Bundesstelle für
Flugunfalluntersuchung

German Federal Bureau of
Aircraft Accident Investigation

Investigation Report

1X001-0/06
August 2009

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Date:	12 January 2006
Location:	Freiburg, Germany
Type of aircraft:	Aircraft, fixed wing
Manufacturer / Model:	Beech Aircraft Corporation / Beech B300
Injuries to persons:	Two fatal
Damage to Aircraft:	Aircraft destroyed
Other Damage:	Damage to trees
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Abbreviations

AGL	Above Ground Level
AMSL	Above Mean Sea Level
AP	Autopilot
CRM	Crew Resource Management
CVR	Cockpit Voice Recorder
DWD	German Meteorological Service
FDR	Flight Data Recorder
FMS	Flight Management System
ft	feet
ft/min	feet per minute
GPS	Global Positioning System
hPa	Hectopascal
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
kt	knot
MCC	Multi Crew Concept
METAR	Meteorological Aerodrome Routine Report
NM	Nautical Mile
NN	Normalnull
OVC	Overcast
QNH	Altimeter setting
TAF	Terminal Aerodrome Forecast

Synopsis

At 18:55[1] hrs on 12 January 2006, the German Federal Bureau of Aircraft Accidents Investigation (BFU) was advised by the Münster Search and Rescue centre that an aircraft accident had taken place in the vicinity of Freiburg Airfield. A BFU investigation team arrived at the accident site at about 01:00 hrs. Aided by a local external expert for field investigation who was tasked with the location and recording of any volatile traces, the team began the immediate investigation on-site.

The Beech B 300 (B300) took off on the morning of 12 January 2006 from its home base at Freiburg im Breisgau (EDTF) Airfield for a commercial flight in which passengers were to be transported from Karlsruhe/Baden-Baden (EDSB) to Braunschweig (EDVE) and return.

The B300 landed back at Karlsruhe at 17:19 hrs. The passengers disembarked at their destination and the flight crew took off for Freiburg at 17:59 hrs. This latter sector was flown under Visual Flight Rules Night (VFR-Night).

The flight continued south at 4,500 ft in radio contact with Strasbourg Approach (119,450 MHz). Before leaving this frequency at 18:12 hrs, the commander asked the Air Inspection Officer (*'Flugleiter'*) at Freiburg for the current airfield weather. The cruising altitude was reduced to 3,500 ft.

In subsequent radio exchanges, the crew gave position reports to the Flight Information Service at Freiburg and received current weather information. At 18:16 hrs the aircraft was above the destination aerodrome on a southerly heading.

When above the town, the aircraft then reversed heading to a northerly course to begin an approach to land. This was followed by a further 180° turn to intercept the approach path to Runway 16.

The undercarriage was lowered during final approach to Runway 16, and a short time later the commander gave his position to the Flight Information Service at Freiburg as 3 to 4 NM from the airfield.

The aircraft made contact with trees at 18:26 hrs about 450 m from the threshold to Runway 16 at Freiburg Airfield.

Both pilots were killed by the impact.

The accident occurred during the final stages of an approach under Visual Flight Rules, when the aircraft made a controlled descent and then had contact with trees. The causes of the accident were:

- because the decision was made to undertake a VFR Night flight although the weather was marginal, and
- the approach to Freiburg Airfield was continued in conditions of insufficient visibility.

[1] All times local, unless otherwise stated

1. Factual Information

1.1 History of the flight

The Beech B 300 (B300) took off on the morning of 12 January 2006 from its home base at Freiburg im Breisgau (EDTF) Airfield for a commercial flight in which passengers were to be transported from Karlsruhe/Baden-Baden (EDSB) to Braunschweig (EDVE) and return. The Beech 300 returned and landed at Karlsruhe at 17:19 hrs. The passenger flights were planned and conducted under Instrument Flight Rules (IFR).

After the passengers had disembarked at Karlsruhe/Baden-Baden Airport, the crew obtained weather reports for the onward flight to Freiburg. The commander referred to the weather reports available at the airport and telephoned the Air Inspection Officer at the destination aerodrome. The crew decided to conduct the flight under Visual Flight Rules Night (VFR-Night) and filed a flight plan accordingly. On this day, sunset at Karlsruhe was at 16:51 hrs.

The aircraft took off from Runway 03 in Karlsruhe/Baden-Baden at 17:59 hrs and left the airport control zone at compulsory reporting point BRAVO in a southerly direction. The Cockpit Voice Recorder (CVR) indicated the planned departure track was via the compulsory reporting point BRAVO, as called up from the aircraft's Flight Management System (FMS).

According to recordings of the radio communications, the Beech B300 was identified by Strasbourg Approach at 18:02 hrs (119.450 MHz) and after the initial contact was cleared to 4,500 ft.

Four minutes later the commander established radio contact with the Air Inspection Officer and requested the current weather in Freiburg.

The Air Inspection Officer reported the weather as having deteriorated to the north and west of the aerodrome, but that the town was still visible. He advised that the strengthening northerly wind might result in poorer visibility. In conversation with the co-pilot, the commander observed that a diversion would be possible to Lahr, but this was not pursued.

The co-pilot hand-flew the aircraft until 18:10 hrs. Then the autopilot was selected and the commander assumed control.

At 18:12 hrs the crew requested permission to leave the Strasbourg approach frequency to establish contact with Freiburg Tower. At the same time the crew selected Transponder Code 0021. The cruising altitude was reduced to 3,500 ft.

During the remainder of the flight the crew gave several position reports and the Air Inspection Officer gave weather updates for Freiburg.

At 18:16 hrs the aircraft was above the airfield. The CVR indicated that at this time the ground was not in sight. The commander mentioned the cloud tops as 3,500 ft.

At 18:17 hrs the Air Inspection Officer reported ground visibility as about 1,500 m towards the south and that it was not possible for him to see the cloud base.

