COMANDO DA AERONÁUTICA <u>CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE</u> <u>ACIDENTES AERONÁUTICOS</u>



FINAL REPORT A - 188/CENIPA/2013

OCCURRENCE: AIRCRAFT: MODEL: DATE: ACCIDENT PT-NKO EMB-711C 190CT2013



NOTICE

According to the Law n° 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 item 3.1, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree n° 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 19 October 2013 accident with the EMB-711C aircraft, registration PT-NKO. The accident was classified as inflight collision with obstacle.

During the descent for landing, the aircraft collided with a tree and crashed into the ground.

There was post-impact fire.

All aircraft occupants perished in the crash.

An accredited representative of the NTSB (US National Transportation Safety Board - NTSB) - USA, State of Design, was designated for supporting in the investigation.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ATC	Air Traffic Control		
ATS	Air Traffic Services		
CA	Airworthiness Certificate		
CAVOK	Ceiling and Visibility OK		
CENIPA	Aeronautical Accident Investigation and Prevention Center		
CFIT	Controlled Flight Into Terrain		
CG	Center of Gravity		
CHT	Technical Qualification Certificate		
CMA	Aeronautical Medical Certificate		
ELT	Emergency Locator Transmitter		
GPS	Global Positioning System		
HP	Horse Power		
IFR	Instrument Flight Rules		
METAR	Meteorological Aerodrome Report		
MNTE	ASEL – Airplane, Single Engine, Land)		
NTSB	National Transportation Safety Board		
PMD	Maximum Take-Off Weight		
PPR	Private Pilot – Airplane category		
ROTAER	Air Routes Auxiliary Publication.		
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service		
SIPAER	Aeronautical Accident Investigation and Prevention System		
SSIE	ICAO location designator - Teruel aerodrome		
UTC	Universal Time Coordinated		
VFR	Visual Flight Rules		
VMC	Visual Meteorological Conditions		

1. FACTUAL INFORMATION.

	Model:	EMB-711C	Operator:
Aircraft	Registration:	PT-NKO	Private
	Manufacturer:	Neiva	
	Date/time: 1	9 OCT 2013 / 11:05 UTC	Type(s):
	Location: /	Minador Farm	In-flight collision with obstacle
Occurrence	e Lat. 18°40'55"S Long. 055°56'55"W		
	Municipality – State: Corumbá – Mato		
	Grosso do Sul		

1.1 History of the flight.

At 09:56 UTC, the aircraft took off from *Teruel* Aerodrome (SSIE), destined, according to the flight plan filed, for SSZF. The pilot and four passengers (a toddler included) were on board.

When the aircraft was near *Minador* Farm (a property of the pilot's family), the last radio contact with Curitiba Center (ACC-CW) was made, in which the pilot reported ready for descent.

Some time later, signals from the aircraft Emergency Locator Transmitter were received.

The airplane was found completely destroyed.

All the aircraft occupants had perished in the crash.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	1	4	-
Serious	-	-	-
Minor	-	-	
None	-	-	

1.3 Damage to the aircraft.

The aircraft caught fire, and was completely destroyed.



Figure 1 – View of the aircraft after the accident.

1.4 Other damage.

Nil.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown				
	Pilot			
Total	Unknown			
Total in the last 30 days	01:09			
Total in the last 24 hours	01:09			
In this type of aircraft	Unknown			
In this type in the last 30 days	01:09			
In this type in the last 24 hours	01:09			

N.B.: No official records of the pilot's flight hours were found.

The flight hours total was estimated by third parties to be between 70 and 130 hours.

Except for the hours flown during the private pilot course, it is supposed that his other flight hours were flown aboard EMB-711 aircraft.

1.5.2 Professional formation.

The pilot did his Private Pilot Course (airplane category) at the Aeroclube de Aquidauana - State of Mato Grosso do Sul - in 2012.

1.5.3 Category of licenses and validity of certificates.

The pilot held a Private Pilot License (airplane category), and a valid ASEL Technical Qualification Certificate.

1.5.4 Qualification and flight experience.

The pilot was qualified and licensed for the conduction of VFR flights, but it was not possible to confirm his flight experience.

The accident occurred a little more than one year after the pilot finished his Private Pilot course (airplane category).

