COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 153/CENIPA/2019

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PP-BSS**
MODEL:	**C90GT**
DATE:	**02DEC2019**

NOTICE

According to the Law nº 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination and execution of the activities of investigation and prevention of aeronautical accidents.

The elaboration of this Final Report was conducted taking into account the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the different factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree nº 21713, dated 27 August 1946.

Thus, it is worth highlighting the importance of protecting the persons who provide information regarding an aeronautical accident. The utilization of this report for punitive purposes maculates the principle of "non-self-incrimination" derived from the "right to remain silent" sheltered by the Federal Constitution.

Consequently, the use of this report for any purpose other than that of preventing future accidents, may induce to erroneous interpretations and conclusions.

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Taking into account the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

SYNOPSIS

This is the Final Report of the 02DEC2019 accident with the C90GT aircraft model, registration PP-BSS. The accident was classified as “[CFIT] Controlled Flight Into Terrain”.

The aircraft took off from the Comandante Rolim Adolfo Amaro Aerodrome (SBJD), Jundiaí - SP, to the Campo de Marte Aerodrome (SBMT), São Paulo - SP.

Due to meteorological conditions at the destination, the pilot was instructed to return to the Aerodrome of origin. During this journey, the plane collided in controlled flight into terrain.

The aircraft was destroyed.

The pilot suffered fatal injuries.

An Accredited Representative of the Transportation Safety Board (TSB) - Canada, (State where the engines were manufactured) was designated for participation in the investigation.

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AATD	Advanced Aviation Training Device
AIC	Aeronautical Information Circular
ANAC	Brazil's National Civil Aviation Agency
APP-SP	Approach Control – São Paulo
ATC	Air Traffic Control
ATZ	Aerodrome Traffic Zone
BECMG	Becoming
BKN	Broken (5-7 oktas)
BR	Mist
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CFIT	Controlled Flight Into Terrain
CIV	Pilot`s Flight Logbook
CMA	Aeronautical Medical Certificate
CTR	Control Zone
CVR	Cockpit Voice Recorder
DECEA	Airspace Control Department
DZ	Drizzle
EGPWS	Enhanced Ground Proximity Warning System
FEW	Few (1 and 2 oktas)
FSTD	Flight Simulation Training Devices
GOES	Geostationary Operational Environmental Satellite
IAM	Annual Maintenance Inspection
ICA	Command of Aeronautics' Instruction
IFR	Instrument Flight Rules
IFRA	Instrument Flight Rating - Airplane
INFRAERO	Brazilian Airport Infrastructure Company
KT	Knots
METAR	Meteorological Aerodrome Report
MLTE	Airplane Multi Engine Land Rating
OVC	Overcast (8 oktas)
PCM	Commercial Pilot License – Airplane
PIC	Pilot in Command
PN	Part Number
PPR	Private Pilot License – Airplane
RADAR	Radio Detection And Ranging
RBAC	Brazilian Civil Aviation Regulation

RBHA	Brazilian Aeronautical Certification Regulation
REA	Special Aircraft Routes
RMK	Remark
RPM	Rotations Per Minute
SACI	Integrated Civil Aviation Information System
SBGR	ICAO Location Designator - Governador André Franco Montoro International Airport, Guarulhos - SP
SBJD	ICAO Location Designator - Comandante Rolim Adolfo Amaro Aerodrome, Jundiaí - SP
SBMT	ICAO Location Designator - Campo de Marte Aerodrome, São Paulo - SP
SCT	Scattered (3 and 4 oktas)
SIC	Second in Command
SIPAER	Aeronautical Accident Investigation and Prevention System
SPECI	Aviation Selected Special Weather Report
SN	Serial Number
TAF	Terminal Aerodrome Forecast
TMA	Terminal Control Area – São Paulo
TPP	Registration Category of Private Service - Aircraft
TSB	Transportation Safety Board
UTC	Universal Time Coordinated
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

1. FACTUAL INFORMATION.

Aircraft	**Model:** C90GT **Registration:** PP-BSS **Manufacturer:** Hawker Beechcraft	**Operator:** Private
Occurrence	**Date/time:** 02DEC2019 - 0902 UTC **Location:** Wooded area in the municipality of Caieiras - SP **Lat.** 23°24'42"S **Long.** 046°42'14"W **Municipality – State:** Caieiras – SP	**Type(s):** "[CFIT] Controlled Flight Into Terrain" **Subtype(s):** Nil

1.1 History of the flight.

The aircraft took off from the Comandante Rolim Adolfo Amaro Aerodrome (SBJD), Jundiaí - SP, to the Campo de Marte Aerodrome (SBMT), São Paulo - SP, at about 0850 (UTC), in order to carry out a transfer flight, with a pilot on board.

The flight was being conducted under Visual Flight Rules (VFR). Due to the meteorological conditions of the destination, the pilot was instructed to return to the Aerodrome of origin. During this journey, the air traffic control lost contact with the aircraft.

Search teams located the wreckage of the plane in a wooded area in the municipality of Caieiras - SP.

The aircraft was destroyed.

The pilot suffered fatal injuries.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	1	-	-
Serious	-	-	-
Minor	-	-	-
None	-	-	-

1.3 Damage to the aircraft.

The aircraft was destroyed.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	PIC
Total	Unknown
Total in the last 30 days	00:00
Total in the last 24 hours	00:00
In this type of aircraft	211:36
In this type in the last 30 days	00:00
In this type in the last 24 hours	00:00

N.B.: The data related to the flown hours were obtained through the digital CIV records, available at the ANAC's SACI.

1.5.2 Personnel training.

The PIC took the PPR course at the Biritiba Mirim Aeroclub - SP, in 1997.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PCM License and had valid MLTE and IFRA Ratings.

1.5.4 Qualification and flight experience.

The Digital CIV records indicated that the pilot had been operating the C90GT aircraft, registration PP-BSS, since January 2018 and that he had SBMT Aerodrome as a frequent destination. His last flight recorded in this system took place on 23SEPT2019.

Much of the pilot's operational history developed when he worked for two air taxi companies between September 2004 and January 2018. Although this data was not recorded in the digital CIV, according to statements from these organizations, in that period, the crewman would have accumulated more than 4,500 flight hours as a PIC.

In these companies, he flew the following aircraft models: 208/208B Caravan, EMB-820C Navajo and EMB-821 Carajá.

According to a CV submitted by the family, he had a PCM license and over 6,000 total flight hours, having worked in different private companies. Based on this curriculum, it was found that the PIC had experience in single-engine, multi-engine, type and instrument flight equipment. For the past two years, he has been in business aviation, flying the King Air C90GT.

