

# Investigation Report

## Identification

Type of Occurrence:	Accident
Date:	12 January 2014
Location:	Near Trier-Fohren
Aircraft:	Airplane
Manufacturer / Model:	Cessna / Cessna 501 Citation I/SP
Injuries to Persons:	Two pilots and two passengers fatally injured
Damage:	Aircraft destroyed
Other Damage:	Open wire, forest and crop damages
State File Number:	BFU CX001-14

This investigation was conducted in accordance with the 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 the Federal German Law relating to the investigation of accidents and incidents associated with the operation of civil aircraft (*Flugunfall-Untersuchungs-Gesetz - FIUUG*) of 26 August 1998.

The sole objective of the investigation is to prevent future accidents and incidents. The investigation does not seek to ascertain blame or apportion legal liability for any claims that may arise.

This document is a translation of the German Investigation Report. Although every effort was made for the translation to be accurate, in the event of any discrepancies the original German document is the authentic version.

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## Abbreviations

AAL	Above Aerodrome Level
AGL	Above Ground Level
AIP	Aeronautical Information Publication
AMC	Acceptable Means of Compliance
AMSL	Above Mean Sea Level
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
BFU	Bundesstelle für Flugunfalluntersuchung (German Federal Bureau of Aircraft Accident Investigation)
BMVI	Bundesministerium für Verkehr und digitale Infrastruktur (Federal Ministry for Transport and Digital Infrastructure)
CAS	Calibrated Airspeed
CAVOK	Clouds and Visibility Okay
CRM	Crew Resource Management
CVR	Cockpit Voice Recorder
DWD	Deutscher Wetterdienst (German Meteorological Service)
EASA	European Aviation Safety Agency
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulation
FCU	Fuel Control Unit
FDR	Flight Data Recorder
FL	Flight Level
GPS	Global Positioning System
hPa	Hectopascal

HSI	Horizontal Situation Indicator
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
KIAS	Knots Indicated Airspeed
LBA	Luftfahrt-Bundesamt (German civil aviation authority)
NCC	Non Commercial Operation with Complex Aircraft
NfL	Nachrichten für Luftfahrer (Notices for airmen)
NM	Nautical Mile
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board
OBS	Omni Bearing Selector
PAPI	Precision Approach Path Indicator
PIC	Pilot in Command
RVR	Runway Visual Range
SAR	Search and Rescue
SOP	Standard Operating Procedures
TSO	Technical Standard Order
UTC	Universal Time Coordinated
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation

## Synopsis

On 12 January 2014 at 1235 hrs the German Federal Bureau of Aircraft Accident Investigation (BFU) was informed by Search and Rescue (SAR) that near Trier-Fohren Airfield an accident had occurred involving a twin-engined business jet Cessna 501 with US registration. An investigation team consisting of four BFU staff members was dispatched to the accident site.

During the flight from Shoreham, Great Britain, to Trier-Fohren Airfield, the airplane on VFR (Visual Flight Rules) approach to runway 22 collided in fog with an obstacle and impacted the ground about two Nautical Miles (NM) prior to the threshold. The four occupants were fatally injured and the airplane was destroyed.

The accident was due to the following:

- The Pilot in Command (PIC) decided to conduct the VFR approach even though he was aware of the prevailing instrument weather conditions at the airport
- It is likely that a wrong vertical profile was flown due to an erroneous selection on the navigation system
- Due to an insufficient situational awareness of the pilots the descent was not aborted in time.

The following factors contributed to the accident:

- Insufficient Crew Resource Management (CRM)

# 1. Factual Information

## 1.1 History of the Flight

On Friday, 10 January 2014, the airplane had flown from Trier to Shoreham, where it landed at 1456 UTC. Two pilots and two passengers were on board the aircraft. Over the weekend, the passengers wanted to participate in a hunt. On the afternoon of 11 January 2014 the PIC told the service provider, tasked by the aircraft owner with the flight planning, to prepone the scheduled return flight on Sunday, 12 January 2014, from 1400 UTC to 1015 UTC. In the ATC flight plan Trier-Fohren Airfield was the destination aerodrome and Luxembourg Airport the alternate aerodrome. According to the flight plan the change of flight rules from IFR to VFR was to occur at reporting point PITES.

The handling agent at Shoreham Airport stated that the PIC and the co-pilot had arrived on Sunday at 0850 UTC. The airport made the recordings of a video camera for apron surveillance available to the BFU. These recordings show that the airplane was refuelled in the presence of the pilots. The two passengers arrived at 0936 UTC and about 11 minutes later the aircraft taxied from the apron. At 1000 UTC, the airplane took off from runway 20.

At 1138:25 hrs, the co-pilot established contact with Langen Radar. At that time the airplane was in Flight Level (FL) 170. At 1142:51 hrs, after the airplane had descended to FL140, the controller issued the descent clearance to FL70. Approximately one minute later the controller said: "... proceed direct destination again and descend altitude five thousand feet ... Spangdahlem QNH one zero two five." The pilot in command acknowledged the clearance. At 1145:23 hrs the PIC said: "... standing by for cancelling IFR." The controller answered: "... roger, IFR is cancelled at one zero two five, your position is one five miles northwest of your destination airfield, squawk VFR, approved to leave." According to radar data, the airplane was approximately in FL90 and continued to fly with a southern heading.