After a short discussion, the commander took a decision to fly an approach towards Runway 16 and said: "*ja, dann probieren wir es mal*" ("Yes, let's give it a try"). The aircraft then turned 180° above the town of Freiburg, and flew towards the north.

According to the CVR recordings, the crew prepared the approach by entering and subsequently altering waypoints in the Flight Management System. The Auto Flight System was prepared for a track of 163°. After these entries, the aircraft flew a further 180° turn to follow the extended approach centreline to Runway 16.

The landing gear was lowered at 18:22 hrs. At this time, the aircraft was on final approach to land. The commander reported his position to the Air Inspection Officer as being 3 to 4 NM from the airfield, in response to which the agent reported the ground visibility as being more than 1,500 m towards Freiburg and the University Medical Center Freiburg.

The Flight Data Recorder indicates that the flaps were first lowered to the 'Approach' setting, and a little later were lowered to their full setting.

The commander instructed the co-pilot to maintain an external look-out. The co-pilot reported the 1,000 ft radio altimeter indication to the commander, adding that he could not yet see anything.

A few seconds before the 500 ft radio altimeter acoustic marker signal, the Air Inspection Officer gave the QNH as 1,030 hPa. At this point, the commander believed his position to be above the Autobahn Intersection Freiburg North. After passing through the 500 ft radio altimeter acoustic marker the co-pilot had sideways visual contact with the ground, but could see nothing in the direction of flight.

The co-pilot saw a road at the same time as the minimum report (200 ft radio altimeter) came on. In response to the commander's question he said: "*Das ist vermutlich der Zubringer, ich kann es aber nicht sicher sagen*" ("It's probably the feeder road, but I can't be sure").

At this moment the aircraft had an approach speed of 115 kt, with both engines delivering 30 to 40 per cent power.

The radio altimeter emitted the 100 ft acoustic warning at 18:25:50 hrs. Two seconds later, the Flight Data Recorder and Cockpit Voice Recorder ceased operation.

The aircraft hit trees and then crashed into the ground at 18:26 hrs, about 450 m from the threshold of Runway 16 at Freiburg Airfield.

1.2 Injuries to persons

Injured	Crew	Passengers	Total	Other
Fatal	2		2	
Serious				
Slight				
Uninjured				---
Total	2		2	

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

There was damage to trees in the woods at the accident site.

1.5 Personnel information

Commander:

Age:	64 years, male
Licence:	Air Transport Pilot's Licence (ATPL (A)) in conformity with ICAO guidelines
Type Rating:	Beech 300/1900
	Instrument Flight Rules (IR)
	Instructor Class Rating (CRI)
Medical:	Class 1
Total Flight Hours:	about 6,500 hours, of which about 1,500 on Beech B300

Co-pilot:

Age:	25 years, male
Licences:	Commercial Pilot's Licence (CPL (A)) in conformity with ICAO guidelines,
	Air Transport Pilot's Licence (ATPL (A2)) in conformity with ICAO guidelines
Type Rating:	Beech 300/1900 as co-pilot,
	Beech B90/99/100/200 as pilot in command,
	Instrument Rating (IR),
	Long-Range Rating (LR)
Medical:	Class 1
Total Flight Hours:	about 500 hours (following enquiries; pilot's logbook unavailable)

As part of the accident investigation, the BFU interviewed a number of co-pilots employed by the operator. They were asked to give their assessment of the professional skills and personalities of the two deceased pilots.

The respondents were unanimous in describing the commander as a highly skilled pilot; he tended to be authoritarian and was disinclined to accept opinions that differed from his own. He was described as a typical 'one-man band', who although he incorporated his co-pilot in cockpit tasks, did not practice genuine Crew Resource Management (CRM).

Pilots who had known the commander for many years and had worked with him during training, check flights and on regular flight operations, described him as having a high degree of experience and ability. The respondents were unanimous in describing teamwork with him in the cockpit as difficult. There had also been repeated disagreements between the commander and Air Inspection Officers.

The co-pilot was seen as being of average ability, who accepted the decisions of an experienced commander and was disinclined to question or even criticise them.

1.6 Aircraft information

The Beech 300 is a twin-engined low-wing all-metal aircraft with a T-tail, registered and classified in the Federal Republic of Germany as a Commuter Aircraft.

The aircraft had seats for eleven passengers.

Manufacturer:	Raytheon Aircraft Company
Type:	Beech B300
Year of manufacture:	2001
Manufacturer's serial number:	FL-311
Gross weight:	6,800 kg
Engine manufacturer:	Pratt & Whitney
Engine type:	Two PT6A-60A turboprops
Maintenance:	Aircraft maintained under contract to an approved maintenance schedule
Total flight time:	About 1,500 hours

Photo 1: Beech B300 aircraft Source: Operator

In addition to the standard equipment required for operation in accordance with Instrument Flight Rules, the aircraft was fitted with the following systems:

- Rockwell Collins Autopilot System APS-65
- Universal Flight Management System UNS 1-D with GPS-Sensor
- Honeywell EGPWS
- Emergency Locator Transmitter (ELT) Kannad 406 AF

1.7 Meteorological information

The DWD German Meteorological Service was asked to describe the meteorological circumstances relevant to the accident.

1.7.1 Meteorological flight briefing

The DWD reported that on 12 January 2006, the meteorological flight briefing service had not been asked to provide an individual weather briefing to a crew whose aircraft bore the registration of the aircraft which subsequently crashed.

During the early morning of 12 January 2006 the registered user called up information from the DWD Internet Service. The information given was the current weather reports (METARs), Terminal Aerodrome Forecasts (TAFs) and EUR flight documentation.

The GAFOR General Aviation Forecast for the period between 16:00 hrs and 22:00 hrs in GAFOR areas 51 and 61 (the area around the accident site), was given as X-Ray (closed). The relevant GAMET (Area Weather Forecast) for the Frankfurt FIR western sector was given as Overcast (OVC) between 200 ft AGL and 500 ft AGL.