The pilot had a total of 1,055 hours of instrument flight time recorded in the digital CIV, and the last flight for the revalidation of the MLTE and IFRA Ratings took place on 24AUG2019, in a PA-34 model aircraft.

The digital CIV also included the launch of one hour of IFR performed in an AATD simulator, on 22AUG2019. The IFRA revalidation flight was conducted in a PA-34 model aircraft and there was a record of 7 hours and 16 minutes of operation of the PP-BSS aircraft in an IFR flight in September 2019.

The RBAC No. 61, in force at the time of the accident, established the following requirements for proof of recent experience:

> 61.21 Recent Experience
>
> (a) Except for the deadlines established in section 61.19 of these Regulations, a pilot may only act as pilot-in-command of an aircraft if, within the preceding 90 (ninety) days, he has performed:
>
> (1) for day flight operations:
>
> [...]
>
> (ii) in the case of other aircraft, at least 3 (three) take-offs and 3 (three) landings during the day or night, during which the controls of the aircraft of the same category and class/type have actually been operated;
>
> [...]
>
> (b) To work as pilot-in-command of an aircraft on instrument flights, a pilot must:
>
> (1) have the recent experience provided for in paragraph 61.21(a); and
>
> (2) have, in the last 6 (six) months:
>
> (i) performed at least 6 (six) approaches under instrument flight rules in the category of aircraft; or
>
> (ii) has passed an instrument flight proficiency test in the aircraft category;
>
> (c) The procedures set forth in paragraph 61.21(b)(2) above may be performed in an ANAC-qualified FSTD representing the category of aircraft to be flown.

Thus, with the information collected, it was found that the pilot was qualified and had experience in the type of flight.

1.5.5 Validity of medical certificate.

The pilot had valid CMA.

1.6 Aircraft information.

The aircraft, serial number LJ-1839, was manufactured by Hawker Beechcraft in 2007 and was enrolled in the TPP.

The aircraft had valid CA.

The airframe, engines and propellers logbook records were updated.

The last inspection of the aircraft, the IAM type, was carried out on 18JUN2019 by the maintenance organization *Construtora Nacional de Aviões* Ltd. - CONAL, in Sorocaba - SP. It was not possible to find out about the flown hours after the inspection, as the logbook was destroyed in the fire that followed the plane's collision with the ground.

The aircraft was equipped with an EGPWS which, among other functions, provided ground proximity alerts during flight.

1.7 Meteorological information.

In the course of the investigation, the METAR and the TAF were collected from the Aerodromes closest to the accident site, as shown in Figure 1.

Figure 1 - Image showing the position of the Aerodromes closest to the accident site.
Source: Adapted from Google Earth.

The METARs at the SBMT Aerodrome, 12km away from the accident site, had the following information:

METAR SBMT 020900Z 11006KT 6000 SCT006 BKN009 BKN013 19/18 Q1017=

METAR SBMT 021000Z 15007KT 7000 FEW009 BKN011 19/17 Q1017=

The SBMT TAF, valid from 0600 (UTC) until 1800 (UTC) on 02DEC2019, had the following information:

TAF SBMT 020015Z 0206/0218 15008KT 8000 BKN013 TN18/0209Z TX20/0217Z BECMG 0207/0209 12008KT BECMG 0212/0214 9999 BKN025 BECMG 0214/0216 15010KT RMK PGF=

There were also two SPECI for SBMT, issued at 0916 (UTC) and 0933 (UTC), respectively, which had the following information:

SPECI SBMT 020916Z 17006KT 1000 -DZ BR FEW006 OVC009 19/17 Q1017=

SPECI SBMT 020933Z 17007KT 5000 BR FEW006 BKN009 18/17 Q1017=

The METARs at the Governador André Franco Montoro International Aerodrome (SBGR), 23km away from the accident site, had the following information:

METAR SBGR 020800Z 13003KT 7000 FEW015 SCT030 BKN083 19/17 Q1016=

METAR SBGR 020900Z 14002KT 7000 FEW015 SCT026 BKN100 19/17 Q1017=

METAR SBGR 021000Z 16006KT 4000 -RA BR SCT006 BKN011 BKN020 18/18 Q1018=

The SBGR TAF, valid from 0600 (UTC) on 02DEC2019 until 1200 (UTC) on 03DEC2019, had the following information:

TAF SBGR 020015Z 0206/0312 15008KT 8000 BKN011 TX19/0217Z TN14/0309Z BECMG 0211/0213 12005KT 9999 BKN020 BECMG 0214/0216 BKN030 BECMG 0216/0218 15010KT BECMG 0220/0222 BKN011 BECMG 0222/0224 12005KT BECMG 0301/0303 OVC009 RMK PGF=

There was also a SPECI for SBGR, issued at 0925 (UTC), which contained the following information:

SPECI SBGR 020925Z 12003KT 6000 BKN011 BKN017 19/18 Q1017=

The GOES 16 satellite image showed low cloudiness over the entire state of São Paulo (Figure 2).

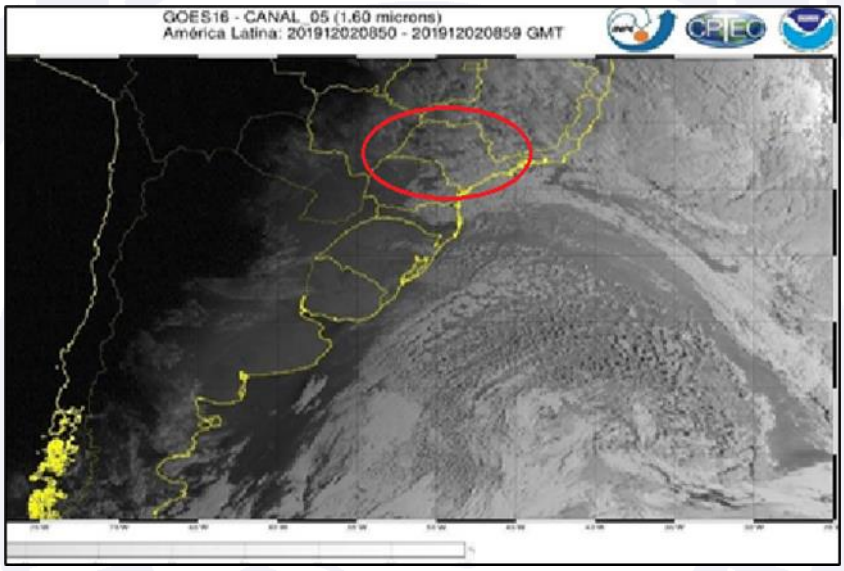

Figure 2 - Image of the GOES 16 satellite at 08:59 (UTC) on 02DEC2019.