At 1147:26 hrs, about 5 NM east of the omnidirectional radio beacon Nattenheim (VOR NTM), the altitude was 4,900 ft AMSL. According to the radar data at 1148:10 hrs the airplane had reached 3,500 ft AMSL. The flight path continued east until 1149 hrs when, in the area of the city of Wittlich in an altitude of 3,500 ft AMSL, the airplane turned right. The ground speed was approximately 180 kt. In the course of the right turn until 1150:30 hrs, the altitude decreased further to about



2,800 ft AMSL and the ground speed to about 160 kt. At 1151:10 hrs the aircraft turned left maintaining altitude until it had reached a southern heading. From 1151:30 hrs on it continued to descend. At the time the airplane was approximately 6.7 NM from the runway threshold and about 0.5 NM north of the extended runway centre line. Approximately 15 seconds later it reached the extended runway centre line of runway 22 while it turned right into the final approach direction. It was in about 2,300 ft AMSL and approximately 5.7 NM from the runway. From 1152:20 hrs on, at approximately 4.6 NM from the threshold, the aircraft began to leave the extended runway centre line to the south. At that time, altitude was approximately 1,600 ft AMSL and ground speed about 160 kt.

The last radar target was recorded at 1152:40 hrs with an altitude indication of approximately 1,300 ft AMSL and a ground speed of about 140 kt.

The attention of several witnesses, located about 600 m north-east and south-east, respectively, of the accident site in the valley of the river Salm, was drawn to the airplane by engine noise. They congruently stated that the aircraft had come from the direction of the town Esch and flown in low altitude, below the fog or cloud cover, toward the south-west. One of the witnesses estimated the altitude was 15 to 20 m above the trees bordering the river Salm, approximately the same height as the open wire located in the area. According to congruent witnesses' statements, the engine thrust was increased and the airplane pulled up shortly before reaching a wooded escarpment rising by about 60 m, banked left and disappeared in the fog. Immediately afterwards fire had become visible and impact noises had been heard.

The airplane impacted the ground in an inverted position. The occupants suffered fatal injuries and the aircraft was destroyed.

The Flugleiter (A person required by German regulation at uncontrolled aerodromes to provide aerodrome information service to pilots) at Trier-Fohren Airfield stated, that on the morning of the accident day, at about 1010 hrs, he had received a phone call from the PIC. During the call the arrival of the airplane had been announced for 1230 hrs. The Flugleiter had informed the PIC about the severe fog prevailing at the airfield. He had also told him that, if at all, he expected visibility would increase after 1330 or 1400 hrs. After the phone conversation the Flugleiter assumed, that the airplane would fly to another airport.

According to statements by the PIC's wife, she had talked with her husband on the landline and then witnessed the PIC's phone conversation on his mobile phone with

the passenger, where he was asked to prepone the return flight to late morning. An unexpected appointment of the passengers was named as reason for the wish.

During a phone conversation prior to departure her husband had explained that he had talked with Trier Airfield and learned that fog was prevailing there and one would fly either to Hahn or Luxembourg.

The son of the passengers stated at the police that on the morning of the day of the accident his father had called him. He had told him that the airplane would probably land at Frankfurt-Hahn Airport. He stated that for his parents there was no deadline pressure. He said, that for him it is "völlig unvorstellbar (entirely inconceivable)" that his father would pressure the pilot to fly to Trier. In the past deviation to another airport had often been the case. It had never been a problem.

## 1.2 Injuries to Persons

Injuries	Crew	Passengers	Third Party
Fatal	2	2	0
Serious			
Minor / None			

## 1.3 Damage to Aircraft

The aircraft was destroyed.

## 1.4 Other damage

The open wire, the forest and crop were damaged.

## 1.5 Personnel Information

### 1.5.1 Pilot in Command

The 55-year-old pilot in command held a Commercial Pilot's License (Airplane) (CPL(A)) which was initially issued by the Luftfahrt-Bundesamt (German civil aviation authority, LBA) in accordance with JAR-FCL German on 28 January 2002 and valid until 11 July 2014. It listed the ratings: C525 PIC, IR valid until 31 October 2014, Piaggio 180 PIC, IR valid until 31 August 2014, Multi-Engine Piston (MEP) (land) PIC, IR valid until 12 July 2014 and Single-Engine Piston (SEP) (land) PIC valid until 12 July 2014.

He also held an Airline Transport Pilot's License (ATPL) issued on 17 July 2013 by the Federal Aviation Administration (FAA) listing the ratings: Airplane Multi-Engine Land, CE-500, CE-525S and Airplane Single-Engine Land.

His class 1 medical certificate was issued on 13 February 2013 and valid to 25 March 2014.

In the insurance documentation for the airplane of 18 January 2013 his total flying experience was given as 4,800 hours; 2,740 of which on Cessna 525; and on Piaggio 180 more than 1,500 hours. The BFU received pilot log books Nos 1-3 during the course of the investigation. The first entry in the pilot log book No 1 dated from 27 August 1991 and the last in pilot log book No 3 from 19 April 2013. Hence, he had at that time a total flying experience of 4,238 hours, 3,940 hours of which as PIC. The analysis of the pilot log books showed that he had flown a total of 1,256:18 hours on Cessna Citation CJ1, CJ1+, and CJ2. The aircraft log book showed, that since February 2013 he had flown about 32 hours in the Cessna 501, Citation I/SP and conducted eight of these flights with a total of 10 flight hours together with the co-pilot.

The BFU interviewed three pilots, who were also working for the same company, about the personality of the PIC. He was described as rather dominant and assured of himself.

Another pilot, who was also working for the same company, told the BFU that the PIC and the co-pilot had known each other from their mutual time working for another operator. Regarding the relationship between the two pilots he said that between PIC and co-pilot the authority gradient was distinct. In addition, during the weekend there had been a dispute between the two pilots. The PIC had voiced his intention that

after their return from Great Britain he would have the working relationship with the co-pilot terminated.

A statement of the PIC's wife gives similar information. She said that her husband had been displeased with the work of the co-pilot and had assessed his skills and proficiency as low.

### 1.5.2 Co-pilot

Since 26 January 2001 the pilot held a Commercial Pilot's License (Airplane) (CPL(A)). This license was changed by the LBA and then initially issued in accordance with JAR-FCL German on 4 April 2013 and was valid until 4 April 2018. It listed the ratings: C525 PIC, IR valid until 31 December 2014 and SEP (land) PIC valid until 30 June 2014. The BFU does not have a medical certificate of the pilot.

