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**REPORT ON THE MISHAP
OF THE AIRCRAFT SOCATA TB21 TRINIDAD
REGISTERED PH-UBG AT NEEROETEREN
(BELGIUM) ON 10 APRIL 2001**

**CELLULE D'ENQUETES
D'ACCIDENTS
ET D'INCIDENT D'AVIATION**

**CEL VOOR ONDERZOEK VAN
LUCHTVAART
ONGEVALLLEN-EN INCIDENTEN**

**REPORT ON THE MISHAP OF THE AIRCRAFT
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FOREWORD

In accordance with Annex 13 to the International Civil Aviation Organization, Council Directive 94/56/EC, and Royal Decree 9/12/1998, the sole purpose of these investigations is to prevent aviation accidents. It is not the purpose of any such accident investigation and the associated investigation report to apportion blame or liability.

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0.1. Investigation.

The ACC of BRUSSELS informed AAIU BELGIUM about the accident. An investigation according to ICAO Annex 13 was opened on the same day. BEA France (country of manufacturing) nominated an accredited representative and an advisor to him for this investigation.

0.2. Place.

NEEROETEREN (BELGIUM).

0.3. Date and hour of the mishap.

April 10, 2001, 06.30UTC1.

0.4. Aircraft.

SOCATA TB21 TRINIDAD.

0.5. Owner.

UBROEK MACHINEFABRIEK B.V.

0.6. Type of operations.

Business travel.

0.7. Phase of flight.

Cruise.

0.8. Persons on board.

02 pilots.

0.9. Short description of the mishap.

Disintegration in flight.

1 All times in this report are in UTC time. To get local times, add 2 hrs.

1 FACTUAL INFORMATION

1.1. History of the flight.

At 06.22 on April 10, 2001, the aircraft SOCATA TB21 TRINIDAD registered PH-UBG takes off from BEEK (EHBK) under an IFR flight plan. The destination is ANTWERPEN-DEURNE (EBAW). On board, two pilots. At 06.27, level at FL 60 inbound ONT, he is handed over to BRUSSELS DEPARTURE. The ATC clears him left straight towards ANT. Shortly after 06.29 flying on heading 280, he climbs abruptly to 068 FL and goes down again to 60 FL while making a 180 to the right. At 06.30, the crew transmits an unreadable message and the airplane disappears from the radar screens. It disintegrates shortly after that on a heading of 245 Southeast of NEEROETEREN. Both occupants are fatally injured.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	2	0	0
Serious	0	0	0
Minor/None	0	0	

1.3. Damage to aircraft.

The aircraft is completely destroyed.

1.4. Other damage.

Aircraft debris, sometimes very small, are spread on approximately two km across woods, meadows and fields. There is some pollution of the soil at the impact point of the fuselage and of the left wing by fuel and lubricant.

1.5. Information on the pilots.

1.5.1. Left seat.

LICENSE: **Private Pilot Single Engine (reciprocating) N° NL1999.9976-13315 valid until 01/09/01.**
EXPERIENCE: **399.55hr (on 01/09/00).**

1.5.2. Right seat.

LICENSE: **Private Pilot Single Engine (reciprocating) N° NL 1999.12125-7933 valid until 12/08/01**
IFR Single Engine valid until 12/08/01
EXPERIENCE: **3800hr (on 04/11/00).**

1.6. Information on the aircraft.

1.6.1. Airframe.

■ Manufacturer:	EADS -SOCATA.
■ Type:	TRINIDAD TB21.
■ Serial NR :	1012.
■ Registration:	PH-UBG.
■ Airworthiness Certificate	NR 4677 valid until 04/08/01.
■ Year of manufacture :	1990.
■ Total flight time :	2153.20 (on 12/02/01).
■ Empty weight:	997kg.
■ Weight at time of mishap:	Could not be calculated. No indication that it was out of limits.
■ CG:	Idem.