It was found that conditions were not favorable for visual flight, with visibility restrictions and clouds based close to 1,000 ft in height.

1.8 Aids to navigation.

Nil.

1.9 Communications.

From the transcripts of the communication audios between the PP-BSS and the control agencies, it was found that the PIC kept radio contact with the APP-SP and that there was no technical abnormality of communication during the flight.

In order to support the analysis of the sequence of events that preceded the collision of the aircraft with the ground, the Investigation Team highlighted some transmissions that can help in understanding the dynamics of the accident.

To record the times described in this field, the UTC was used as a reference.

HOUR (UTC)	ISSUER	TRANSCRIPTION
08:55:37	APP-SP	BSS, I inform you that Marte will open at zero zero only for helicopters due to weather conditions.
08:55:46	PP-BSS	Jeez... well... let's get closer than. If anything happens, we go back to Jundiaí from there.
08:59:26	APP-SP	BSS, are you visual in the sector?
08:59:29	PP-BSS	Visual.
08.59:34	APP-SP	BSS, do you still copy?
08:59:58	APP-SP	The Marte tower said it operates below minimums, it`s for you to return.
09:00:02	PP-BSS	Okay then... let's get back then. Can I turn left on the heading of... uh... MORATO?
09:00:11	APP-SP	Affirmative, BSS.
09:00:13	PP-BSS	It`s MORATO heading, then.
09:01:19	PP-BSS	Keeping MORATO heading now, BSS.
09:01:22	APP-SP	Affirmative BSS. Report in LAGOA.
09:01:25	PP-BSS	It will report in LAGOA.
09:02:14	APP-SP	BSS, I ask that you keep the Echo corridor. You are to the right of the corridor.
09:02:28	APP-SP	SS São Paulo?

1.10 Aerodrome information.

The Campo de Marte Aerodrome (SBMT), São Paulo - SP was public/military, managed by the INFRAERO and operated under VFR, day and night.

The runway was made of asphalt, with 12/30 thresholds, dimensions of 1,600 x 45 m, with an elevation of 2,371 ft.

1.11 Flight recorders.

The aircraft was equipped with a CVR, Part Number (PN) 2100-1010-00, Serial Number (SN) 000434820/SD 53038, model FA 2100, manufactured by L3 Harris Technologies (Figure 3).

Figure 3 – The CVR image recorded at the accident site.

The voice recorder was forwarded to the TSB - Canada, State where the engine was manufactured, and where the data was successfully downloaded.

The equipment worked normally and contained data relating to the flight of the event. The information found allowed performing a spectral analysis of the engine noise and identifying the alarms emitted by the aircraft.

From the data obtained, it was found that the rotation of the propellers during the entire flight, from the take-off to the moment of collision, as well as several alerts issued and a sequence of impact sounds (Figure 4).

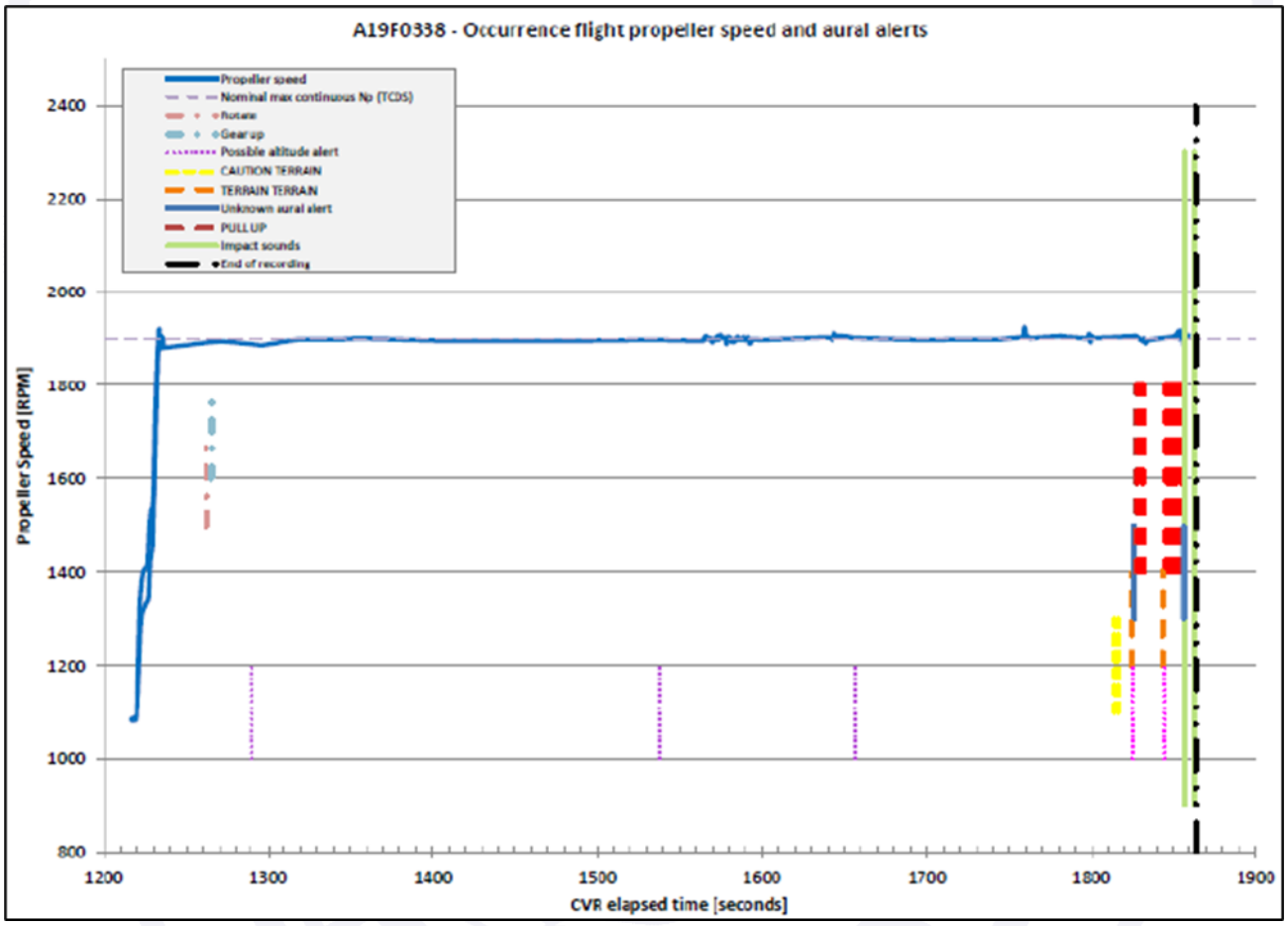

Figure 4 - Propeller rotation graph and the alerts recorded by the CVR.