In accordance with the insurance documentation of the aircraft, in April 2013 the pilot had a total flying experience of 1,350 hours. In the aircraft types SA226/227 he had flown 550 hours and 250 hours in the Cessna 525. The BFU did not have any pilot log book of the co-pilot. Since the beginning of June 2013 the pilot had flown in the aircraft. According to the aircraft log book, he had flown about 39 flight hours on the Cessna 501.

The pilots interviewed by the BFU described the co-pilot as reticent, level-headed, and a cooperative team player.

## 1.6 Aircraft Information

The Cessna 501 Citation I/SP is a twin jet, low-wing aircraft in all-metal construction with retractable landing gear in nose wheel configuration. The aircraft type is certified in accordance with FAR 23 for single pilot operation. The airplane had five passenger seats.

Manufacturer:	Cessna
Type:	501
Manufacturer's Serial Number (MSN):	501-0231
Year of manufacture:	1981
MTOM:	5,375 kg (11,850 lb)

Engines: Pratt & Whitney Canada JT15D-1A

The airplane had a registration from the United States of America. Total operating hours of the aircraft were 4,282 hours at 4,413 cycles.

The BFU has the fuel receipt for the airplane from Shoreham Airport of 12 January 2014 showing 1,000 l Jet A1 fuel.

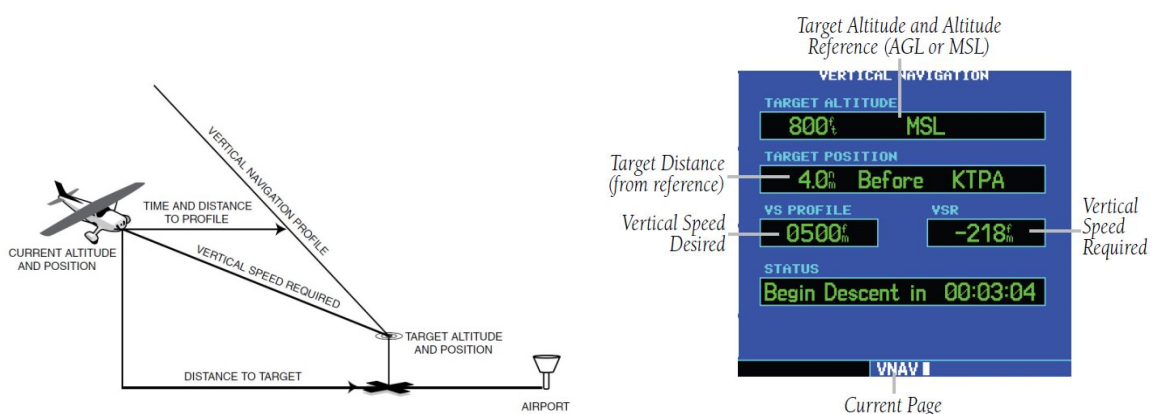
An Artex Emergency Locator Transmitter (ELT) 406 MHz had been installed in the tail section of the aircraft.

### 1.6.1 Navigation Equipment

Among other things, the airplane was equipped with a navigation and communications system King KX165A, two satellite navigation systems (Garmin GNS 430W and GPS 500), and a radio altimeter. In addition, a Garmin Aera 500 had been in the cockpit.

With the help of the GPS, precision and non-precision approaches to airports with published instrument approach procedures can be conducted. For lateral navigation, e.g. to an airport without instrument approach procedure, the direct-to function can be used, among other things, to fly directly to a waypoint or even with a chosen course.

The GPS has a vertical navigation (VNAV) function to support a crew during climb or descent.



Garmin GPS 500 Vertical Navigation (VNAV)

Source: Garmin

Using the VNAV function a target altitude above ground (AGL) or above the GPS altitude above sea level (GPS-MSL) can be selected for a certain waypoint or some

distance before or after this waypoint. By selecting a target altitude, the target position (before or after the waypoint), and the vertical speed profile, the beginning of the descent and the vertical speed required are displayed. One minute prior to reaching the initial descent point, a message occurs: “Approaching VNAV Profile”. Another message: “Approaching Target Altitude” is provided 500 ft above (or below, in climb) the target altitude. Climbs are programmed the same way.

The manufacturer of this particular Garmin GPS 500 stated that it was also equipped with a Terrain Awareness and Warning System (TAWS). The manufacturer also stated that the TAWS met the requirements for TAWS Class B certification of the Technical Standard Order TSO-C151b the FAA had published.

The pilots could choose a 360° depiction displayed on the TAWS pages on the GPS display or a forward-facing 120° depiction. The obstacle situation was displayed according to the selected depiction. The terrain was depicted in a three-colour code. Black (no danger) terrain in more than 1,000 ft below the airplane’s flight altitude. Yellow (caution) terrain between 100 ft and 1,000 ft below. Red (warning) terrain higher or within 100 ft. In addition, obstacles or potential collision points were also depicted in red or yellow.

The so-called TAWS alerts are announced as caution or warning. Either a yellow (Terrain) or red (Pull Up) annunciation or a pop-up Terrain Caution or Warning Alert appear in the GPS display together with a commensurate acoustic message.



Garmin GPS 500 TAWS Caution &amp; Warning Pop-up

Source: Garmin

During descent in 500 ft above ground the TAWS issues an acoustic message “Five Hundred”.

## 1.7 Meteorological Information

### 1.7.1 Meteorological Pre-Flight Preparation

The Deutsche Wetterdienst (German meteorological service provider, DWD) stated that for the flight no individual weather information was obtained from one of the Meteorological Advisory Centres for Aviation.