His technical and practice training on the EMB-711C aircraft was basic, according to information provided by another pilot, who had experience in flight instruction and knew the pilot of the accident aircraft. This acquaintance of the accident pilot said that, sometimes, the PT-NKO captain still had very primary doubts.

1.5.5 Validity of medical certificate.

The pilot held a valid Aeronautical Medical Certificate (CMA).

1.6 Aircraft information.

The low wing single engine EMB-711C (*Corisco*) aircraft, SN711125, utilized for private air services, equipped with a 200HP Lycoming engine, was manufactured by Neiva in 1977 and registered in the Private Air Services (TPP) category.

The aircraft airworthiness certificate (CA) was valid.

According to the Flight Equipment and Instruments Form, the aircraft was certified for day-time VFR flight only.

The last inspection (100-hours type) was done on 11 January 2013 by ONA (Oficina de Aviação Nazário Ltda) in Campo Grande, State of Mato Grosso do Sul.

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The aircraft, airframe, propeller, and engine logbooks were onboard the aircraft at the time of the accident, and were completely destroyed. Therefore, the investigation commission was not able to determine whether the aircraft had been operating in accordance with the maintenance program.

1.7 Meteorological information.

The prevailing meteorological conditions in *Campo Grande* were VMC. The weather reports (METAR) of 19 October 2013 indicated CAVOK conditions the whole day, that is, no significant clouds below 5,000 ft, nor horizontal visibility restrictions within a radius of 10 km from the aerodrome.

Data Mensagem (METAR_SPECI)	
19/10/2013 SBCG 190000Z METAR SBCG 190000Z 25004KT CAVOK	23/13 Q1012=
19/10/2013 SBCG 190100Z METAR SBCG 190100Z 26004KT CAVOK	22/12 Q1013=
19/10/2013 SBCG 190200Z METAR SBCG 190200Z 23006KT CAVOK	20/12 Q1013=
19/10/2013 SBCG 190300Z METAR SBCG 190300Z 24003KT CAVOK	20/12 Q1013=
19/10/2013 SBCG 190400Z METAR SBCG 190400Z 18004KT CAVOK	19/12 Q1012=
19/10/2013 SBCG 190500Z METAR SBCG 190500Z 14005KT CAVOK	19/12 01012=
19/10/2013 SBCG 190600Z METAR SBCG 190600Z 14005KT CAVOK	18/12 01011=
19/10/2013 SBCG 190700Z METAR SBCG 190700Z 12005KT CAVOK	18/12 01011=
19/10/2013 SBCG 190800Z METAR SBCG 190800Z 11006KT CAVOK	18/12 Q1011 =
19/10/2013 SBCG 1909007 METAR SBCG 1909007 14005KT CAVOK	$17/12 \ 01013 =$
19/10/2013 SBCG 1910/00Z METAR SBCG 1910/00Z 12005KT CAVOK	19/13 01013=
19/10/2013 SBCG 191100Z METAR SBCG 191000Z 12005KT CAVOK	$\frac{10}{13} \frac{01013}{01014}$
10/10/2013 SDCG 1012007 METAR SDCG 1012007 12006KT CAVOK	25/12 Q1014-
19/10/2013 SBCG 191200Z METAR SBCG 191200Z 12000K1 CAVOK	23/12 Q1013=
19/10/2013 SBCG 191300Z METAR SBCG 191300Z 13006K1 CAVOK	2//11 Q1015=
19/10/2013 SBCG 191400Z METAR SBCG 191400Z 25002K1 CAVOK	29/10 Q1014=
19/10/2013 SBCG 191500Z METAR SBCG 191500Z 25005KT CAVOK	30/10 Q1014=
19/10/2013 SBCG 191600Z METAR SBCG 191600Z 31007KT CAVOK	30/08 Q1013=
19/10/2013 SBCG 191700Z METAR SBCG 191700Z 28007KT CAVOK	31/07 Q1012=
19/10/2013 SBCG 191800Z METAR SBCG 191800Z 30006KT CAVOK	31/05 Q1011=
19/10/2013 SBCG 191900Z METAR SBCG 191900Z 29006KT CAVOK	31/07 Q1011=
19/10/2013 SBCG 192000Z METAR SBCG 192000Z 29007KT CAVOK	30/08 Q1010=
19/10/2013 SBCG 192100Z METAR SBCG 192100Z 26005KT CAVOK	29/08 Q1010=
19/10/2013 SBCG 192200Z METAR SBCG 192200Z 21004KT CAVOK	24/07 Q1010=
19/10/2013 SBCG 192300Z METAR SBCG 192300Z 19001KT CAVOK	23/08 Q1010=

Figure 2 - METAR weather reports for the whole day (19 Oct 2013) in Campo Grande.