1.6.2. Engine.

■ Manufacturer:	LYCOMING.
■ Type:	T10-540 AB1AD.
■ Serial NR:	L-8997-61A.
■ Total flight time:	2153.20 (on 12/02/01).
■ Total since overhaul:	NA.

1.6.3. Propeller.

- Manufacturer: HARZELL.
- Type: HC-C2YK 1BF.
- Serial NR: CH29618.
- Total Flight Time: Could not be found.
- Total since overhaul: 96.15.

1.6.4. Last inspections.

- 100Hr inspection: 28/10/00 at 2108.20Hr.
- 50Hr inspection: 12/02/01 at 2153.20Hr.

1.7. Meteorological information.

1.7.1. Weather conditions at BEEK (05.00-07.00).

Wind (1500ft): 230-250, 20-25Kts.
 Visibility (1500ft): 0-2Km.
 Cloudiness: SCT 1000ft
 SCT CB 1200-1500ft, tops above FL 100
 BKN 2000-2500ft.
 Freezing level 4000ft.
 Icing: moderate above 4000ft.
 Turbulence: moderate to severe.

1.7.2. Weather conditions at BRÜGGEN (ETUR).

05.00.

Visibility: 9Km.
 Cloudiness: BKN-ST 1200ft
 BKN-SC.2400ft
 OVC-SC 5000ft.

Wind at 5000ft: 280°-20Kts.

06.00.

Visibility: 10Km.
 Cloudiness: SCT-SC 1200ft
 BKN-AC.8000ft.

07.00.

Visibility: 8Km.
 Cloudiness: OVC-SC 1100ft.
 Significant Wx: showers.

1.7.3. Weather conditions at KLEINE-BROGEL (EBBL).

06.00.

Visibility: 3.2Km.
 Cloudiness: 2SC 1400ft
 4SC 2200ft
 7SC 4200ft.

Significant Wx: rain.

07.00.

Visibility: 6Km.
 Cloudiness: 3SC 1200ft
 4SC 2200ft
 7SC 3000ft.

Significant Wx: showers in past hour.

1.7.4. Weather radar picture.

The 06.30 picture of the KNMI weather radar is at page 4 of annex 1.

1.8. Aids to navigation.

NA.

1.9. Preparation of the flight.

The board has very few information's on the way the flight was planned. Obviously, the crew got weather information, possibly on the net, because some weather charts relevant to the time of the mishap were recovered among other papers on the site (index 5 at map page 1 of annex 1). The most experienced pilot and the only one heaving an IFR qualification was sitting, according to witnesses, in the right seat, while the flight instruments are in front of the left seat pilot.

1.10. Communications.

A copy of the radio communications between the PH-UBG and BRUSSELS ACC is at annex 4.

1.11. Aerodrome information.

NA.

1.12. Flight recorders.

The PH-UBG was not equipped with on board recorders and was not required to.

1.13. Wreckage and impact information.

1.13.1. Description of the impact site.

Preliminary remark: a map of the site is to be found at page 1 of annex 1. All references mentioned in this paragraph refer to it. Pictures are at annex 2.

The PH-UBG is disintegrated and the parts are spread on a little bit more than 2km across woods and fields southeast of NEEROETEREN. The general direction of the site is 065-245. Starting from the eastern side of the site and following the trajectory, the first pieces found are coming from the cabin (insulation material, plastic from the interior fittings, pieces of the canopy/windshield, papers,...) and from the wings (pieces of skin plates, pieces of ribs, pieces of wingtips,...), mainly the right one. Photos 01 and 02 show some of these pieces. Then comes a part of the right flap (Ref 19 and photo 03) and the right aileron (Ref 21). Close to them along a small road, a dead goose has been found (Ref 20 and photo 04). In the woods, the pieces are becoming bigger when approaching the main part of the wreckage: horizontal tail (Ref 23 and picture 05), rear seat (Ref 24), part of the canopy frame (Ref 24), left aileron (Ref 24), amongst other smaller fragments (pieces of flight control rods, ribs, sheared plates,...pictures 06 and 07). The right wing (Ref 30 and photo 08) is at the edge of the wood alongside a garden. The fuselage and the left wing (Ref 31, picture 09), both inverted, are in a meadow 70m away from there. There is only one rather deep crater under the fuselage, which indicates that it did not rebound. There is no indication that it skidded on the ground. The bodies of both occupants (Ref 32 and 33) are respectively 40 and 50m from the fuselage. They made an impact approximately 20cm deep in the rather soft soil before rebounding a few meters.