According to the Terminal Aerodrome Forecast (TAF) for Luxembourg Airport of 12 January 2014 at 0500 UTC visibilities of 300 m and freezing fog were forecast between 0600 UTC and 1100 UTC.

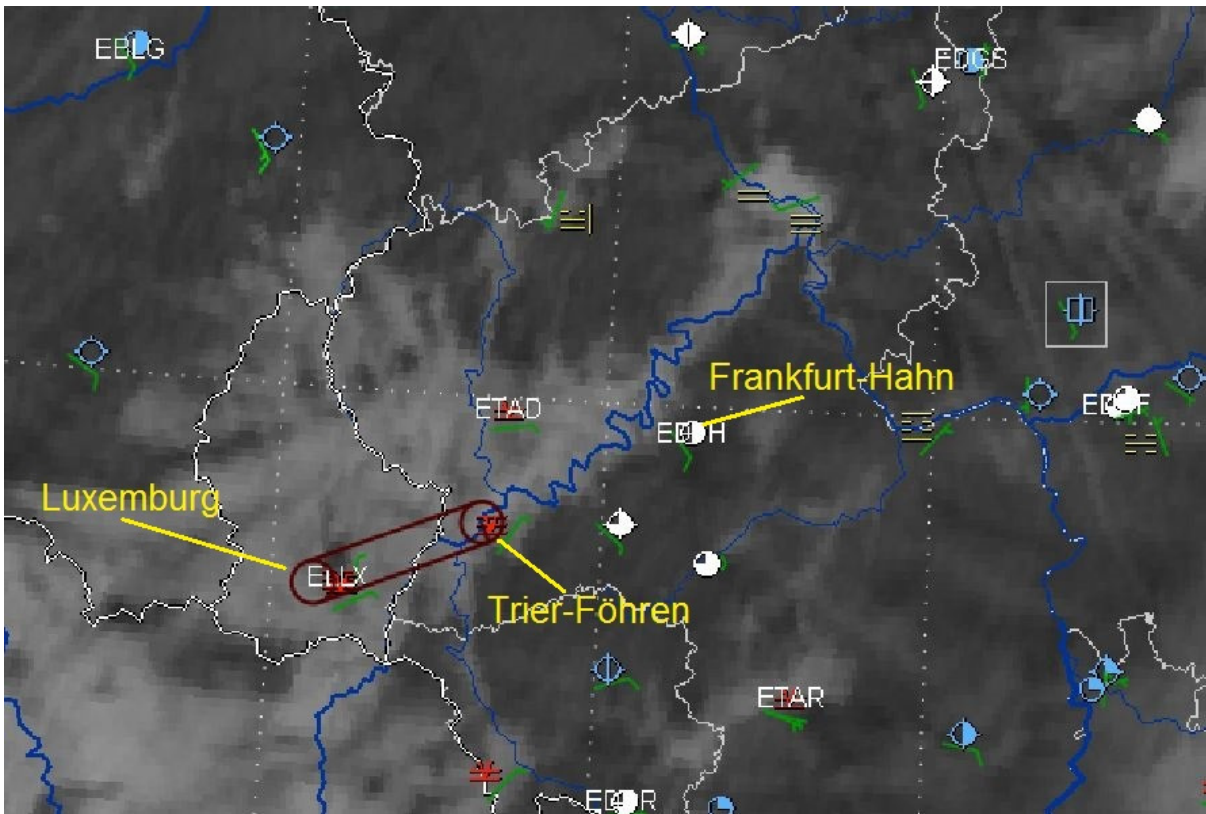
The BFU had available all METARs issued for Frankfurt-Hahn Airport between 11 January 2014 at 0020 UTC and 12 January 2014 2250 UTC. The reports for the day prior to the accident day showed good weather conditions with visibilities of more than 10 km.

The METARs of the day of the accident between 0020 UTC and 0450 UTC reported CAVOK conditions. The report of 0520 UTC showed prevailing visibilities of more than 10 km and clear skies, but did include the note of individual wafts of mist. The METARs issued 30 minutes later until 0750 UTC reported visibilities of generally more than 10 km, but locally decreasing visibilities of 600 m in the south-east of the airport and up to 300 m in the north as well as partial fog. The following two METARs (0820 UTC and 0850 UTC) reported decreasing general visibilities to 500 m (Runway Visibility Range (RVR) 350 m) and then 300 m (RVR 250 m), each included the note about freezing fog. The METAR of 0920 UTC showed once again visibilities of more than 10 km but still fog in the vicinity of the airport.

### 1.7.2 Weather Conditions during the Flight

The DWD stated that, at the time of the accident the weather pattern was dominated by an extended inversion in approximately 2,000 ft AMSL influenced by ridges of high pressure. Beneath it, fog or high fog prevailed in the clammy ground layer.





Satellite image of 1100 UTC

Source: Deutscher Wetterdienst

The area Trier - Luxembourg is marked on the satellite image. It shows a complete fog or high fog layer (white colour) in the entire area of the Mosel valley. The weather report of Trier of 1100 UTC shows freezing fog, the sky is not visible and visibility is below 100 m. The weather station Trier is located a few meters higher than Trier Airfield.

The DWD estimates that at the time of the change of flight rules from IFR to VFR the airplane was probably still above the fog or high fog.

#### 1.7.2.1 Weather Observations in the Vicinity of the Accident Site

The witnesses congruently stated that in the valley normal visibilities prevailed and the ceiling of the clouds or high fog was probably 50 m higher. The upper row of trees on the slope and the power pole had been in the clouds or fog, respectively. Initially the airplane had crossed the valley below the clouds and then vanished in the fog when pulled upward.