The analysis of the recorded data showed that the EGPWS issued several alerts related to the proximity to the ground, such as “Caution Terrain”, “Terrain, Terrain” and “Pull Up”. In the last moments of the recording, the CVR recorded sounds that were identified as being from impacts (Figure 5).

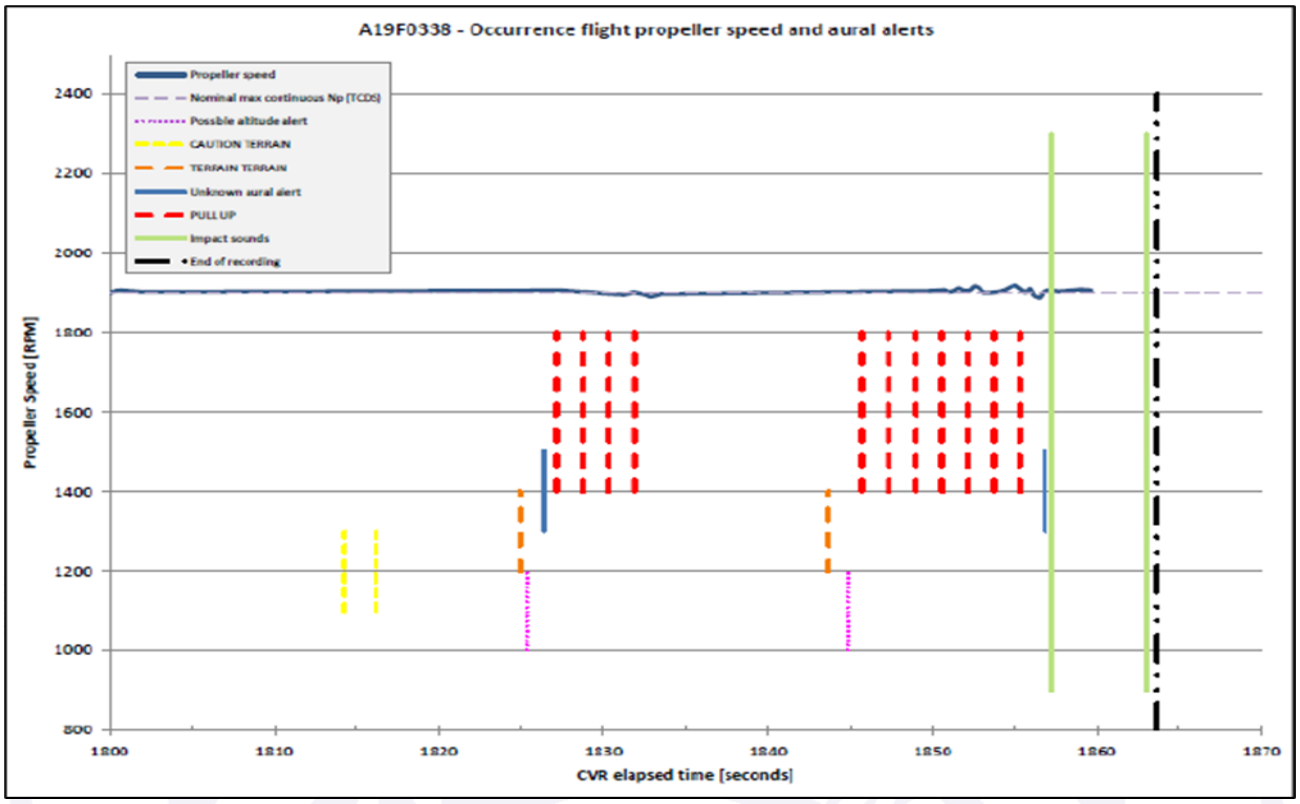

Figure 5 - Graph of propeller rotation and sounds recorded by the CVR in the final moments of the flight.

The information extracted from the CVR allowed us to observe that, from the take-off of SBJD, the rotation of both propellers increased and stabilized at approximately 1,900 RPM, remaining in this regime until the moment of impact.

No tensions were observed in the pilot's voice that would indicate the existence of any abnormality in the plane and its systems. He did not utter any expression that indicated the existence of an abnormal situation in the cabin.

1.12 Wreckage and impact information.

The accident occurred in a mountainous area, in the municipality of Caieiras - SP, approximately 12 km from SBMT and 32 km from SBJD.

The distribution of the wreckage was linear (Figure 6).

Figure 6 - Top view of the crash site.

The first impact occurred against the top of some trees (Figure 7).

Figure 7 - Image of the point of the first impact against the top of the trees.

The engines were found opposite the side corresponding to their installation in the aircraft and the direction of flight, indicating that the aircraft rotated on its longitudinal axis during the impact against the trees (Figure 8).

Figure 8 - Impacted tree, aircraft trajectory and final position of the engines.

The cabin wreckage was found approximately 60 meters from the site of the first impact.

Figure 9 - Image of the cockpit wreckage.

The engines were about 30 meters from the point of first impact and 4.5 meters apart.

Figure 10 - Image of the left engine.

Figure 11 - Image of the right engine.

The empennage was found approximately 35 meters away.

Upon impact with the ground, the aircraft caught fire and was consumed by it.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

In the last three inspections carried out, the pilot was considered able for air activity. His medical history had records of hypercholesterolemia, hypertriglyceridemia and hyperuricemia.

In the last inspection carried out, he reported high blood pressure. However, physical examination and measurement showed that her blood pressure was normal. The PIC stated that he did not use medication for this condition.

The pilot reported in all his exams that he suffered from allergic rhinitis but did not use antihistamine medications.

The necroscopic examination showed that the pilot's cause of death was multiple trauma resulting from the impact of the aircraft on the ground.

The toxicological examination did not reveal the presence of psychoactive substances or alcohol in his body.

It was found that the pilot had not flown in the twenty-four hours prior to the accident and that, according to family members, he had slept on average, about eight hours in the days prior to the accident.

Thus, there was no evidence that physiological or incapacitating considerations affected the crewmember's performance.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot began his career at the age of 18, in 1995, when he obtained his PPR License.

According to the information collected, the pilot demonstrated that he was fulfilled and considered that he was going through a good phase in his professional life, as he acted independently and could manage the conditions of the aircraft and the flights he performed.

With 24 years of experience, the commander was considered responsible, organized, quite experienced and, according to the interviewees, did not take unnecessary risks.

According to the reports collected, he had the autonomy to determine if the conditions were suitable for the flight and informed his technical point of view to his contractor, with whom he had a close relationship, and this did not interfere with the pilot's professional performance.