At the time in question, weather for airports and regional airports in the southerly part of the Rhine Valley gave the visibility in places (horizontal visibility at ground level) as being less than 1,500 m and/or a cloud base between 200 ft AGL and 500 ft AGL.

According to the weather reports of 12 January 2006 the Freiburg weather observation station (automatic data acquisition) documented the following values at around 18:00 hrs and 19:00 hrs:

Wind:	330° - 360° with 2 kt; gusting 6 kt
Cloud:	7/8 to 8/8 at 100 ft
Temperature:	0° Celsius
Dew point:	-1° Celsius
QFF:	1,032,6 hPa

1.7.2 Weather at accident site

The recorded communications between the B300 crew and the Air Inspection Officer gave the following indications of the actual aerodrome weather at the time of the accident:

- The horizontal visibility at Freiburg Airfield varied greatly in different directions, and changed during the course of the flight between Karlsruhe/Baden-Baden and Freiburg.
- The best horizontal visibility was towards the south (town of Freiburg). The Air Inspection Officer gave the visibility as 1,500 m.
- The Air Inspection Officer assessed the visibility towards the north as much poorer. The northerly wind pushed fog banks towards Freiburg Airfield.
- At no time was the Air Inspection Officer able to estimate the cloud base.

The fire fighters who arrived at the accident site a few minutes after the event reported the visibility at ground level as 300 to 400 m. A turntable ladder was deployed to 24 m where the top was in fog.

A witness who stood on a bridge between the aerodrome and accident site gave the horizontal visibility as about 100 m.

1.8 Aids to navigation

There were no navigation or approach aids in the vicinity of Freiburg Airfield.

In the wider area there were VOR/DME stations in Stuttgart, Trasadingen, Basel Mulhouse and DVOR Sulz. However, these could not be used down to the decision height or touch down point, due to a combination of inadequate range and local topography in the vicinity of the aerodrome.

The aircraft was equipped with a Flight Management System (FMS) with a sensor for satellite navigation (GPS).

1.9 Communications

Communications between Freiburg Info and the aircraft on frequency 118.25 MHz were recorded by Freiburg Airfield.

Communications between Strasbourg Approach and the aircraft were recorded by the French Air Traffic Service Provider.

1.10 Aerodrome information

Freiburg im Breisgau (EDTF) Airfield is located in the southerly part of the River Rhine Valley just north of the town of Freiburg im Breisgau and is 799 ft above mean sea level. The aerodrome coordinates are N 48 01.2 and E 007 50.0.

The aerodrome has a single asphalt runway 1,240 m long and 30 m wide. The Landing Distance Available (LDA) in the direction 160° is given as 990 m, and 980 m in direction 340°.

An industrial zone is located in the immediate vicinity of the aerodrome together with a shopping centre and a refuse disposal site, now closed.

The aerodrome is located within Class G airspace and used by VFR traffic. The airfield has runway lights and a VHF direction finder (VDF).

The Air Inspection Service is provided by a combination of full-time and part-time employed Air Inspection Officers.

1.11 Flight recorders

For reconstruction of the flight path, the BFU had access to the data from the F1000 Flight Data Recorder and the FA 2100 Cockpit Voice Recorder, both manufactured by L 3 Communications.

1.11.1 Flight data recorder

The Flight Data Recorder had a semiconductor memory device that recorded 20 parameters.

All the data traces were legible without reservation and gave information including the following:

- The autopilot was engaged up to the moment of the accident.
- The final approach was flown with both engines delivering a constant 40% (torque) at 1,500 rpm.
- The final approach to Freiburg was flown on a steady heading of 160°. There were no roll moments along the longitudinal axis.
- During the last 33 seconds of the approach, the average rate of descent was about 500 ft/min.
- The landing flaps were deployed to 35° (full flaps).
- During the last 33 seconds of the approach to Freiburg, the aircraft speed increased from 113 to 132 kt.
- Half a second prior to aircraft impact, the value recorded for vertical acceleration increased to 1.6 g, and the pitch angle increased to + 4°.

1.11.2 Cockpit voice recorder

The Cockpit Voice Recorder had a semiconductor memory device with a recording duration of 120 minutes on two channels. Four channels were available for the final 30 minutes.

The voice communications between the crew members, between the crew members and Air Traffic Control and Freiburg Flight Information Service, were played back with no difficulty and transcribed.

The CVR recordings were used as the basis for a reconstruction of the sequence of events and the flight.

1.12 Wreckage and impact information

During its approach to Freiburg Airfield the aircraft first made contact with the tops of a group of trees about 20 m high and 700 metres before the threshold of Runway 16. This initial impact ripped a winglet off the right wingtip, which was subsequently located about 65 m behind the trees; parts of the fuel tank cladding were found about 20 m farther.

As the aircraft continued (see Appendix 2) the right wing made contact with a branch about 15 cm thick, when a large quantity of fuel of fuel escaped and the aircraft slewed to the right. The wing flaps, ailerons and large parts of the wings and the left propeller were scattered over a wide area.

After having made contact with the tree tops the aircraft came to a stop on the forest floor about 250 m farther on, and 450 metres from the Runway threshold. On impact, the right engine was torn from the wing and thrown forward about 15 m.

Picture 2: The main wreck at the accident site Source: BFU

The wreck revealed the following:

- The cockpit area and forward fuselage were destroyed.
- The T-tail unit was bent and folded to one side.
- The landing gear was lowered and locked.
- The flap drive spindle was in the position for the 35° landing flap setting.
- The engine instruments, engine controls and cockpit avionics were destroyed by impact and fire.
- The altimeter on the right hand side of the cockpit was set to a QNH of 1,031 hPa. The altimeter on the commander's side of the cockpit (left) was mechanically destroyed and no longer suitable for evaluation.

Inspection of the wreck revealed no evidence of technical defects.

1.13 Medical and pathological information

The remains of the two pilots were subject to post mortem examination at the University Medical Center Freiburg.

1.14 Fire

The first traces of fire were found about 125 m after the point of first contact with tree branches.