Nevertheless, despite the lack of weather reports relative to the destination aerodrome, the satellite imagery (available on <u>www.redemet.aer.mil.br</u>) showed, at the time of the flight, the presence of concentrated nebulosity exactly over the area where the pilot intended to land (Figure 3).



Figure 3 - Presence of nebulosity (11:00 UTC) over the intended destination of the PT-NKO aircraft around the time of the accident.

A witness, who worked in a rural area adjacent to *Minador* Farm at a distance of 12 km, reported that it had rained the night before and, on the morning of the day of the accident, fog had risen in the region, making it impossible for him to do his job with the cattle on account of poor visibility.

In the satellite image of 09:30 UTC (Figure 4), prior to the aircraft takeoff, it is possible to observe that fog was already present over the destination.



Figure 4 – Nebulosity over the intended destination of the PT-NKO at 09:30 UTC.

1.8 Aids to navigation.

Some pieces of information were gathered from the GPS equipment (Garmin 695, Figure 5), which was thrown out of the aircraft at the moment of the crash and, for this very reason, was not burnt with the remainder of the wreckage.



Figure 5 - GPS of the PT-NKO (Garmin 695).

The records relative to 19 October 2013, showed a trip of 140.9 nautical miles starting in SSIE, with the aircraft failing to arrive at the final destination.

By means of the GPS readout, it was possible to determine the aircraft flight profile. The last position recorded by the equipment was at a distance of 7 nautical miles from the location where the wreckage was found.

This is owed to the fact that, for purposes of memory preservation, the data are recorded at certain time intervals, such as, for example, every five or ten minutes.

Thus, it was not possible to determine the profile flown by the aircraft between the last GPS position recorded and the point of impact.

Since the GPS was damaged, the commission was not able to identify the recording time interval programmed in the equipment.

The track recorded in the last route stored in the GPS memory was 343°.

The track from Teruel Aerodrome to Minador Farm was 343°.

There were only 3 (three) flight plans saved in the memory of this GPS, and in one of them the route was SSIE – *Minador* Farm.

In addition to the GPS, an Apple 3GS IPhone was found amid the wreckage, together with an IPhone holder.

There is no concrete evidence that the pilot might be utilizing an application as a navigation aid at the moment of the accident. However, pilot's friends confirmed that he owned aeronautical utility programs such as artificial horizon, ROTAER consultation, GeoRef maps, etc.



Figure 6 - IPhone in the holder.

1.9 Communications.

The last contact of the pilot with ATC agencies was made at 10:58 UTC, in which he informed Curitiba Center (ACC-CW) that he was starting descent towards the destination.

At 11:05 UTC, ground stations received the first signal transmitted by the aircraft Emergency Locator Transmitter (ELT).

1.10 Aerodrome information.

The site where the aircraft crashed is located less than 1 nautical mile from the landing strip of *Minador* Farm, which belongs to the pilot's family.

The landing strip was neither homologated nor registered. It was grass-covered, measuring 900 m x 15 m, with thresholds roughly aligned with the tracks 013° and 193° , at an elevation of 411 ft. (137 m).

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The aircraft wreckage was found at a distance of .9 nautical miles from one of the thresholds of *Minador* Farm landing strip. The aircraft had the flap extended to the first position (10 degrees) and the landing gear was in the retracted position.

The terrain was flat, lying at an altitude of 136 meters above mean sea level. There were mid-size trees in the area in a non-concentrated fashion.

Along the trajectory leading to the collision, the first tree was hit near the top and only the highest branches were damaged.

In the second impact with another tree, the aircraft hit a higher section of the branch making it cleave at the junction with the tree trunk, as shown in Figure 7.



Figure 7 - Fracture of the branch, which was detached from the trunk of the tree.

The approximate trajectory flown by the aircraft could be estimated from the marks made on the trees where the first impacts occurred, and from the final position of the aircraft. These data suggest that, at the moment of the collision, the aircraft was flying approximately in a 107° direction.

After hitting this second tree, the aircraft turned around its vertical axis, since the direction the aircraft was pointing when found differed approximately 210° from its estimated initial trajectory.