1.14 Fire.

The fire, which started after the impact, consumed practically the entire aircraft.

1.15 Survival aspects.

The search for the aircraft was conducted by the Civil Police and the Fire Department of the State of São Paulo. The location of the wreckage was performed visually.

There was no survivor.

1.16 Tests and research.

The engines had extensive damage, and both had been separated from their nacelles and their respective propellers. Its external parts showed evidence of torsional forces associated with compression caused at the moment of impact.

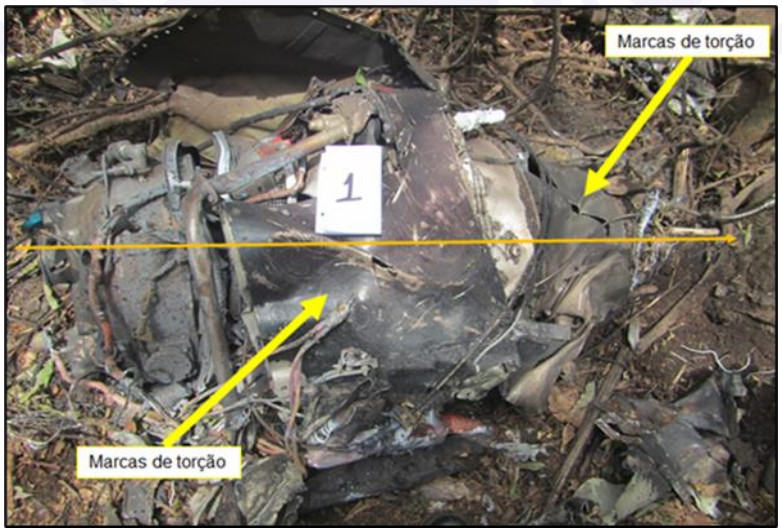

Figure 12 - Structure of the left engine with torsion marks.

The propellers had substantial damage from the impacts that occurred. In one of the sets, it was identified a blade that presented deformation in the direction of flight (Figure 13).

Figure 13 - Image of one of the propeller sets. In the red highlight, one of its blades deformed in the direction of flight.

1.17 Organizational and management information.

The crewmember was hired based on the indication of the previous pilot who worked with the plane's owner and who had known the PIC for a long time.

Other pilots who flew for the same operator reported that he always respected the commanders' decisions and that they were never questioned or pushed to fly in unsafe situations.

As it turned out, the PIC performed, on average, one flight every fifteen days. According to reports, when it was necessary to carry out flights lasting more than three hours, the owner used to authorize the presence of a Second in Command (SIC), who was chosen by the pilot himself.

In addition to piloting the PP-BSS, the PIC was responsible for taking care of the aircraft's documentation and monitoring its maintenance, which was performed by a specialized company.

As the aircraft was hangared in SBJD, the pilot made the trip to Campo de Marte, quite often, to pick up passengers. However, when the Aerodrome was closed, the owner would go overland to Jundiaí.

1.18 Operational information.

It was a transfer flight between the SBJD and SBMT Aerodromes, conducted in accordance with the RBHA No. 91, in force at the time of the occurrence, under visual flight rules.

The Investigation Team did not have access to the aircraft's fuel supply receipt. According to the flight plan, the plane had 4 hours of autonomy from SBJD take-off.

As it was possible to ascertain, there was no cargo on board and the pilot was the only occupant of the aircraft. Thus, it was concluded that the PP-BSS operated within the weight and balance limits

The aircraft was certified for IFR flight, and the pilot was qualified for flight under instrument rules.

The origin and destination Aerodromes only allowed operation under VFR.

The intended route, according to the VFR flight plan, provided for the takeoff from SBJD at 0900 (UTC) and the flight to SBMT by the REA DELTA at the maximum height of the corridor.

REA DELTA was a visual corridor commonly used for visual flights between SBJD and SBMT Aerodromes (Figure 14).

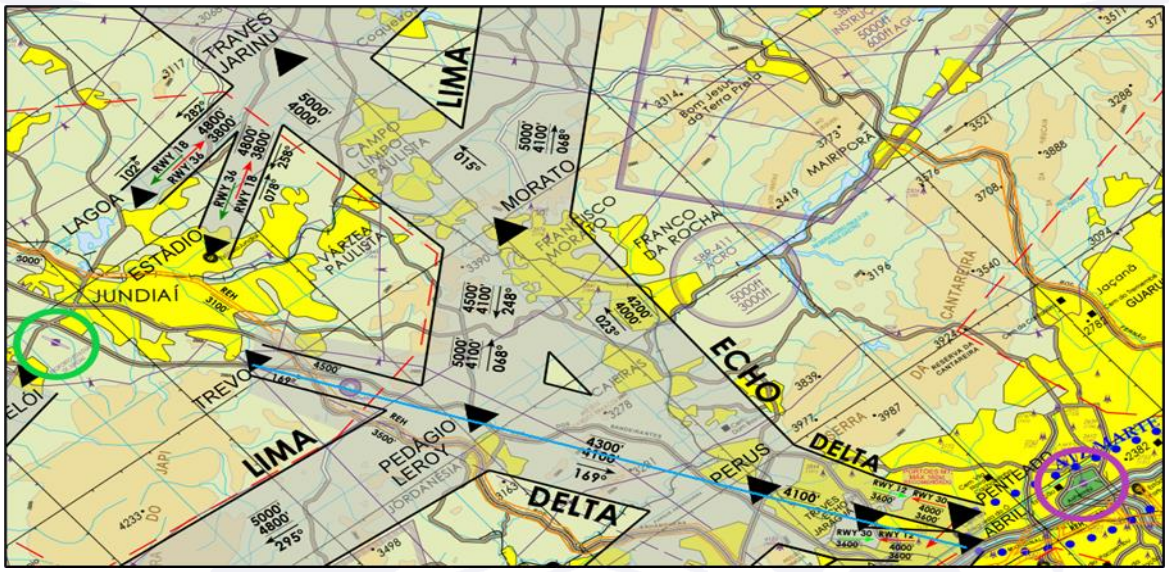

Figure 14 - Special Aircraft Routes at the TMA-SP 2. Highlights for SBJD (green circle), the route via REA DELTA (blue line) and SBMT (purple circle).

To remain within this corridor, the aircraft should fly over the positions specified on the chart and maintain the altitudes determined for each section, as shown in Figure 15.

	Trecho	Altitude (MSL)	Trecho	Altitude (MSL)	Trecho	Altitude (MSL)	Trecho	Altitude (MSL)
SBJD/SBMT	Trevo/Pedágio Leroy	4.500	Pedágio Leroy/Perus	Entre 4.100 e 4.300	Perus/Través Echo Jaraguá	4.100	Través Echo Jaraguá/Abril	3.600

Figure 15 - Positions and altitudes of each section of the REA DELTA.