Fire spread through the main wreckage. The cockpit area and front fuselage were destroyed by fire. The upper side of the fuselage burned out almost completely.

The local fire service was called to the accident site and arrived eleven minutes later to extinguish the blaze.

1.15 Survival aspects

The accident was not survivable for the two crew members.

The Air Inspection Officer did not see the accident itself happen. However, his attention was drawn to the event by an explosive blaze, whereupon he alerted the rescue and fire services.

The 406 MHz on-board Kannad 406 AF emergency locator transmitter signal was not detected by the COSPAS-SARSAT satellite system. The transmitter was found in the wreck, but the cable to the external antenna was destroyed.

1.16 Tests and research

None

1.17 Organizational and management information

The aircraft operator was based at Freiburg Airfield and had an Air Operator Certificate issued in accordance with EU Council Order No. 2407/92 in conjunction with Section 20 Para. 2 to 4 Air Transport Law.

The aircraft was entered on the Air Operator Certificate (AOC) and was used for commercial transport of persons and goods in accordance with JAR-OPS 1 German. Other than the Beech B300, no other aircraft were entered on the AOC.

The Operator's responsibilities were defined in the Operations Manual, Part A. These gave the commander's responsibilities as:

- Flight Operations Manager
- Maintenance Manager
- Training Manager
- Flight/Ground OPS Manager

The Quality Manager function was exercised by an external contractor who conducted an audit about three times each year.

The Operations Manual Part A, 8.3.1.5, specified that the aircraft should only depart for a VFR flight, if the appropriate weather minima were met in the respective airspace category at the destination aerodrome.

The procedure for crew coordination in the cockpit and the use of checklists in the Beech B300 are described in the Operating Manual, Part B.

The operating company's business related primarily to transporting persons, human organs and accompanying medical teams. In the three months prior to the accident, the company had made about 30 such flights from its home base at Freiburg Airfield.

1.18 Additional information

During interviews with co-pilots (see chapter 1.5) who had flown with the commander, information was given about the procedures and techniques that the commander had used to approach Freiburg in good and bad weather.

They reported he had used the Autopilot, Flight Director and FMS to define the waypoints for commencement of the descent, the touchdown point and the decision point, should it be necessary to go around.

These waypoints had been established and validated in good weather.

1.19 Useful or effective investigation techniques

None

2. Analysis

Approaching Freiburg Airfield the Beech B300 flew controlled into ground. The accident was classified as CFIT (Controlled Flight Into Terrain).

The accident investigation gave no indication of a possible defect in the aircraft performance or its systems. According to the FDR the aircraft and systems were performing correctly. The aircraft was fully controllable. The crew members were not handicapped in the performance of their duties.

Against this background the investigation concentrated primarily upon: the weather at the destination of Freiburg Airfield; the decisions taken before the flight; the approach procedure; and the approach path flown to an aerodrome equipped only for Visual Flight Rule approaches, in weather conditions which called for an approach to be flown under Instrument Flight Rules to an aerodrome with a commensurate infrastructure.

2.1 Operational aspects

Under the given weather conditions, this flight could only have been conducted safely under Instrument Flight Rules. The aircraft was equipped for flights in accordance with Instrument Flight Rules and the crew had the necessary qualifications and experience. Freiburg Airfield did not have the necessary infrastructure such as an Instrument Landing System (ILS) or an approved GPS approach procedure. Under the given weather situation, a landing would have required a precision approach procedure with a Category II (CAT II) Instrument Landing System.

The commander's decision to depart from Karlsruhe/Baden-Baden at night under Visual Flight Rules should have presupposed Visual Meteorological Conditions (VMC). In controlled airspace (Class E), the requirement would have been for horizontal visibility of 8 km while maintaining a vertical distance from clouds of 1,000 ft, and a horizontal distance of 1.5 km. In the vicinity of Freiburg Airfield (Class G), the requirement would have been for horizontal visibility of 1.5 km and clear of clouds.

While studying the pre-flight weather reports at Karlsruhe/Baden-Baden, and during the course of telephone and subsequent radio communications with the Air Inspection Officer, the pilot in command must have been aware that the formal requirements laid down in German Air Law (LuftVO) for a flight and landing at Freiburg Airfield could not be met. Probably he concluded that, with his many years of flying experience, good local knowledge and the modern high-performance electronics systems fitted to his aircraft, he would nevertheless embark upon the flight.

The recorded radar track indicated no navigational problems associated with the cruise and initial approach. The flight path, FDR and CVR recordings, indicated that the aircraft was controlled by the Autopilot System and Flight Management System (FMS), which was equipped with a GPS sensor.

No later than their arrival over the town of Freiburg with full cloud-cover, the crew had first-hand confirmation of the previous weather forecasts. The commander had to act on the assumption that the cloud base was low and unpredictable.

The FDR recorded operation of the autopilot up to the moment of impact. The autopilot computer and Flight Management System were badly damaged, so it was not possible to determine their mode of operation with complete certainty.

The aircraft's Flight Management System had an 'Approach Mode' for vertical control of an approach to an aerodrome. The system allows for an automated approach, analogous to a ground-based Instrument Landing System. Because of the lack of precision and reliability, this approach procedure was no

satisfactory substitute for a ground-based Instrument Landing System with localizer and glideslope transmitter.

The BFU cannot exclude the possibility that the commander used this approach procedure, because during the course of this investigation other co-pilots who had flown with this commander reported he had used this approach procedure in conditions of reduced visibility. He had programmed the Flight Management System with vertical profile waypoints defining positions, distance and height. He had flown and fixed the necessary waypoints in good weather.

The reconstructed vertical profile indicated a constant sink rate of about 500 ft/min. Had the aircraft been a few metres higher, it would have missed the wooded hill in the approach area.

At the very latest, when the ground could not be seen and there was no view ahead at 500 ft above ground, the commander should have abandoned the approach. Further, the acoustic warning given by the radio altimeter at 100 ft above ground was not followed by a go-around.