The position of the wreckage suggests that the aircraft rotated clockwise and hit the ground with a small pitch-angle, that is, it hit the ground practically with its belly first.

Based on the marks left on the trees, and on the distance between the trees and the wreckage, the calculated angle of the aircraft trajectory in relation to the ground was 42.1°.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

The medical records relative to the pilot's last health-inspection indicated that he was considered fit for the air activity with a recommendation for wearing correcting lenses. However, his visual acuity without correcting lenses met his private pilot license requirements.

Entering bad weather excludes the human visual system as a reference for spatial orientation. Thus, total or partial loss of the visual component affects not only the balance system, but also the system for perception of the body position in space.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Individual Information

According to reports, the pilot was both physically and emotionally fit for the exercise of the air activity.

Self-confidence and persistence were mentioned as his more noticeable personal characteristics. He was quite articulate and outgoing in communicating with others.

On the day of the accident, the planned route (*Teruel* Aerodrome – *Minador* Farm) was habitual for the pilot, since he was the farm owner. What was not habitual for him was to fly at that period of the day, if one considered the actual time of departure.

The pilot took off from *Teruel* Aerodrome at about 05:56 local time, whereas he would normally take off at or after 7 a.m.

According to reports, despite the careful and vigilant posture assumed by him during flights, a situation once occurred when he was flying with a friend to *Chapadão do Sul* in the State of *Mato Grosso do Sul* in which he decided to enter an area of bad weather with no visual references, despite not being IFR-rated. He even lost, for some time, reference as to the aircraft direction and position in space.

The entire luggage to be carried in the flight was stored for the overnight in the back of a pickup truck inside the hangar. According to information provided, luggage was usually transported to *Minador* Farm by land. On the day of the accident, however, it was transported in the very aircraft.

Another pilot that had been in the hangar informed having seen the luggage, which made him suspect a possible excessive aircraft weight, considering the number of persons that would be on board. He affirmed that the pilot had possibly assumed the risk of taking off with the aircraft outside of the operating envelope.

1.14 Fire.

After the accident, a post-impact fire started. It was not possible to identify the source of ignition, but the combustion material was the aircraft fuel.

1.15 Survival aspects.

An infant, who was not protected by a seat belt, was expelled from the aircraft at the crash. The other occupants were tied to their seats, but the high decelerating generated by the accident deprived them of any chance of surviving.

1.16 Tests and research.

The backward direction of the propeller deformation indicates that the engine had little or no power at the moment of impact (Figure 8).



Figure 8 – Propeller bent backwards.

1.17 Organizational and management information.

None.

1.18 Operational information.

The pilot did neither have experience on, nor qualification for, IFR flights, and the aircraft was not certified for flying IFR.

The captain's family owned a farm in the municipality of *Corumbá* (*Minador* Farm), on which there was a landing strip that was neither registered nor homologated.

The pilot normally utilized this landing strip recurrently, even when he reported in the flight plan that his destination would be *Santa Gertrudes* Farm, which had a homologated runway, at a distance of 12 nautical miles from Minador Farm.

The aircraft was refueled on the day before the accident with 30 liters of AVGAS in order to fill up the tanks to the maximum capacity (189.2 liters).

According to witnesses, on the day before the accident, a vehicle containing several suitcases was seen parked overnight beside the aircraft. According to estimates made by these witnesses, the total weight of the luggage would exceed 70 kg, but this was not confirmed. The suitcases were put onboard the aircraft on the morning of the day of the accident.

Considering, in addition, the approximate weight of the occupants, the basic weight of the aircraft, and the weight of the usable fuel, a total weight of approximately 1,189 kg would be reached, when the maximum weight was 1,202 kg.

For the calculation shown above, the weight of the aircraft occupants was estimated based on the testimony of several people that knew them. According to witnesses, the pilot weighed about 70 kg, his wife (pregnant for 23/24 weeks) weighed around 65 kg, his daughter approximately 12 kg, the baby-sitter some 65 kg, and the farm manager's weight was around 100 kg.

The flight plan had been filed via telephone the day before at about 22:30 local time (01:30 UTC). According to the flight plan, the final destination was *Santa Gertrudes* Farm, the EOBT was 09:30 UTC, cruise level was FL045, the EET was 1 hour and 15 minutes, and the POB was 4.