According to the ATC RADAR review image, after the take-off, the PP-BSS took the heading from the *TREVO* position and climbed to 4,200 ft (Figure 16).

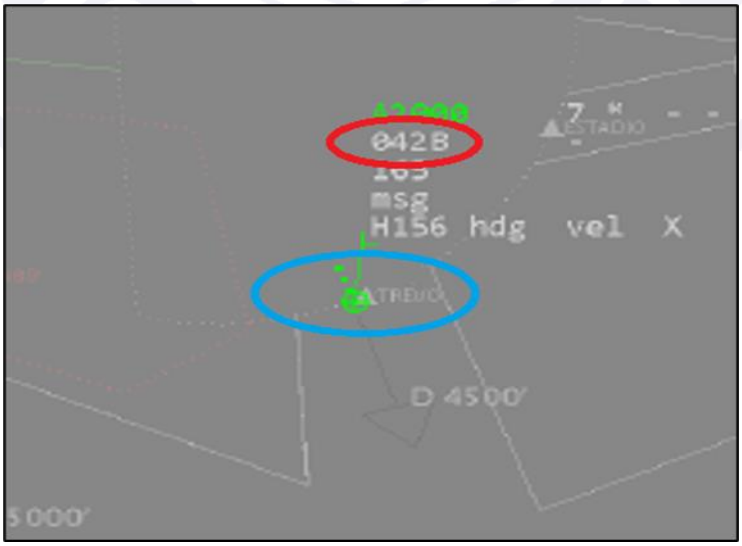

Figure 16 - Synthesis of the ATC RADAR at 08:54:33 (UTC). In the red and blue highlights, the altitude in hundreds of feet and the plot of the aircraft over the *TREVO* position, respectively.

Shortly after making the first contact with the APP-SP, the PP-BSS was informed that the meteorological conditions in SBMT did not allow the operation of fixed-wing aircraft. At that moment, the pilot informed that he would proceed and, when he was closer, if conditions remained unchanged, he would return to SBJD.

The ATC RADAR review images made it possible to observe that, in some moments of the path between the *TREVO* and *TRAVÉS ECHO JARAGUÁ* positions, the aircraft remained below the minimum altitudes established for the visual corridor (Figures 17 and 18).

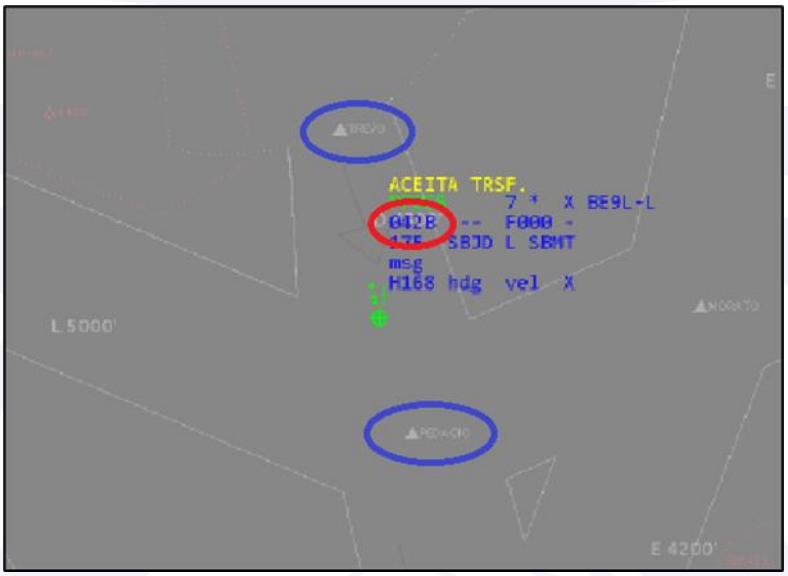

Figure 17 - Synthesis of the ATC RADAR at 08:55:45 (UTC). Highlighted in red, altitude in hundreds of feet. Highlighted in blue, the *TREVO* and *PEDÁGIO* positions.

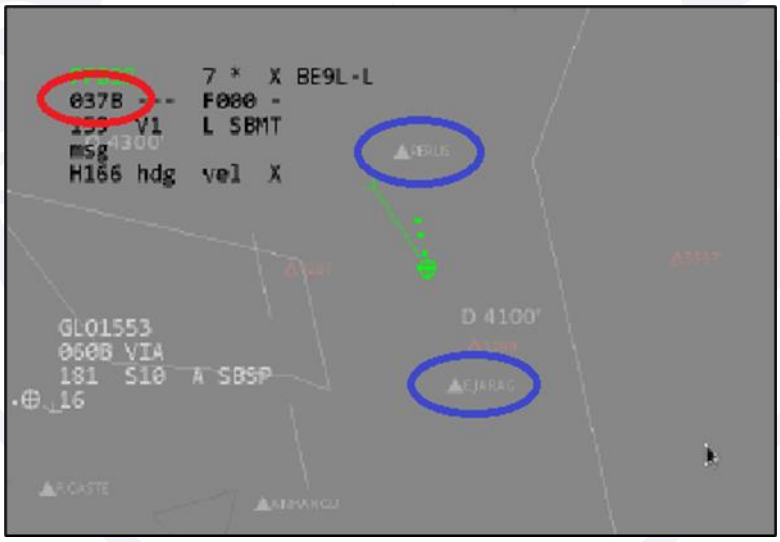

Figure 18 - Synthesis of the ATC RADAR at 08:59:39 (UTC). Highlighted in red, altitude in hundreds of feet. In the blue highlight, the *PERUS* and *ECHO JARAGUÁ* ABEAM positions.

While approaching the *ECHO JARAGUÁ* ABEAM position, the pilot was asked if he was visual in the sector and answered affirmatively. Subsequently, he was informed that conditions in SBMT remained below the minimum and instructed to return to SBJD. At that moment, the PIC proposed to fly in the direction of the MORATO position and was authorized by the APP-SP to proceed in this way.

The AIC N 33/18, of 26APR2018, which dealt with the Circulation of Aircraft in VFR Flight at the São Paulo Terminal, in force on the date of the occurrence, specified that the

movements of entering or leaving the traffic circuit of the SBMT ATZ should be carried out through the gate defined by the position *ABRIL*.

Therefore, to fly from SBMT to SBJD, the aircraft should follow via REA DELTA, up to the *PERUS* position, enter REA ECHO, fly over the positions specified on the chart, maintaining the altitudes determined for each segment.