1.13.2. Information on the wreckage.

The wreckage is completely disintegrated. The biggest parts are:

- the fuselage with the vertical tail still attached
- both wings with missing parts at the tips (as from the tips of the flaps)
- the horizontal tail.

1.13.2.1. Fuselage (annex 2, picture 09).

The fuselage is inverted. The central part, behind the cockpit, is partially burned. The battery most probably caused this fire after impact. The vertical tail is still attached but is tilted 180°. The rudder is still attached by the lower hinge. The only visible propeller blade doesn't give any clue on the power. The nose gear is down. The biggest part of the cockpit (doors, roof, sides, back seat) are in the woods approximately 300m from the fuselage.

1.13.2.2. Left wing (annex 2, pictures 10 and 11).

Detached from the fuselage and laying a few meters from it. Parts of the left side of the cockpit together with some straps are still attached to it. The wing tip as from the tip of the flap is missing except the spar that is bent backwards without any trace of mud. The first part of the left wing that has been found along the trajectory (part of the upper wing skin, annex 1, page 1, Ref 6) was found approximately 1250m from the main parts of the wreckage, the left aileron is approximately 400m from it (annex 1, page 1, Ref 24). The flap is partially down. The left main landing gear is down.

1.13.2.3. Right wing (annex 2, picture 08).

Detached from the fuselage, it has been found about 70m from it upstream the trajectory. Here also, almost all the wing tip as from the extremity of the flap is missing. The biggest part of the flap is missing as well. Only the inner part of it is still attached through the inner hinge. The rest has been found at 750m from the fuselage (annex 1, page 1, Ref 19). The aileron is at 540m from the main impact point (annex 1, page 1, Ref 21). The

first part of the right wing along the trajectory (part of a plate of the upper wing) has been recovered some 1800m from the fuselage (annex 1, page 1, Ref 2). The right main landing gear is down. An impact marked with green painting is visible on top of the wing starting from the leading edge (annex 2, picture 12).

1.13.2.4. Horizontal tail (annex 2, picture 05).

Detached from the fuselage, the horizontal tail has been found approximately 400m from it. It is in one piece. The trim surfaces are bent upwards.

1.14. Fire.

There was a fire in the central part of the fuselage just behind the cockpit, most probably caused by the battery. There is no indication of airborne fire.

1.15. Survivability.

The force of the ground impact did not let any chance of survival to the persons on board, besides this, they were most probably ejected airborne during the latest phase of the disintegration of the plane.

1.16. Witness statements.

One witness observed the final part of the disintegration of the aircraft. A copy of her statement is at annex 3. Some other witnesses stated how the pilots were sitting in the aircraft, but they didn't make any written statement.

2.1. Wreckage repartition – sequence of disintegration.

The repartition of the parts on the ground shows that the disintegration started with the right wing. Quite a lot of parts of it (plates, ribs, wheel bay) were found in the first hundreds of meters of the site. The left wing started disintegrating very soon after the right one as shown by the position of the first plate of it (annex 1, page 1, Ref 6). It is important to realize that the first parts of the wings found are coming from the wingtips, which is typical of disintegration caused by exceeding the ultimate load factor (ULF).

In the mean time, the cockpit started disintegrating. Very soon cabin insulation material (annex 1, page 1, Ref 1), documents usually found in the cabin (weather charts, parts of the aircraft flight log found at the place referenced 5 at the map at annex 1, page 1). These elements were blown by the wind in the direction of the beginning of the site. At short distance from there, one begins finding the first pieces of windshield and canopy perspex.