The aircraft's ground proximity warning system (EGWPS) was unable to generate a warning or go-around instruction, because the aircraft was in the landing configuration.

The aircraft could have diverted to Lahr (EDTL), where the crew could have switched from Visual Flight Rules Night to Instrument Flight Rules.

2.2 Specific conditions at the time of the accident

Aerodrome and weather situation

The aerodrome was licensed for aircraft movements under Visual Flight Rules. Although the aerodrome was equipped with runway lighting, there were no precision approach aids for use in conditions of reduced visibility such as an Instrument Landing System. Likewise, GPS/FMS-overlay or GPS stand-alone approach procedures were not established at the aerodrome.

During the flight from Karlsruhe/Baden-Baden and approach to Freiburg, the visibility at Freiburg Airfield was marginal. The Air Inspection Officer could only estimate the horizontal visibility by simple aids, such as the known distance to particular buildings or structures. These distances were only valid for particular compass directions; at night, no estimate was possible for the approach to Runway 16. In darkness, the Air Inspection Officer could only make out forest. There were no visual reference points.

The Air Inspection Officer could not make out the cloud base at the aerodrome. He had no measuring instruments for this purpose. The only instruments in the Tower gave the QNH altimeter setting and wind direction.

At the time of the accident, the cloud base extended almost to ground level. This was confirmed by witnesses and the Cockpit Voice Recorder.

Aircraft equipment

The aircraft was equipped for flights in accordance with IFR and had an autopilot, a Flight Director and Flight Management System of very modern design. This electronic equipment, supported by a GPS sensor, allowed for cruise navigation independent of ground features. The aircraft was equipped with precision approach equipment for landings in conditions of reduced visibility. Under the visibility conditions at that time, a ground-based Category I/II Instrument Landing System (ILS) with localizer and glide path transmitters would have been indispensable.

2.2.1 Human factors

Commander

The commander was properly licensed and experienced. He was very experienced on the type and thoroughly familiar with the locality of his home aerodrome.

It can be inferred from the CVR recordings and observations made by co-pilots who had flown with the commander, that he was very self-assured and did not consider opinions that deviated from his own. This personality trait and work-style were self-evident during the flight and approach to Freiburg. He would probably not have accepted suggestions or contradictions from the co-pilot. It has not been possible to establish what degree of trust the commander placed in the co-pilot.

Co-pilot

The co-pilot was at the beginning of his flying career. There was a large authority gap between himself and the commander due to the differences in age, seniority within the company, and vast difference in flying experience.

Teamwork in the cockpit

There was not the slightest indication of teamwork in the cockpit, in the sense of Crew Resource Management (CRM). It was evident from the CVR recordings that the division of labour was one in which the commander issued instructions to undertake specific tasks. Related decisions were neither discussed nor reached by agreement. The commander took decisions and announced them without discussion or giving reasons.

During the flight, the co-pilot made scarcely any objections. If he had, they would probably have been ignored and he might have had to face future unpleasantness with a commander who was seen as authoritarian. For this reason -- and also probably because the co-pilot was seen by his colleagues as an adaptable individual not inclined to protest -- he voiced no criticism.

When the aircraft had reached the Approach Minimum of 200 ft above ground, and there was still no visual contact with the ground towards the aerodrome, he did not call upon the commander to go around. If there had been good teamwork in the cockpit, this would have been normal and a good practise.

Cooperation and communication with the Air Inspection Officer

Prior to departure from Karlsruhe/Baden-Baden and during the flight, communication between the commander and the Air Inspection Officer was limited to the exchange of weather information. The Air Inspection Officer was able only to pass his own observations, as to the visibility at the aerodrome.

On the one hand, the Air Inspection Officer was in the subordinate position of providing a service to the commander and the operator. On the other hand, he stayed strictly within the bounds of his legal responsibility, ensuring that he did not overstep either his authority or responsibility under air law. He only provided information on the ground level visibility in certain directions. He gave no information about the cloud base or horizontal visibility on the approach path. He had no measuring instruments for such purpose.

As seen by the BFU, the Air Inspection Officer could see, based on the weather situation, that an approach would be illegal and risky, but he did not communicate these concerns. As an Air Inspection Officer ('*Flugleiter*') at an uncontrolled aerodrome he had no authority to issue instructions, other than to ward off danger.

2.3 Safety mechanisms

The Beech B300 had a Ground Proximity Warning System (EGWPS) with an acoustic warning to prevent CFIT accidents. This did not operate because the aircraft was in the landing configuration.

In this context, the radio altimeter should also be regarded as an on-board safety system. The system generated acoustic warnings on passing through 500 ft and 100 ft AGL. In both instances, there was no visual contact with the ground. Irrespective of the question of whether the approach should have been attempted, the approach should have been abandoned, at the latest, when the 500 ft warning was given.

Under the weather conditions then pertaining, a safe landing could only have been made with the use of an Instrument Landing System and associated procedures. Since the aerodrome did not have a precision approach aid of this kind, the risks associated with an attempted approach and landing were out of control.

In an aircraft of this category with two-crew operation, one safety component for the avoidance of accidents should include the systematic implementation of the MCC (Multi-Crew Concept as defined by JAR-FCL); this describes the cockpit crew team procedures to be implemented as part of established Crew Resource Managements (CRM) arrangements. Neither of these concepts was employed. The use of these procedures and concepts would have required the preparedness for teamwork, which was absent due to the commander's authoritarian manner and procedures. The attempted approach might have been avoided if both crew members had monitored each other with respect to the decisions taken and their procedures.

During the investigation the BFU found no indication that the commander had made any attempt at risk evaluation, of whether the flight should have been attempted under the current weather conditions; or whether as an alternative the flight should have been conducted under Instrument Flight Rules with a diversion to Lahr.

Emergency locator transmitter (ELT)

The 406 MHz signal emitted by the emergency transmitter was not received by the COSPAS-SARSAT satellite system because the cable from the transmitter to the external antenna was destroyed on impact. Investigation of the emergency transmitter conducted by the manufacturer under supervision of the BFU showed that the transmitter remained fully functional after the accident and generated an emergency signal.