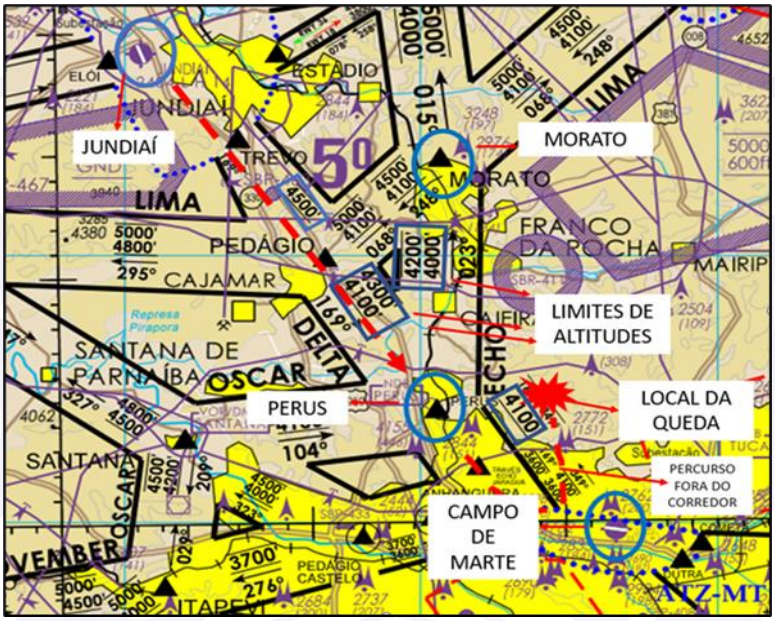

Figure 19 - Cutout of the Visual Corridors Chart - Special Aircraft Routes in the TMA-SP 2 showing the REA DELTA visual corridor and the route taken by the plane.

At 09:01:22 (UTC), the APP-SP requested the PP-BSS to report the position *LAGOA* (Entrance Gate to runway 18 of SBJD) and this message was collated.

About a minute later, at 09:02:14 (UTC), the APP-SP tried to contact the PP-BSS to advise him to keep the corridor, as the controller saw him on the right of the route, but there was no response.

In the last available RADAR plot, the aircraft was at 3,700 ft altitude, on the east abeam of the *PERUS* position, to the right of the visual corridor, at the coordinate 23°24'23"S /046°42'27"W.

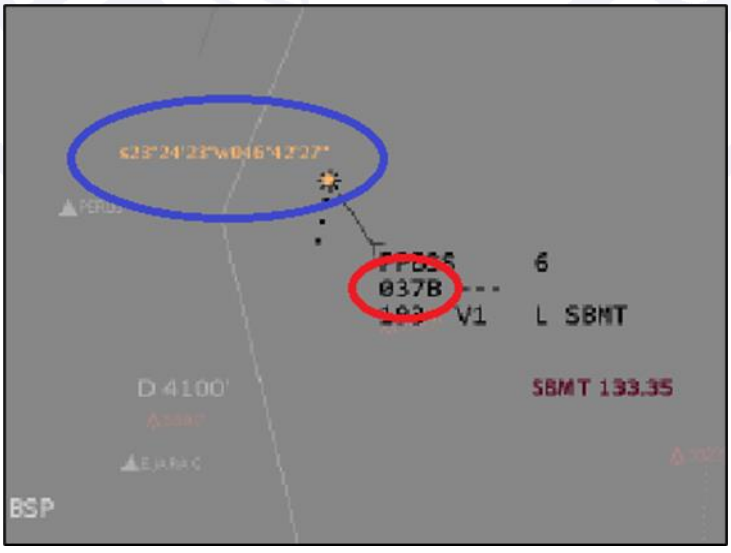

Figure 20 - Synthesis of the ATC RADAR at 09:02:27 (UTC). Highlighted in red, altitude in hundreds of feet. In the blue highlight, the position where the RADAR plot was lost.

1.19 Additional information.

A phenomenon known as "tunnel vision" occurs when, under conditions of stress and high workload, among others, a person's attention turns to a few parameters of an aircraft`s operation, while other parameters are left aside, leading to poor “situation awareness”.

Regarding the minimum visibility and distance from clouds in VMC, the ICA 100-12/2016, brought, in its paragraph 4.9, the following limits:

Classe de Espaço Aéreo	B	C D E	FG	
			Acima de 900 m (3000 pés) AMSL ou acima de 300 m (1000 pés) sobre o terreno o que for maior	A 900 m (3000 pés) AMSL abaixo ou 300m (1000 pés) acima do terreno, o que for maior
Distância das Nuvens	Livre de Nuvens	1500 m horizontalmente 300 m(1000 pés) verticalmente	1500 m horizontalmente 300m verticalmente	Livre de nuvens e avistando o solo
Visibilidade	8 km se voando no ou acima do FL100	8 km se voando no ou acima do FL100	8 km se voando no ou acima do FL100	5 km
	5 km se voando abaixo do FL100	5 km se voando abaixo do FL100	5 km se voando abaixo do FL100	
Limite de Velocidade	380 kt	250 kt IAS se voando abaixo do FL100		
		380 kt IAS se voando acima do FL100		

Table 1 - Visibility and cloud distance minimums in VMC (our emphasis).
Source: ICA 100-12/2016.

The AIC N 33/18 defined the REA DELTA and ECHO as Class C airspaces controlled by the APP-SP.

Regarding the deterioration of meteorological conditions until they are below the meteorological minimums for visual flights, the ICA 100-12/2016 determined, in its paragraph 4.6.2.7, the adoption of the following procedures:

> 4.6.2.7 Deterioration of weather conditions to below visual weather conditions
>
> When it becomes evident that flying in VMC is not feasible, in accordance with its Flight Plan in force, the aircraft in VFR flight, conducted as a controlled flight, shall:
>
> a) request a change of clearance that allows it to proceed VMC to the destination or an alternate Aerodrome, or leave airspace within which an ATC clearance is required;
>
> b) continue in VMC flight and notify the corresponding ATC unit of the measures taken either to leave that airspace or to land at the nearest appropriate Aerodrome if a change of clearance cannot be obtained;
>
> c) request authorization to proceed as a special VFR flight, if it is within a TMA or CTR; or
>
> d) request authorization to fly in accordance with instrument flight rules.

With regard to the responsibilities of the pilot in command, paragraph 5.2 of the same ICA established:

> 5.2 PILOT RESPONSIBILITY
>
> The pilot-in-command of an aircraft in VFR flight will be responsible for providing his own separation from obstacles and other aircraft through the use of vision, except in Class B airspace, in which the separation between aircraft is the responsibility of the ATC, and must , however, observe the provisions in 4.2.1.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a transfer flight between the SBJD and SBMT Aerodromes, conducted in accordance with the RBHA No. 91, under visual flight rules, through the REA DELTA corridor at the TMA-SP.