The aircraft took off from SSIE at 09:56 UTC. *Campo Grande* Control (APP-CG) cleared the pilot to fly direct toward the destination. The pilot replied that the ideal track would be 343°, and that his estimate for landing was 11:03 UTC.

At 10:22 UTC, the aircraft was handed over to Curitiba Center.

At 10:25 UTC, the pilot made a slight change in the estimated time of arrival for 11:04 UTC, and at 10:41 UTC he informed that the aircraft was cruising at 3,000 ft. instead of FL 045.

The minimum safe altitude for an IFR flight along that route (off airway), according to the criteria defined in the AIP *Brasil* – ENR 1.3 (Instrument Flight Rules) would be 4,000 ft, considering that the terrain was not mountainous.

The pilot made the last contact with Curitiba Center at 10:58 UTC, i.e., 6 minutes before the estimated time of arrival at the destination. In this contact, the pilot reported that he was starting the descent.

The airspace being utilized was not controlled (category "G" airspace), and, so, Curitiba Center reported that the descent was at the pilot's discretion, and requested the pilot to coordinate the maneuver on the aircraft coordination frequency (123.45 MHz).

At 11:05 UTC, the first signal sent out by the Emergency Locator Transmitter (ELT) was received.

1.19 Additional information.

The signal emitted by the aircraft emergency locator transmitter pointed toward geographical coordinates located approximately 20 nautical miles from the actual crash site.

The coordinates obtained by the Search and Rescue System were 18°58'24"S 055°51"28"W.

In accordance with the ICA 100-12/2009 (Rules of the Air and Air Traffic Services), item 3.4.2:

3.4.2 FLIGHT PLANNING

3.4.2.1 Before starting a flight, the pilot-in-command of an aircraft must be aware of all the pieces of information necessary for the planning of the flight.

3.4.2.2 The information necessary for the flight mentioned in 3.4.2.1 above shall include, at least, a detailed study of:

a) The meteorological conditions (updated reports and forecasts) of the aerodromes involved, and of the route to be flown;

b) The calculation of the fuel necessary for the flight;

c) An alternative plan for the case that completing the flight is not possible; and

d) The pertinent flight conditions contained in the AIP-BRASIL and in the ROTAER, as well as those published by means of NOTAM.

In accordance with the RBHA 91.102 – GENERAL RULES, paragraph (d):

No person is allowed to utilize an aerodrome, unless it is registered and approved for the type of aircraft involved and for the operation proposed.

The *Corisco* aircraft Manual of Operations MO 711C Rev. 05, Section 05 – Performance – contains a graph of Glide Performance, by means of which it is possible to

calculate the aircraft glide-path angle in a condition of retracted landing gear and flaps, with the engine inoperative.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

For the analysis of the factors involved in this accident, the investigation commission verified aspects concerning the profile of the aircraft captain, the meteorological conditions present at the moment of the accident, and operation of the aircraft.

The pilot had little flight experience and was not qualified for IFR flights.

The pieces of evidence indicate that the weather at the destination was not favorable for VFR flights due to the presence of fog, such condition was enough for impeding the flight in that region, since both the pilot and the aircraft could only fly in VMC.

Besides, the aircraft wreckage was found at a distance of .9 nautical miles from a non-homologated and non-registered landing strip, located on the farm owned by the pilot.

Since landing on the aforementioned landing strip was routinely made by the pilot, there was evidence that he had already neglected compliance with the rules established by the RBHA 91.

On the day of the accident, the takeoff from *Teruel* Aerodrome was possibly made with the aircraft weight above the maximum allowed, since, considering the total weight of the aircraft with all the fuel plus the occupants (1,189 kg), there was only a limit of 13 kg for the luggage in order to not exceed the maximum takeoff weight of 1,202 kg. However, with the quantity and volume of the suitcases onboard the aircraft, according to witness, that limit was probably exceeded.

Although the weight of the aircraft did not have a direct cause-effect relationship with the accident, assuming the risk of a takeoff above the allowed maximum takeoff weight, reinforced that non-observation of rules seemed to be an acceptable behavior for the pilot.

The presence of such attitudes led the investigation commission to an in-depth analysis of the pilot's personal and professional profile, aimed at a better understanding of his actions before the adverse weather encountered on the day of the accident.