The wings went on disintegrating, the right one more than the left one as shown by the repartition of the fragments. The right flap then sheared off. The external part of it separated from the wing. Almost immediately after that, both ailerons detached from the wings, first the right then the left one, the latter found approximately at the same height as the horizontal tail that separated from the fuselage as well. In fact, the complete rear cone of the fuselage where the horizontal tail is attached failed and separated in flight. This is also typical of exceeding the ULF. Many parts coming from the cabin (roof, sides, doors, rear seat, interior fittings) are found between the place where the horizontal tail was found and the fuselage. The failure of the main wing spar caused the complete destruction of the cabin, both wings being bent upwards. Both occupants have most probably been ejected at that moment or very soon after. The separation of the horizontal tail causes a violent pitch down of the aircraft and the external attaching points of the harnesses stayed with the sides of the cabin that remained with the wings.

The crater dug by the front part of the fuselage is rather deep. Both occupants are found 40 and 50m away from that point and penetrated the ground by approximately 20cm. All this indicates a high energy, thus a high speed.

2.2. Analysis in the workshop.

The aircraft has been reconstructed in the Belgian CAA workshop. This confirmed that the totality of the aircraft was on the site, thus that the disintegration started approximately above the beginning of it.

A team of SABENA Technics engineers analyzed the main failures and distortions of the wings and of the horizontal tail. Their report is at annex 5. They conclude that the failure of the wing tips is typical of overspeed combined with asymmetrical loading. This could happen during a high-speed pull-up combined with a rather fast rolling maneuver.

2.3. Weather.

The weather conditions were good in terms of visibility and ceiling. But some moderate to severe turbulence was forecasted, as was moderate icing above 4000ft. The PH-UBG was flying at 6000ft in an area of relatively heavy showers (see weather radar map and trajectory at annex 1). It most probably encountered heavy turbulence. He might also have sustained some icing with the relevant consequences in terms of gross weight.

2.4. Trajectory of the PH-UBG.

The map at page 6 of annex 1 is the superposition of the radar image of the KNMI at 06.30 (page 4 of the same annex) on a normal navigation map. The final part (from 06.27.04 to 06.30.05) of the BRUSSELS CONTROL radar track has been reproduced. The accident site, the final heading of the aircraft and the radio calls have been added as well.

For the good understanding of the following paragraphs, one should bear in mind that the aircraft was flying in IMC.

Between 06.28.28 and 06.29.19, the altitude changes constantly between FL 60 and 62 (the aircraft was supposed to maintain FL 60). He flies at that moment between a zone colored in pink meaning heavy precipitation (3-10mm/hr) on the weather radar picture and another one depicted in black meaning very heavy precipitation (more than 30mm/hr). The turbulence in such a zone is usually heavy. The speed of the aircraft is about 145 KCAS. The recommended speed in turbulence for this type of aircraft is 129 KIAS (130KCAS).

Between 06.29.19 and 06.29.37, the PH-UBG climbs at an average VVI of 2700ft/min. According to the aircraft flight manual, the normal VVI of the TRINIDAD at 6000ft is around 1000ft/min at 95 KIAS. During the climb, the speed drops to 135 KIAS. It is thus completely impossible that the pilot initiated this climb. It is due to a heavy updraft. During this climb, the aircraft might have sustained a rather heavy load factor. At 06.29.37, the flight level is FL 68.

At 06.29.42, the PH-UBG is down to level 67 and starts a steep right turn (average $\pm 10^\circ/\text{sec}$) still descending. During this turn, the speed drops to 98 KIAS while the average rate of descent is 3450ft/min. This reduction of the speed might have been caused by an increase of the load factor combined with a reduction of the power. A $10^\circ/\text{sec}$ level turn would require a load factor of 1.5 G. During this turn, the aircraft enters a zone colored in black on the weather radar picture, which means more precipitation and turbulence and possibility to be submitted to relatively high load factors. Why this steep turn? There are several hypotheses. The pilot does it intentionally estimating that the weather is unsuitable and decides to go back to the departure airfield. He might also have lost control of the aircraft due to spatial disorientation. The aircraft might also have already sustained some structural damage due to the previously sustained load factors. The aircraft might also have met the scissors effect that appears at the limit between an updraft and a downdraft initiating a right roll.