#### **1.7.2.2. Weather Conditions at Trier-Fohren Airfield**

The Flugleiter stated the following weather conditions prevailed at Trier-Fohren Airfield:

Wind: 040°/3-5 kt

Visibility: 100-150 m

Weather phenomena: Fog

Temperature: -1°C

Barometric air pressure (QNH): 1,020 hPa

#### **1.7.2.3 Weather Conditions at Luxembourg Airport**

The BFU had available the weather information for Luxembourg Airport (ELLC), aerodrome elevation 1,234 ft AMSL. The METARs for Luxembourg Airport are updated every 30 minutes. The ones issued on the day of the accident between 0550 UTC and 1050 UTC reported visibilities of 100 m. The runway visibility range decreased until the time of the accident from 352 m at 0550 UTC to 125 m at 1050 UTC. The reported freezing fog and layered clouds remained unchanged in all listed METARs.

#### **1.7.2.4 Weather Conditions at Frankfurt-Hahn Airport**

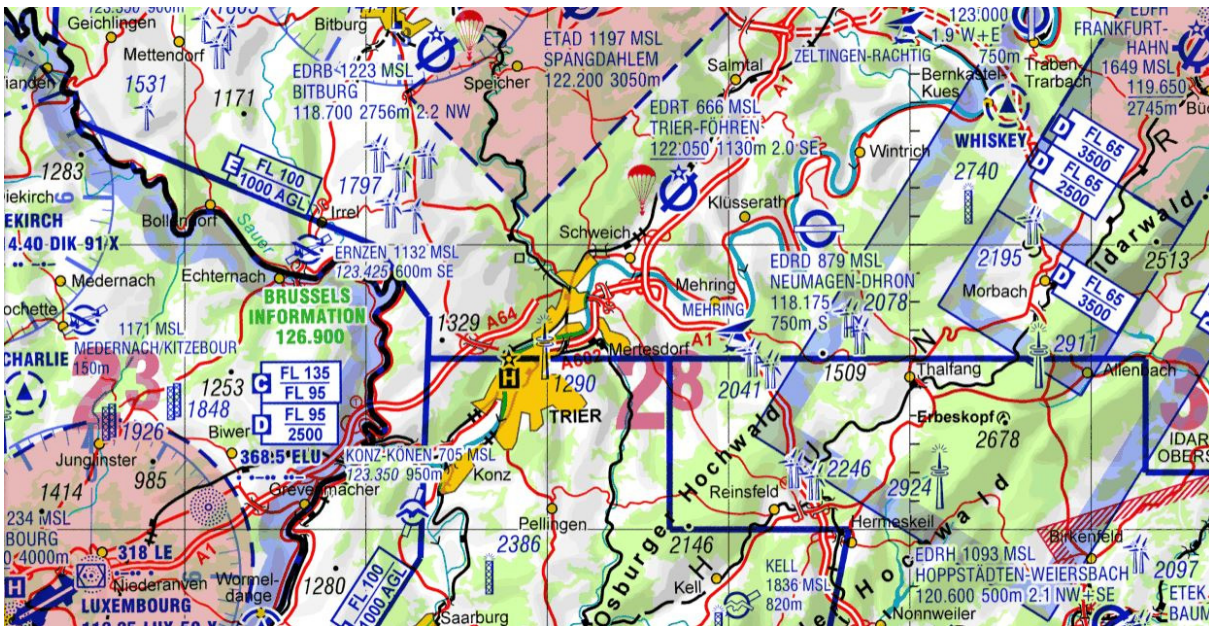
The METARs between 1020 UTC until the evening hours reported CAVOK conditions.

The satellite photo of the DWD shows that at the day of the accident at 1100 UTC Frankfurt-Hahn Airport was outside the fog and high fog cover lying in the Mosel valley.

According to the METAR of 1150 hrs (1050 UTC) valid at the time of the accident the wind at the airport came from 140° with 8 kt. Airport elevation is 1,649 ft AMSL. Visibility and clouds were given as CAVOK. Temperature was 1°C, dewpoint 0°C. Barometric air pressure (QNH) was 1,023 hPa.

### **1.8 Aids to Navigation**

The ICAO Aeronautical Chart 1:500 000 showed a maximum elevation figure of 2,800 ft AMSL for the area around Trier-Fohren Airfield.



Excerpt ICAO Aeronautical Chart 1:500 000

Source: DFS

The highest point around Trier-Fohren Airfield published in the visual operation chart of the Aeronautical Information Publication VFR (AIP-VFR) was 1,472 ft AMSL.

## 1.9 Radio Communications

Radio communications between the crew and Langen Radar were recorded and made available to the BFU for evaluation.

The Luxembourgian air accident investigation authority stated that there were no radio communications with Luxembourgian air traffic control units.

Radio communications of the frequency of Trier-Fohren Airfield are not recorded.

## 1.10 Aerodrome Information

Trier-Fohren Airfield is located about 8 NM north-east of the city of Trier. Airport elevation is 666 ft AMSL. It has one asphalt runway oriented 042°/222°, which is 1,200 m long and 30 m wide. The airport is certified for airplanes up to 15,000 kg.

The runway is equipped with threshold, edge, and end lights. Both landing directions are equipped with a Precision Approach Path Indicator (PAPI). The approach angle for runway 04 is 4° and for runway 22 it is 4.5°. The Flugleiter stated that at the time of the approach of the Cessna the PAPI system for runway 04 was active.

The location of the airport reference point is not depicted in the aerodrome chart.

The airfield is certified for VFR approaches only.

The Landing Distance Available (LDA) for runway 22 was 1,130 m.

Due to the airspace classification, visibilities for a VFR approach to Trier-Fohren Airfield must be at least 8 km above 1,000 ft AGL and the aircraft has to maintain a distance to the clouds of at least 1.5 km lateral and 1,000 ft vertical. Below 1,000 ft visibility shall not be less than 1.5 km. Ground in sight is required at all times and the aircraft has to remain free of clouds.

## 1.11 Flight Recorders

The aircraft was not equipped with a Flight Data Recorder (FDR) or a Cockpit Voice Recorder (CVR). These were not mandatory for this airplane.