The word "attitude" in terms of human behavior means the tendency of a person to act in a certain way in face of a specific personal and situational context. It is based on prior experiences, and helps to determine, in such situations, "what" will be perceived and "how" it will be perceived.

Naturally, every attitude results from reasoning, which always involves limitations, and is vulnerable to the influence of the individual's psychological, situational, and physical conditions.

During the investigation of this accident, three aspects were verified in relation to the pilot's psychological and situational conditions, which were important for the understanding of his attitude and decision-making process:

- The pilot had little flight experience, and sometimes still presented doubts that were rather basic if one considered his function;

- The pilot became known in his social environment for displaying personal characteristics of high self-confidence and persistence; and

- There were reports that the pilot had intentionally experimented putting the aircraft in bad weather conditions, even though he was aware that neither the aircraft nor himself

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were qualified to fly IFR, and, on such occasions, he even lost for some seconds his perception relative to direction and space.

The analysis of all these factors in conjunction indicated the existence of a few weaknesses in the pilot's operational profile which, when associated with the personal characteristics reported, point toward a possible limitation of his levels of situational awareness.

In addition, the commission also considered pertinent to evaluate the characteristics of the route flown by the pilot on the day of the accident.

Flying along the route *Teruel* Aerodrome – *Minador* Farm was something common for the pilot; one can say that he was familiar with the characteristics of the region.

However, on the day of the accident, the pilot was confronted with a factor with which he was not familiar with: the time of departure (05:56 local time). Therefore, the pilot is likely to have been unaware of the possibility of fog formation in the region at that time of the day.

It is a known fact that, in accordance to the ICAO 100-12 (Rules of the Air and Air Traffic Services); it is the pilot-in-command's responsibility, still in the flight preparation phase, to verify the meteorological conditions.

It was not possible to determine whether the pilot had access to the satellite images of the region available on the internet (REDEMET), or whether he had planned the flight based only on METAR information, which reported CAVOK conditions in the region of *Campo Grande*, State of *Mato Grosso do Sul*.

Nonetheless, what was possible to observe was that when the pilot approached *Minador* Farm and encountered conditions of nebulosity incompatible with VFR flights, he chose not to deviate from the bad weather.

There were alternate aerodromes, including the aerodrome of origin (SSIE), to which the pilot could have diverted and wait until the flight conditions in the region of *Minador* Farm got better to the point of allowing VFR flights. The aircraft had a quantity of fuel that was sufficient for accommodating such possible alterations of the route.

During the Initial Action carried out by the investigators, the position in which the aircraft wreckage was found suggested that the aircraft could have been on the base leg for landing. This hypothesis is based on the following facts:

- The approximate trajectory flown by the aircraft could be estimated from the marks made on the trees where the first impacts occurred, and from the final position of the aircraft. These data suggest that, at the moment of the collision, the aircraft was flying approximately in a 107° direction; and

- Considering that the threshold closer to the crash-site had a 013° direction, the ideal heading for a base leg with a turn to the left would be 103°. In this case, there would be a difference of only 4° between the ideal track and the one supposedly flown by the aircraft (107°).

However, the first impact occurred in a position beyond the landing strip extended axis, that is, for some reason the pilot did not turn to the left to join the final leg.



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Figure 9 – Representation of the aircraft trajectory before the impact.

A hypothesis that could justify the fact that the pilot did not turn to join the final leg would be the one of spatial disorientation (triggered by the restriction of visibility).

In relation to orientation, it is important to highlight that aircraft acceleration and deceleration, associated with changes of attitude, reflect directly on the human body.

Such alterations may replicate similar effects (acceleration and deceleration) in the vestibular system of the inner ear (a balance system that provides the human being with his/her position and orientation in space).

These effects may generate wrong or confusing information in relation to reality, especially when one does not have visual references, which, together with the labyrinth, compose the system of orientation and balance of the human body.

If the pieces of information between these systems are conflicting, they will eventually generate perceptions in the central nervous system that are also conflicting or confusing (illusions, false impressions of positioning and/or attitude, etc.)

Therefore, during a flight without external visual references, the accelerations imposed on the pilot, resulting from the movement of the aircraft, may influence his perceptive references, leading him into believing that he is flying in certain conditions (leveled off, banking, with accelerations, etc.) when, in reality, the aircraft may be in a situation totally different from the ones perceived.

In cognitive terms, visual perception plays an important role, since it is the most dependable source of perception to provide a true image of the body attitude in space.