2.4 The operator

The Operator was a small company with a single aircraft used primarily to carry persons and human organs for transplant and subject to the requirements of JAR-OPS 1 (German). This resulted in a situation in which the aircraft commander had to fill all the positions of responsibility, with the exception of the Accountable Manager and Quality Manager. In particular, when it came to defining and adhering to flight operational procedures, there were no mutual checks or monitoring.

During the course of the investigation, the BFU gained the impression that the Operations Manual existed only on paper and had little practical meaning in day-to-day flight operations. Definitions in the Operations Manual such as VFR minima, the use of checklists, the implementation of the Multi-Crew Concept and Crew Resource Management, were not used on the flight between Karlsruhe/Baden-Baden to Freiburg.

The Quality Manager had recognised this situation, but in the opinion of the BFU he had no realistic means of ensuring the company would adhere to its own objectives, as described in the Operations Manual.

In the view of the BFU, there was a fundamental difficulty for the Operator in flying the Beech B300 from its home aerodrome at Freiburg and meeting the requirements of JAR-OPS 1 (German) and other aviation regulations. Because the aircraft was equipped for Instrument Flight Rules -- and was used primarily for IFR flights -- there would have been repeated situations in which a flight should have been declined for reasons of weather, because the weather was too poor for a VFR departure from the home base.

Conflict situations were pre-programmed, because a company's objective is to meet the customer's wishes while remaining within the law. This is a general problem for all operators, but the difficulty was made worse by the fact that the company was frequently called upon to fly organ transplant teams and human organs. These flights were very urgent. When considering such flights, there was considerable pressure for those in the risk evaluation process.

On disembarking passengers at Karlsruhe Baden-Baden, the contract was completed. The flight to Freiburg can be seen as a positioning flight in which the Operations Manual definitions should have been applied. As seen by the BFU, there was no particular pressure to return to Freiburg that evening.

3. Conclusions

3.1 Findings

The aircraft was registered and had a Certificate of Airworthiness.

The aircraft was equipped for flight in accordance with Instrument Flight Rules, and was further equipped with an autopilot, and a Flight Management System capable of using GPS data for navigation.

The aircraft was used by an Air Operator and was entered on the Air Operator Certificate (AOC). It was used for the commercial transport of persons and goods as described in JAR-OPS 1 (German).

Examination of the aircraft wreck, evaluation of the Flight Data Recorder and Cockpit Voice Recorder gave no indications of a technical fault.

Both pilots were in possession of the necessary licenses and medical certificates.

Post mortem examination of the two pilots found no indication of an adverse physical condition.

For the period between 16:00 hrs and 22:00 hrs, the DWD German Weather Service gave the GAFOR General Aviation Forecast for the entire southern Rhine valley area (GAFOR areas 51 and 61) as 'closed' (X-Ray). The cloud cover was completely overcast (OVC), with the cloud base between 200 ft and 500 ft above ground.

For the period in question, the Terminal Aerodrome Forecasts (TAFs) for aerodromes in the southern Rhine Valley gave the horizontal visibility at ground level as being less than 1,500 metres in places, and/or with a cloud base of between 200 ft and 500 ft above ground.

At about the time of the accident, the Freiburg weather observation station (automatic data acquisition) measured 7/8 to 8/8 cloud cover at 100 ft above ground.

The Air Inspection Officer in Freiburg was unable to estimate the cloud base; he estimated the horizontal visibility at ground level as about 1.5 km in a southerly direction.

The crew advised the Air Inspection Officer that the cloud tops were at about 3,500 ft AMSL.

The Fire Service reported horizontal visibility at the accident site as being 300 to 400 m, and that the tip of a turntable ladder extended to 24 m was in fog.

Freiburg Airfield (EDTF) is licensed for Visual Flight movements. It has no precision approach aids.

The crew flew over Freiburg Airfield above the cloud cover but without being able to see the aerodrome.

The approach was flown by the autopilot.

The radio altimeter acoustic warnings given when passing through 500 ft and 100 ft AGL were not followed by a decision to go around.

The aircraft touched trees about 700 m before Freiburg Airfield runway threshold.

3.2 Causes

During the final approach conducted in accordance with Visual Flight Rules, the aircraft descended in controlled flight and contacted trees. This was due to:

- the decision to embark on a VFR Night flight in marginal weather conditions,
- the approach to Freiburg Airfield was continued under conditions of inadequate visibility.

4. Safety Recommendations

After the conclusion of the investigation, the German Federal Bureau of Aircraft Accidents Investigation has issued the following safety recommendations:

Recommendation No.: 25/2009

The European Aviation Safety Agency (EASA) should regulate to require that 'Single-Pilot Aircraft' engaged in EU-OPS 1.940 flights made in accordance with Instrument Flight Rules and at night, must have a minimum crew of two pilots, and that their training is in accordance with JAR-FCL including Multi-Crew-Concept (MCC) training.

Recommendation No.: 26/2009

The Luftfahrt-Bundesamt should verify whether the operator has authorised Freiburg Airfield according to EU-OPS 1.220 and when indicated take regulatory action.

Recommendation No.: 27/2008

The operator of Freiburg Airfield should ensure that technical equipment for measuring the cloud base and determination of ground visibility in flight approach and take-off directions is installed.

Recommendation No.: 18/2009

The International Civil Aviation Organization (ICAO) should include in Annex 6, part II and III, or in Annex 10, part III, that 406 MHz emergency locator transmitters (ELT) for aircraft must have an additional internal antenna, or that the external antenna is designed in a way that the emission of the emergency signal is ensured after an accident.

Recommendation No.: 19/2009

The European Aviation Safety Agency (EASA) and the Federal Aviation Administration (FAA) should ensure that in case of new installations and refitting of 406 MHz emergency locator transmitters (ELT) in aircraft only ELTs with an additional internal antenna, or an external antenna designed in a way that the emission of the emergency signal is ensured after an accident are installed.