The radar data from the air traffic service providers in Germany and Luxembourg and the German Armed Forces were made available to the BFU for investigation purposes.

## 1.12 Wreckage and Impact Information

The accident site was located approximately 2.3 NM prior to the threshold of runway 22 of Trier-Fohren Airfield; about 0.3 NM south-east of the extended runway centre line in 666 ft AMSL.





Accident site

Source: Air traffic service provider/BFU

Approximately 10 m below the plateau of a forested steep slope the aircraft had contact with trees. The traces in the trees show, that the airplane had had a left bank angle of about 25°.



Accident site viewing direction south-east

Photo: Police/BFU

Halfway up, the right wing of the airplane poked out of an approximately 20 m high pylon.

The angle the right wing had had when penetrating the pylon indicated a left bank angle of about 60°. The right wing showed traces of fire. The flap was extended. At the foot of the pylon the right main landing gear, one speed brake, and the right elevator were found.

Between the initial contact with the trees below the plateau and the collision with the pylon the trajectory angle was about 20° upwards.



Wing, view toward the approach direction

Photo: BFU

On an area of about 100 m x 50 m severed branches, parts of the fuselage, the two front cargo doors, the nose landing gear, luggage, and other cargo were found.

The wreckage was lying on its back about 106 m from the pylon. The airplane fuselage pointed in the direction of 187°.

On the left wing the main landing gear was extended and locked; the flap was fully extended



Main wreckage viewed toward the approach direction

Photo: BFU

The N1 drive shaft of the left engine could be rotated freely. Five fan blades showed damages. Two fan blades had been pushed into each other. The blades of the N2 drive shaft did not show any visible damages. Oil leaked from the front bearing housing. The thrust lever on the Fuel Control Unit (FCU) was in the approximately 90° position.

The right engine showed considerable traces of fire. The alternator had been torn off. The mountings of the air intake were partly destroyed and could be separated from the engine without applying too much strength. The N1 drive shaft could be rotated freely. Several fan blades showed damages. One fan blade was missing. The following two fan blades had been pushed into each other. The thrust lever on the Fuel Control Unit (FCU) was in the approximately 70° position.

The fuselage had been destroyed by impact forces and the fire. Parts of a shotgun were found.



In the cockpit the landing gear lever was in position Down and the switches for the landing lights in On.



Horizontal Situation Indicator (HSI)

Photo: BFU

Heading and course of about 220° were selected on the Horizontal Situation Indicator (HSI); the indicated heading was 192°.

### 1.13 Medical and Pathological Information

The post-mortem examination of the pilots showed that they had died due to burn shock resulting from the fire.

No evidence for physiological impairments during the flight was found.

### 1.14 Fire

The fire was ignited by the collision of the airplane with the power pole.

## 1.15 Survival Aspects

The Search and Rescue (SAR) control centre Munster received a report by COSPAS-SARSAT French Mission Control Centre (FMCC) that at 1109 UTC an ELT signal (Distress Initial Alert) had been received from the accident airplane. Among other things, the report contained information regarding the nationality and registration of the airplane and position indications.

Witnesses in the area of the accident site informed police and rescue teams.

## 1.16 Tests and Research

Not applicable.

## 1.17 Organisational and Management Information

In the past the company had chartered airplanes for their non-public company flights. Then they decided to buy a Cessna 501 and establish their own non-public company flight operations. Since mid-February 2013 they had been operating the aircraft. Witnesses stated that the airplane had been used for non-public company flights as well as for trips of the family of the company owner. At the time of the accident six pilots were either deployed as PICs or co-pilots; one only as co-pilot. The company stated that at the time of the accident no operations manual for non-public company flight operations existed. Flight operations post holders had not been designated.

Since the airplane had an US registration it was required to hold an US licence. The costs for the acquirement of these US licences (on the basis of the German licences) and the type rating for several PICs during a training course in the USA were covered by the owner of the aircraft. The aircraft owner had not granted the co-pilot such funding on grounds of costs.



## 1.18 Additional Information

The Luxembourgian accident investigation authority stated that the Aeronautical Information Service (AIS) Luxembourg had never been contacted in preparation of the accident flight.

The aircraft owner had tasked a company with the flight planning and the compilation of the commensurate documentation. These were, among other things, flight plan data, NOTAM, and weather information. The company made data available to the BFU, which document the access of the servers as part of the Cessna flight operations. The analysis showed that on 10 January 2014 at 0724 hrs and at 0952 hrs prior to departure from Trier to Shoreham, the crew briefing section had been accessed. On the morning of the accident day such an access did not occur.

## 1.19 Useful or Effective Investigation Techniques

Not applicable.

## 2. Analysis

### 2.1 Accident / General

The witnesses' statements document that in the area of the accident site low clouds and fog prevailed, as the aircraft flew very low in south-western direction and then pulled up shortly before reaching the slope by increasing power.

The traces at the accident site show that initial contact with trees occurred 10 m below the plateau. At that time the aircraft had a left bank angle. This concurs with the observations of witnesses.

Based on the height differences of the subsequent points of contact, the aircraft had a steep climb attitude and a left bank angle when it collided with the power pole. The right wing hanging in the pole clearly documents the bank angle of approximately 60°. The positions of the landing gear and the flaps show that the aircraft had been configured for landing.

During the collision with the power pole the airplane caught fire and then crashed upside-down. The damage on the main wreckage shows that the intensity of the fire was highest between the front part of the fuselage and the wings fitted with fuel tanks.

The investigation did not reveal any technical deficiencies of the aircraft relevant to the accident.

The course of the flight, the characteristics of the accident site, and the distribution of the wreckage are typical for an accident scenario called Controlled Flight into Terrain (CFIT).

### 2.2 Flight Operational Aspects

#### 2.2.1 Pre-Flight Preparation

The reason for bringing forward the flight from the afternoon to the morning could not be determined with absolute certainty.