At 06.29.56, the PH-UBG is steady on a heading of 065 and carries on descending to FL 60. The speed increases again up to 123 KIAS (at 06.30.05). At that moment, the aircraft seems to be under control, but the pilot sends an almost unreadable message (the only clearly readable word is "problems") and the radar loses control immediately after that.

The aircraft disintegrates on a heading of 245. Between the moment where the radar loses contact and the beginning of the disintegration, we have no information on its trajectory. It seems that it made at least one 180 to the right. The pilot might have started a turn to resume his planned route during which the aircraft might have encountered some heavy turbulence that made it sustain a load factor higher than the ULF initiating the disintegration. It is also possible that the pilot underwent some vertigo and consequently lost control of the aircraft. In that case he might have accelerated in a dive and exceeded the limit if not ultimate load factor above the V_{NA} in an attempt to recover control. Or at least (see conclusions of the SABENA Technics team at annex 5), have performed a roll maneuver combined with a hard pull up. A possible icing of the aircraft could only have worsened the problem. At the end of the disintegration, the energy thus the speed was high as demonstrated by the depth of the impacts in the ground.

2.5. Witnesses statements.

The only eyewitness only observed the final phase of the flight and of the disintegration. This statement confirms, if needed, the loss of control and the disintegration.

2.6. Hypothesis on the pilot's actions.

The pilot in the left seat was experienced but had no IFR qualification. The pilot in the right seat was IFR qualified, and much more experienced. It is strange to some extent that the most experienced and qualified person did not take the left seat in those rather difficult weather conditions, the complete instrument set being in front of the left seat. Anyway, the aircraft being double control, it is not impossible that the right seater might have taken the control.

Looking at the radar track, one can notice that between the take off and the first contact with BRUSSELS ACC, the heading and altitude (supposed stabilized) are constantly varying. It flies inbound ONT in an area where the turbulence is probably high which could explain that unsteadiness of the trajectory.

Immediately after the first radio contact, the ATC authorizes the PH-UBG towards ANT. The pilot understands this as a clearance to carry on to ONT. After a little bit less than one minute, the controller not observing any change in the heading, gives him a correction towards ANT. Why this mistake on behalf of this experienced pilot? One may suppose that the flight conditions were so that he had to concentrate all his attention on the control of the aircraft.

After the correction given by the controller, the pilot takes the heading inbound ANT. Here again heading and altitude are slightly unsteady up to the moment where the aircraft starts a steep climb. One will never know what actions did the pilot take at that moment. He most probably tried to go back to the prescribed altitude by going down, maybe while turning to the right, maybe by just pushing in the stick.

The right hand turn might have been initiated by him or by turbulence. In the later case, why did he not try to resume immediately his heading? It is also possible that he underwent some spatial disorientation that made him initiate the turn. He gives a call announcing "problems" immediately after that. These might be flight controls problems due to some distortion of the structure caused by turbulence. Anyway the pilot seems to have recovered control of his aircraft that flies on a heading that is not the one given to him by the ATC, but the trajectory is almost steady at FL 60.

Fourteen seconds later, the PH-UBG disappears from the radar screens. What happened during that time? Had the process of disintegration of the plane started with new violent turbulence? Had it been caused by the pilot's spatial disorientation and loss of control followed by violent maneuvers in order to try and regain control of the plane, and/or exceeding the V_{NE} with brutal action on the controls in order to do so?

One is reduced to speculations. Anyway the PH-UBG disintegrated in the air following an overstress, which might have been caused by the pilot in an attempt to regain control of his machine, which he had lost for one of the causes suggested previously.