Braunschweig, August 2009

German Federal Bureau of Aircraft Accident Investigation

Johann Reuß

Investigator in charge

The following BFU staff members have contributed to the investigation:

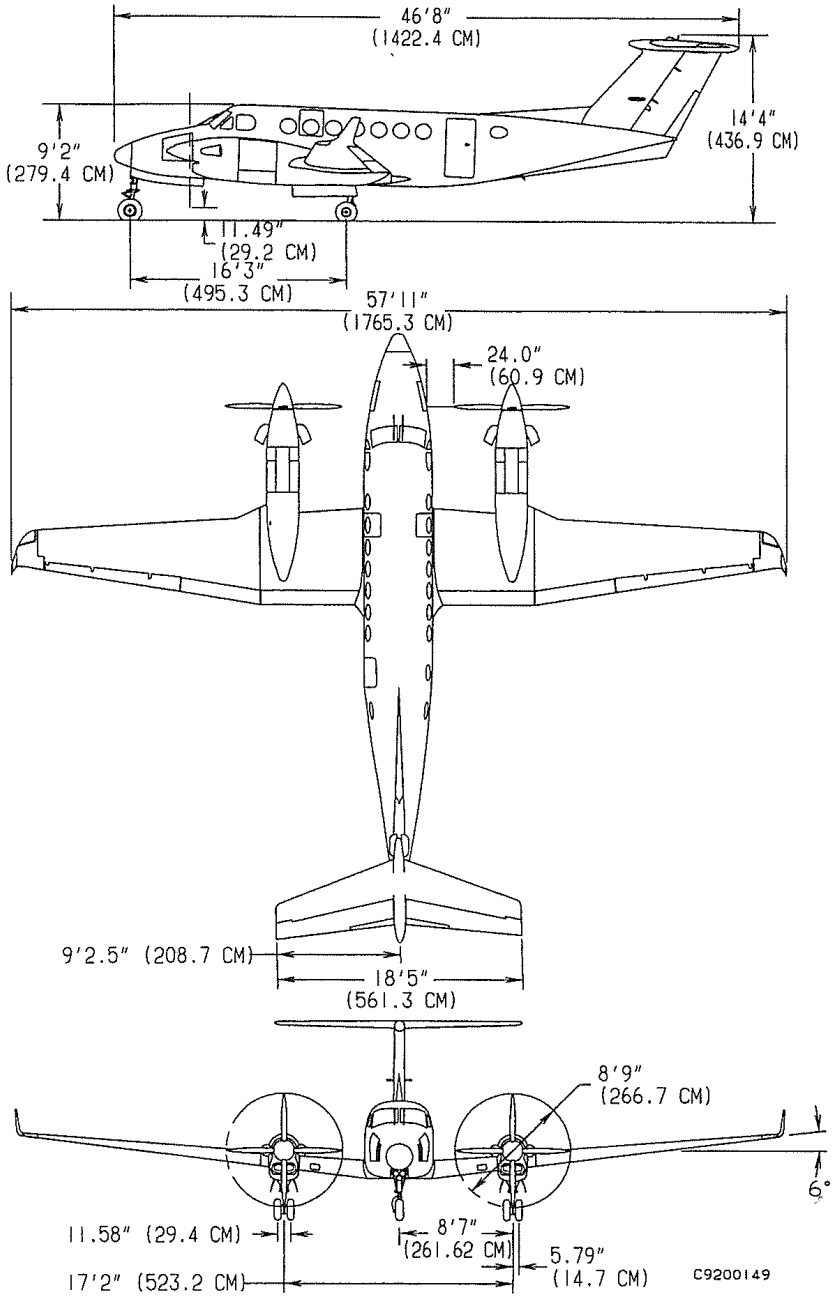
Fritz Kühne

Karsten Severin

5. Appendices

Appendix 1: Three-view drawing
Appendix 2: Overflight and approach track to Freiburg Aerodrome
Appendix 3: Wreck distribution at the accident site