The statements of the relatives of the PIC and passengers show congruently that prior to departure they had been aware of the bad weather conditions in Trier. The statement of the Flugleiter concerning his phone conversation with the PIC shows that shortly before departure in Shoreham, the pilot still had the intention to land in

Trier. However, some relatives' statements document, that PIC and passengers still assumed in their respective phone conversations (taking place after the PIC had talked with Trier) that the flight would go to Frankfurt-Hahn or Luxembourg due to the weather conditions in Trier. The alternate aerodrome Luxembourg filed in the flight plan was not suited as alternate airport during the accident flight due to: the weather forecast on the morning of the day of the accident, the respective weather reports for Luxembourg Airport, the ratings of the pilots, and the equipment of the aircraft.

The analysis of the weather reports for Frankfurt-Hahn Airport show that the weather reports for the day prior to the day of the accident forecast good weather conditions for the time of the flight plan change. Beginning in the early morning of the day of the accident the conditions worsened there also. Based on the process documented by the video recordings it is likely that the crew did not have any information about the CAVOK conditions reported after 0920 UTC.

The analysis of the access data shows that on the day of the accident, prior to departure, neither of the pilots accessed the flight plan data with the prevailing weather information on the server of the service provider. The reasons could not be determined. The statements of the handling agent and the video recordings at the aerodrome of departure did not indicate that either of the pilots had accessed any weather data prior to take-off.

### 2.2.2 Conduct of the Flight

Due to the fact, that the airplane had not been equipped with a CVR or FDR the options of the investigation were limited. Thus motivation, decision making process, and cooperation of the two pilots cannot be clearly understood.

The recordings of the radio communications show that at the beginning of the flight the co-pilot conducted them, including the initial contact with Langen Radar approximately 14 minutes prior to the accident. The PIC then acknowledged the clearance the controller issued about five minutes later to fly to the destination airport and descent to 5,000 ft AMSL. He requested the controller to issue the change of flight rules clearance with the words: "... standing by for cancelling IFR". It could not be determined at what point the decision was made to fly to Trier-Fohren Airfield after all. The BFU is of the opinion, that at the time of the PIC's request the decision had already been made because for an approach to Luxembourg Airport or Frankfurt-Hahn Airport a change of flight rules from IFR to VFR would not have been necessary.

The recordings of the radio communications of Langen Radar frequency show that not at any time did the crew enquire about the prevailing weather conditions in Trier-Fohren, Frankfurt-Hahn or Luxembourg. At the time of the accident, the weather conditions at Frankfurt-Hahn were very good and an IFR or VFR approach would have been possible. There is no evidence whether the crew had listened to the ATIS broadcast of Frankfurt-Hahn Airport or Luxembourg Airport.

The BFU does not understand why the pilots never established radio contact with Trier-Fohren Airfield. Therefore, they did not have any information regarding the prevailing weather conditions, the runway in use, or the status of the runway lights.

The BFU is of the opinion that it is highly likely that the approach was conducted with the help of the autopilot and the GPS.

The course of 220° selected at the PIC's HSI corresponds with the final approach for runway 22 of Trier-Fohren Airfield. It shows that the PIC intended to conduct the lateral navigation with the GPS. It is likely that he wanted to fly the course with the autopilot. The heading bug had also been selected to 220°.

Beginning the descent 6.7 NM (in 2,800 ft AMSL, i.e. 2,134 ft above the threshold) prior to the runway threshold corresponds with the correct distance for a 3° approach (see Appendix 1). The BFU is of the opinion, that the crew had probably selected the descent profile with the VNAV function of the GPS. The pilot then piloted manually towards the selected altitude. The point for the beginning of the descent resulted from the distance to the programmed waypoint. Depending on the time and altitude remaining the GPS indicated the vertical speed required the pilot had to fly to reach the desired vertical profile.

The BFU is of the opinion that, due to their IFR experience, both pilots were familiar with the vertical profile of a 3° approach and its commensurate flight parameters since they had often applied it, especially during IFR approaches. Due to the great experience of the PIC with aircraft types, which are similar in approach speed to the Cessna 501 - the same is true for the co-pilot he knew that at a ground speed of 140 kt the airplane was to be flown with a rate of descent of 700 ft/min.

The analysis of the radar data shows, however, that immediately after the beginning of the descent the airplane already flew with a much higher rate of descent. After about 15 seconds the extended runway centre line was reached. At that point the aircraft was already approximately 300 ft below the 3° glide slope. At the beginning of the final approach the rate of descent had an average of 1,400 ft/min and therefore

more than twice as much as for a 3° approach. The BFU is of the opinion that the pilot had intentionally engaged and maintained a rate of descent of approximately 1,400 ft/min. It is highly likely that an erroneous selection of the target altitude with 0 ft (sea level) instead of the real aerodrome elevation (666 ft AMSL) was the reason. If this was the case, the vertical speed required at the beginning of the descent would correspond very well with the calculated value, which was based on the radar recordings. Obviously the indication of the barometric altimeter was not used to check the flight path.

The witnesses' statements show that the airplane descended to a very low altitude before pulling up. The witnesses described that below the fog or high fog layer normal visibility prevailed. Therefore it can be assumed that the crew suddenly had the ground in sight, realised the steep slope right in front of them, and then initiated the avoidance manoeuvre in form of a steep climb with large bank angle.

## 2.3 Specific Conditions

At the time of the accident, at Trier-Fohren Airfield the weather conditions made a VFR approach impossible. The Flugleiter stated that at the time of the accident the PAPI for landing direction 04 had been in operation. The wind came from 050°. The pilots approached the airfield from the direction to runway 22.

At Luxembourg Airport the weather conditions were bad as well. At the same time, good visual meteorological conditions prevailed at Frankfurt-Hahn Airport.