2.7. Eventuality of birdstrike.

The dead goose that was found in the middle of the site (annex 1, page 1, Ref 20) is not heavily damaged. It was found close to a power line. If a collision between the bird and the aircraft were the cause of a loss of control followed by the disintegration, the remains of the goose would have been found at the beginning of the site. Besides this, they would have been much more damaged than they were. The birdstrike can thus be excluded as a cause for this mishap. It happens to be just a coincidence. The goose most probably impacted the wires of the power line some time before the investigation started.

3 CONCLUSIONS - PROBABLE CAUSES OF THE MISHAP

3.1. Conclusions.

- 3.1.1. Nothing in the technical history of the PH-UBG indicates that he could have had a problem preventing the flight.
- 3.1.2. The pilot in the left seat was experienced but not IFR qualified. The one in the right seat was a very experienced pilot with IFR qualification.
- 3.1.3. The weather was good as far as visibility and ceiling are concerned, but moderate to severe turbulence was forecasted. Moderate icing was forecasted above 4000ft as well.
- 3.1.4. The aircraft entered a zone of heavy turbulence with possible icing.
- 3.1.5. The trajectory of the PH-UBG became erratic in terms of altitude and heading due to turbulence and/or spatial disorientation of the pilot.
- 3.1.6. Icing might have increased the aircraft weight.
- 3.1.7. After having disappeared from the radar screens, the aircraft disintegrated in flight.
- 3.1.8. Both occupants were fatally injured in the mishap.

3.2. Probable causes.

The possible causes of the mishap are:

- 3.2.1. Exceeding of the ultimate load factor due to heavy turbulence.
- 3.2.2. Loss of control of the aircraft due to spatial disorientation of the pilot followed by exceeding of the ultimate load factor during an attempt to recover control.
- 3.2.3. Combination of both of the above.
- 3.2.4. If icing did occur, it could only have worsened the problem.

4 INFRINGEMENT OF REGULATIONS

No infringement of the regulations was discovered.

Done in Brussels, on

A handwritten signature in black ink, appearing to read 'P. Smeets', with a large, sweeping flourish extending from the end of the signature.

Richard Taverniers
Chief Inspector of Accidents
Chairman

Paul Smeets, Lic
Member

ANNEXES.

ANNEX 1 – Diagrams – Maps.

ANNEX 2 – Photographs.