Evidence of torsion found during the examination of the engines suggests that the collision with the ground occurred with the engines running. Due to the detachment of the nacelles and the sudden stop, an effort was transferred to its external parts, causing the observed deformations.

The deformation identified in a propeller blade, which presented bending and twisting in the direction of flight, indicated an impact with high displacement speed and RPM.

Likewise, the analysis of the noise produced by the engines revealed that, from the take-off of SBJD, the rotation of both propellers increased and stabilized at 1,900 RPM, remaining in this regime until the moment of impact, indicating that the thrusters worked properly throughout the flight.

Thus, it was concluded that the engines were producing power at the moment of the collision with the ground and that there was no contribution of a failure of the powerplant to the occurrence of this accident.

Additionally, the sounds recorded in the CVR did not reveal the existence of tensions in the pilot's voice that would indicate any discrepancy in the plane, in its systems or an abnormal situation in the cockpit.

The information collected in relation to meteorological conditions showed that, on the route traveled by the aircraft, there was low cloudiness, especially in the vicinity of SBMT, which made it impossible to continue the visual flight to the destination Aerodrome.

The attempt to proceed with the flight, even after an alert from the APP-SP controller about the meteorological restrictions in SBMT, characterized an inadequate assessment of the risks associated with the operation of the aircraft outside the minimum ceiling and visibility limits required for the flight under VFR.

The fact that the aircraft remained below the minimum altitudes established for the visual corridor for much of the flight suggests that the pilot was finding it difficult to keep himself in visual conditions and, at the same time, to remain within the established limits for REA DELTA.

Also, the fact that the aircraft had dropped to 3,700 ft during the repositioning to return to SBJD, when the lowest altitude of REA ECHO was 4,000 ft, associated with the weather conditions present in SBMT, where the SPECI at 0916 (UTC) reported a ceiling of 900 ft, show that the PIC sought to stay below the clouds.

Considering the last available RADAR plot, in which the aircraft was at 3,700 ft altitude, on the East beam of the *PERUS* position, the investigators concluded that the pilot was trying to maintain visual conditions and did not have a good visibility of the obstacles in front of him.

Thus, it became evident that unfavorable weather conditions interfered with the conduct of the flight and played a role in the occurrence of this accident.

In the last few minutes, the pilot was asked if he was visual in the sector, and he answered affirmatively. After the aircraft took the heading to return to SBJD, there was an attempt by the APP-SP to guide the commander to keep the corridor, as the controller saw the plane to the right of the route, but there was no response.

From the data obtained through the CVR, it was found that, in the last moments of the flight, the EGPWS issued several alerts of proximity to the ground (Caution Terrain) and evasive action to avoid collision (Pull Up).

Based on this information, it was concluded that the pilot did not react to such alerts, a fact that revealed difficulties in thinking and acting in the face of an imminent collision condition, in which the aircraft was.

This attitude denoted that the ability to recognize and project the risks related to the continuation of the flight under visual rules, in marginal ceiling conditions and forward visibility, was impaired, resulting in the reduction of the pilot's situational awareness in a probable geographic disorientation and in the phenomenon known as “tunnel vision”.

It is likely that the pilot experienced a lowering in his state of attention in relation to the information available and the stimuli of that operational context, which generated, as a consequence, the fixation to maintain the flight under visual rules and the inability to implement the most conservative alternative which would be to climb to a safe altitude, request a change in the rules and start flying by instruments.

3. CONCLUSIONS.

3.1 Facts.

a) the pilot had a valid CMA;

b) the pilot had valid MLTE and IFRA Ratings;

c) the pilot was qualified and had experience in the type of flight;

d) the aircraft had a valid CA;

e) the aircraft was within the weight and balance limits;

f) the airframe, engine and propeller logbook records were updated;

g) the meteorological conditions were not favorable for the visual flight;

h) the APP-SP informed the PP-BSS that the meteorological conditions in SBMT did not allow the operation of fixed-wing aircraft;

i) the PP-BSS informed that it would proceed and, when it was closer, if conditions remained unchanged, it would return to SBJD;

j) the aircraft remained below the minimum altitudes established for the visual corridor for part of the route;

k) close to the ECHO JARAGUÁ ABEAM position, the pilot was asked if he was visual in the sector, and he answered affirmatively;

l) the pilot was informed that the conditions in SBMT remained below the minimum and was instructed to return to SBJD;

m) the APP-SP tried to contact the PP-BSS to advise him to keep the corridor, but got no response;

n) on the last available RADAR plot, the aircraft was at 3,700 ft altitude, on the East abeam of the *PERUS* position, to the right of the visual corridor;

o) the EGPWS issued several alerts related to proximity to the ground such as “Caution Terrain”, “Terrain, Terrain” and “Pull Up”;

p) the aircraft collided with the top of some trees and, later, with the ground;

q) there was no evidence of malfunction of aircraft systems or components;

r) the aircraft was destroyed; and

s) the pilot suffered fatal injuries.

3.2 Contributing factors.

- **Attention – undetermined.**

It is likely that the pilot has experienced a lowering of his attention in relation to the available information and the stimuli of that operational context in face of the adverse conditions faced.

- **Attitude – a contributor.**

It was concluded that there was no reaction to the warnings of proximity to the ground (Caution Terrain) and evasive action to avoid collision (Pull Up), a fact that revealed difficulties in thinking and acting in the face of an imminent collision condition, in which the aircraft was found.

- **Adverse meteorological conditions – a contributor.**

The clouds height and visibility conditions did not allow the flight to be conducted, up to SBMT, under VFR rules.

- **Piloting judgment – a contributor.**

The attempt to continue with the visual flight, without the minimum conditions for such, revealed an inadequate assessment, by the pilot, of parameters related to the operation of the aircraft, even though he was qualified to operate it.

- **Perception – a contributor**

The ability to recognize and project hazards related to continuing flight under visual rules, in marginal ceiling conditions and forward visibility, was impaired, resulting in reduced pilot situational awareness, probable geographic disorientation, and the phenomenon known as " tunnel vision".

- **Decision-making process – a contributor.**

The impairment of the pilot's perception in relation to the risks related to the continuation of the flight in marginal safety conditions negatively affected his ability to perceive, analyze, choose alternatives and act appropriately due to inadequate judgments and the apparent fixation on keeping the flight under visual rules, which also contributed to this occurrence.

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident. In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of the air activity operational safety, and shall be treated as established in the NSCA 3-13 "Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State".

Nil.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On May 27th, 2022.