The interviews of other pilots working for the company and the statements of relatives of the passenger and company owner did not determine clear indications that would prove he pressured the pilots.

The pilots interviewed by the BFU described the personality of the PIC as dominant and rather assured of himself; the co-pilot as reticent, level-headed, and cooperative. The witnesses' statements indicate a distinct authority gradient between PIC and co-pilot, as well as a very charged relationship between the two. This is especially indicated by the statements, that he wanted to have the working relationship with the co-pilot terminated after they had had some arguments and his low opinion of the co-pilot.

## 2.4 Defences

In the scope of this investigation, the term "defences" or "safety mechanism" means technical systems, actions, procedures and institutions which shall minimise the effects of technical and human errors to protect flight safety.

Good Crew Resource Management (CRM) is a safety mechanism. One requirement for CRM is the skill of a PIC to motivate a crew member to be a good team player. In order for this to work, a good atmosphere of mutual appreciation between pilots is necessary which would, for example, encourage a co-pilot to share his/her observations and possible concerns. In addition, good teamwork in the cockpit also includes: the other person should be involved in the decision making process, the tasks should be distributed reasonably, and mutual support and supervision, e. g. monitoring or cross checks, should prevail. The BFU is of the opinion, that the course of events shows the application of crew resource management principles was insufficient. The BFU is of the opinion that the different personality traits of the two pilots and particularly the PIC's low appreciation of the co-pilot probably negatively influenced the working relationship in regards to CRM principles. The fact that the co-pilot helped during re-fuelling, loading, and take-off, conducted radio communications during take-off, and established radio contact with Langen Radar shows that a minimum of cooperation occurred between the pilots. The BFU is convinced that the cooperation during the accident flight, especially during the approach, could not have been good in regard to CRM. It is questionable whether the co-pilot had been involved in the decision making process and planning of the approach.

The airplane was equipped with TAWS. If functioning properly, the TAWS would have issued an acoustic warning "Five Hundred" in an altitude of 500 ft AGL and later a caution "Terrain" and a warning "Pull Up". Due to the degree of destruction of the unit and the fact, that the airplane was not equipped with a CVR, a precise analysis was not possible.

## 2.5 Organisational Aspects

The owner of the aircraft did not have any experience with the organisation of one's own non-public company flight operations. The flight operations had been conducted for about one year and not yet been ruled by binding Standard Operating Procedures (SOP).

Therefore, the respective PIC was left with the estimation of risks.

A high degree of safety should be reached with the conceptual fundamental decision of the airplane owner to have the non-public company flight operations be conducted with two pilots even though the airplane was certified for single-pilot operation.

The BFU is of the opinion, that this decision was correct in terms of flight safety, but implementation of the concept was inconsistent. An example was the co-pilot who did not receive the funding for acquisition of the commensurate licence and type rating due to reasons of costs.

On 25 August 2016 Part NCC of Commission Regulation (EC) No 965/2012 (Air Ops) for non-commercial flights with technically complicated powered aircraft comes into force. These stipulations will also apply for non-public company flights and include requirements for the organisation, risk management, and procedures. Therefore, the BFU refrains from issuing safety recommendations regarding this matter.

### 3. Conclusions

#### 3.1 Findings

- The PIC held the required licence and ratings to conduct the flight and was experienced. The co-pilot did not have a US licence and no type rating for the airplane.
- No indications for technical irregularities on the aircraft were found.
- The airplane was equipped for flights in accordance with instrument flight rules and, in addition, had a Terrain Awareness and Warning System.
- The post-mortem examination of the pilots did not reveal any performance impairments.
- The investigation determined insufficient Crew Resource Management.
- It is likely that the cooperation between the pilots suffered due to tension.
- One day prior to the accident, at the time the flight plan change occurred, the weather conditions for the time of the accident at Frankfurt-Hahn Airport had been forecast to be good.
- Prior to departure on the day of the accident, the pilots did not access the server to get the latest flight preparation documentation. No indications were found, that prior to departure the latest NOTAM and weather information were obtained.
- At the departure time from Shoreham, neither the weather conditions at the destination airport nor at the alternate airport stated in the flight plan were sufficient for landing.
- Before departure, the PIC was aware of the bad weather conditions at Trier-Fohren Airfield.
- At the time of the accident, landing in Luxembourg would not have been possible due to the prevailing weather conditions.
- At that time the weather conditions in Frankfurt-Hahn were very good.
- Approximately seven minutes prior to the accident the change of flight rules from IFR to VFR occurred.
- The pilots never established radio contact with Trier-Fohren Airfield.



- At the time of the accident the runway lighting and PAPI for landing direction 04 were active.
- During the final approach the pilot flew the aircraft into instrument meteorological conditions.
- It is likely that the descent, regarding the beginning of the descent and the rate of descent, was conducted with the help of the VNAV function of the GPS, and that an erroneous programming of the target altitude had occurred.
- Due to the error in programming and the lack of visual reference the pilot steered the airplane to a vertical profile which ended in terrain.
- Only very close to the ground did the crew realise the impact risk and initiated an avoidance manoeuvre by pulling up and turning.
- During the avoidance manoeuvre the airplane had contact with trees, and subsequently with the power pole. The right wing was severed; the airplane caught fire, and crashed upside-down to the ground.

## 3.2 Causes

The accident was due to the following:

- The Pilot in Command (PIC) decided to conduct the VFR approach even though he was aware of the prevailing instrument weather conditions at the airport
- It is likely that a wrong vertical profile was flown due to an erroneous selection on the navigation system
- Due to an insufficient situational awareness of the pilots the descent was not aborted in time.

The following factors contributed to the accident:

- Insufficient Crew Resource Management (CRM)

## 4. Safety Recommendations

None

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Braunschweig 18 October 2016	

## 5. Appendix

Analysis of the vertical approach profile based on radar data

Reconstruction of the flight path