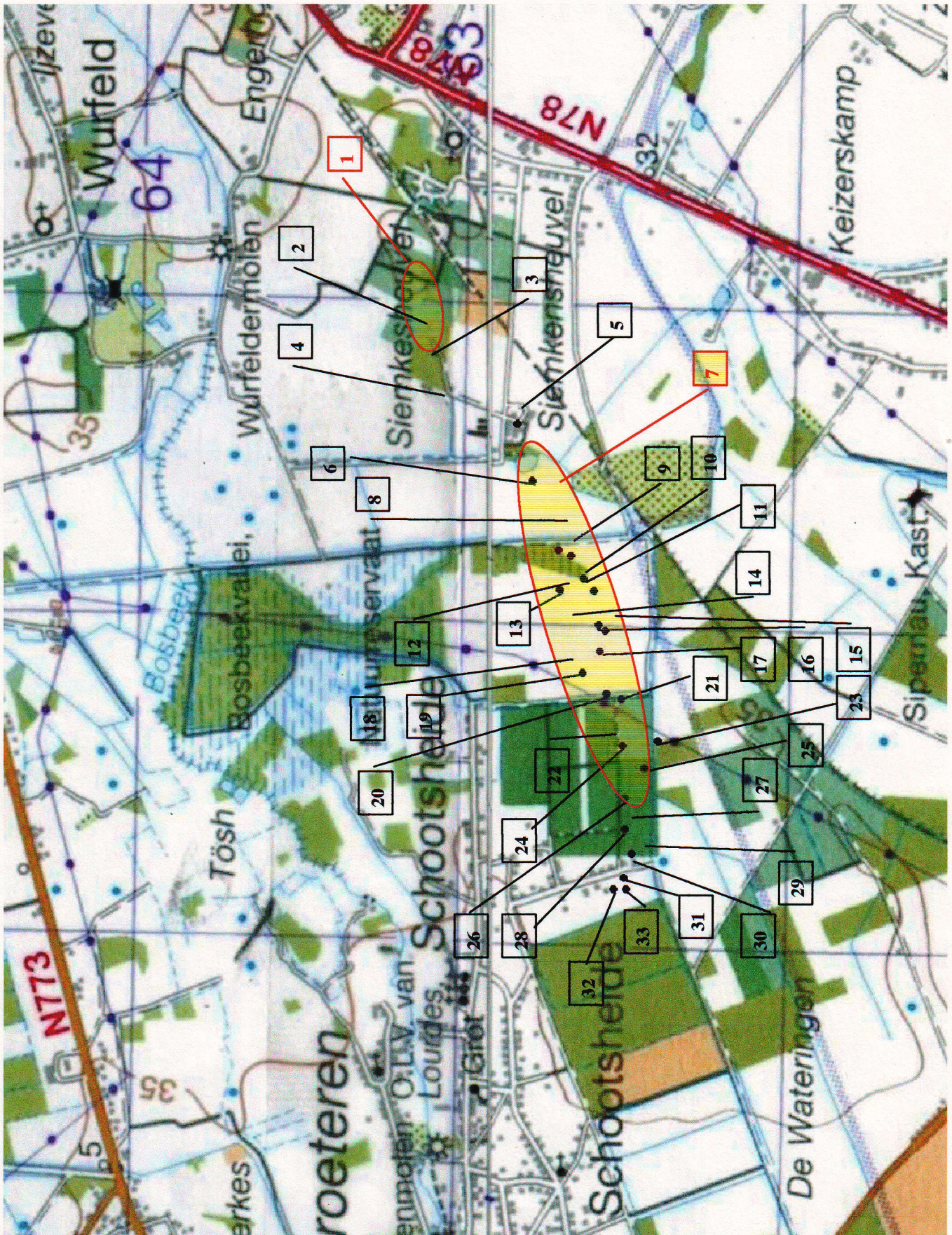
ANNEX 3 – Witness statements.

ANNEX 4 – Transcript of radio communications.

ANNEX 5 – Analysis report of SABENA Technics.

Diagrams - Maps.

Map of the site.



Legend.

N°	PHOTOS	DESCRIPTION	REMARKS	
1		Rock wool	Cabin insulation	
2	H1	Plate upper wing, right wing tip		
3	H2	Plate in front of right flap		
4	H4	Perspex right position light		
5		Papers on house roof		
6		Plate upper wing left wing (with green stripe)		
7		Area where numerous pieces of perspex and white plastic (wing tips) were found. One find also pieces of interior fittings (grey plastic, carpet, ashtray, pieces of dashboard,...)		
8	H2	Plate in front of right flap		
9	I-32	Plates right wing tip	Upper wing plate, in front of the aileron	
10	H3	Wing skin along right aileron		
11	I-33	Part of plate upper wing, right wing		
12	I-35	Part of wheel bay	No grease	
13	I-36	Part of rib right wing		
14		Part of wheel bay	With grease	
15	I-31	Plate right wing with part of registration		
16		Navigation light		
17	I-34	Piece upper wing right wing	Tank	
18		Right tank float		
19	I-29-30	Extremity right flap Piece of rib fm right wing tip		
20	I-28	Dead goose		
21		Right aileron		
22		Wing de-froster tube		
23	I-20-22	Horizontal tail		
24	I-17-19	Rear seat Piece of cabin upholstery Left aileron Piece of right leading edge with part of rib		
25		Piece of rod right aileron		
26	I-15-16	Doors and rear part of roof Left cabin side Side panel Piece of belly Piece of rib Tow bar Tip of right beam		
27		Piece of leading edge left wing		
28		Left step		
29	H5	Piece of plate upper wing - left	Tank	
30	I-25-27	Right wing		
31	I-1-14 I-23-24	Main wreckage		
32		Pilot		
33		Passenger		