to approach point EKRI. These problems indicate that the pilot may have been under pressure because of the impending fuel shortage and tended to be overtaxed in controlling the aircraft. In this context it must be stated that flying an executive turbojet aircraft under instrument flight rules is a demanding task for a single pilot, even under favourable conditions.



At 09:20:30 UTC the pilot again requested radar vectors for an approach, as he was getting low on fuel. This message was not understood by the air traffic controller and he asked for it to be repeated. The pilot did not repeat that he had only little fuel left and was subsequently sent further towards EKRIT, where he began a holding procedure. Only at 09:23:55 UTC, when the pilot learned that he could not expect an approach until ten minutes later, did he declare an emergency because of a fuel shortage. Thus the landing was delayed by a further three and a half minutes.

The emergency situation concerning the fuel shortage was declared about 18 minutes before the landing and the pilot accepted a flight path of about 50 NM or 93 km before touchdown. The amount of fuel found in the tanks at the end of the flight which could still have been used according to the design of the aircraft was approximately 10 litres of kerosene. This amount of fuel represents a flying time reserve of less than one minute. The available facts permit the conclusion that VP-CCD reached Zurich airport under its own power purely by chance.

## CAUSE

The serious incident is attributable to a fuel planning that was based on a flight time which was unrealistic.

The following factors contributed to the development of the incident:

- Execution of the first approach was inappropriate and led to a go-around.
- Communication about the impending fuel shortage took place late and was not appropriate.
- After declaring emergency, the aircraft had to fly a long distance to touchdown.

Berne, 24 April 2006

Aircraft Accident Investigation Bureau

**This report has been prepared solely for the purpose of accident/incident prevention. The legal assessment of accident/incident causes and circumstances is no concern of the incident investigation (art. 24 of the Air Navigation Law).**

Annex 1