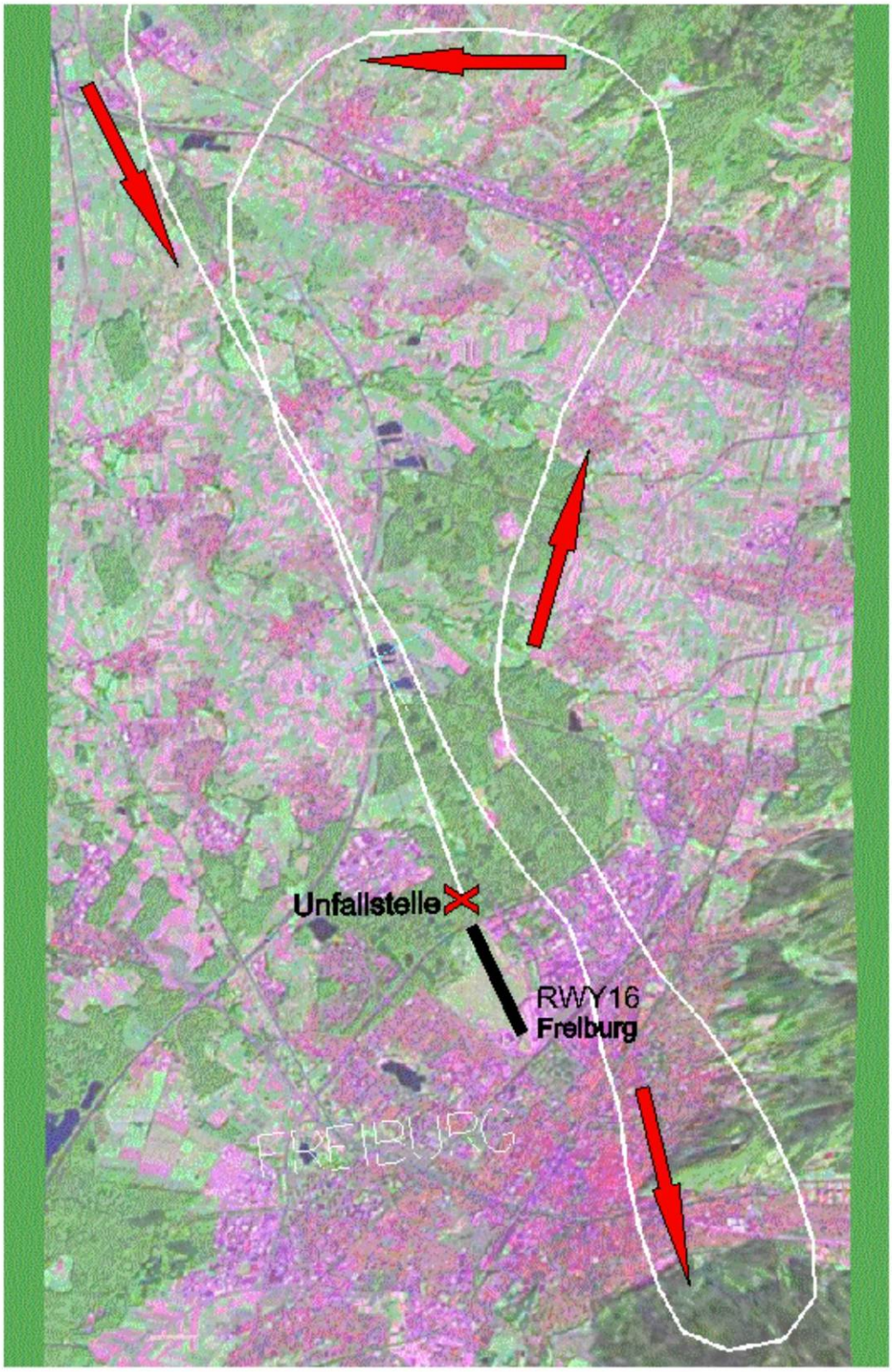
Appendix 1



B300 THREE-VIEW

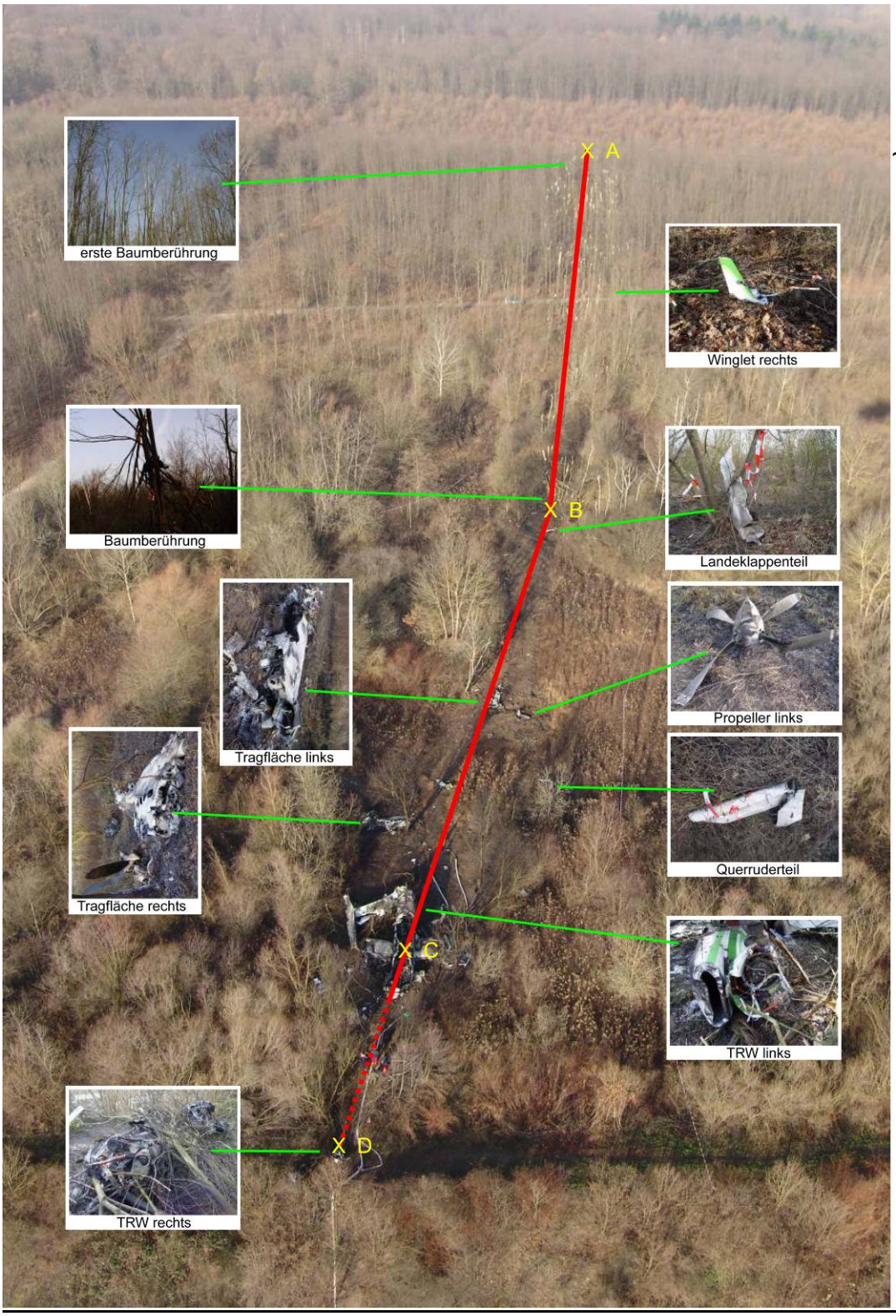
Three-view drawing B300

Appendix 2



Overflight and approach track to Freiburg Aerodrome

Appendix 3



Wreck distribution at the accident site