Thus, in face of the thick fog condition, in which the external visual references were restricted, on a low altitude flight, and without training for utilizing the aircraft instruments, it is possible that the pilot may not have managed to maintain a safe and updated visual image of his orientation in relation to the terrain.

An indication that corroborates with the scenario that the pilot would be getting ready for landing is the position of the flaps at 10° (first indentation) as if he had already configured the aircraft for landing. However, the retracted landing gear allows supposing that for some reason the pilot was not fully certain in relation to landing.

A hypothesis to justify the fact that the pilot did not extend the landing gear is that he, probably, would not have obtained visual contact with the landing strip, and, if necessary, it would be easier for him to go around.

There are a few indications that allow inferring that the plane was at low speed at the moment of the impact, such as, for example, the lack of deceleration marks on the ground, besides the fact that the wreckage distribution was totally concentrated.

In other words, the position of the wreckage suggests that the plane hit the ground and did not move forward. If the plane speed had been high, there would probably be deceleration marks, since the distribution of the wreckage suggests that, in practical terms, the aircraft hit the ground with its underside first.

The *Corisco* aircraft Manual of Operations MO 711C Rev. 05, Section 05 – Performance – contains a graph of the aircraft glide performance with the propeller windmilling, with flaps and landing gear retracted, and a weight of 1,202 kg.

From this graph, one determines that, in such condition, the trajectory angle of the *Corisco* is 6.1^o (tangent arc of the height divided by the glide distance in the same measurement unit).



Figure 10 – Graph of the EMB-711C glide performance.

Before making comparisons between the angle of the trajectory flown by the accident aircraft and the glide-angle obtained from the manual, it is important to stress the difference between the two conditions.

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First, the flaps of the accident aircraft were partially deflected, judging from the position of the surfaces and respective control lever (Figures 11 and 12).



Figure 11 – Flap control.



Figure 12 – Position of the right-hand-side flap (10°).

Based on this fact, it is possible to infer that the aircraft was in a condition of drag higher than the one presented in the manual and, therefore, it had to fly with a larger glideangle. Besides, it is not possible to know for sure the status of the engine operation at the moment of the impact. From the damage observed in the propeller, it is known that the engine was not turning with high power, but it is not possible to determine whether the propeller was windmilling or turning at IDLE.

Finally, it is pointed out that the accident trajectory-angle was calculated from the point of collision with an obstacle. Thus, it is supposed that the aircraft was no longer on a normal controlled flight after the collision with the tree, and this brings restrictions to the comparison between the angle of the gliding trajectory and the one calculated for the accident aircraft.

From the above mentioned, one may consider the two angles being analyzed. On the one hand, it is known that the best glide-angle with an inoperative engine is 6.1°. On the other hand, the trajectory angle calculated was 42.1°.

It can be seen that the trajectory-angle is considerably larger than the angle of best glide.

Excluding the possibility of a dive, which would have become evident through an angle of more severe destruction of the wreckage, it is possible to say that the aircraft was in an aerodynamic condition quite deteriorated when compared to the condition of best glide.

It is worth highlighting that the trajectory-angle of 42° refers to the movement of the aircraft relative to the ground after the collision with the tree, and not to the aircraft pitch-angle.



Figure 13 - two pictures showing the same trajectory angle with different pitch angles.

The low speed of the aircraft, in addition to the position of the flaps at 10°, suggested, therefore, that the pilot was already aimed at configuring the aircraft for landing, and visual contact with the landing strip was probably the only aspect still missing.

In that scenario, in which the external visual references were minimal, it would be natural for the pilot to focus his attention on obtaining visual contact with the landing strip, even because he was used to flying in the region and probably knew that the landing strip was nearby.

Thus, two were the activities that the pilot had to perform in the cockpit in a coordinated and simultaneous manner: the visual search for the landing strip amid a thick fog, and the control of the flight and navigation parameters.

When two tasks belonging to the same sensorial type – in this case, activities of identical visual stimulus – are done simultaneously, there is a high probability that one will interfere with the other, leading to low performance in one of them.

In contexts of a complex operation, in which the anxiety levels tend to be higher, this performance may become even more affected.

Therefore, the condition of flight without external visual references (a condition for which the pilot was not qualified) may have configured a complex operation scenario for him, and he was led to focus on one action, that is, obtainment of visual contact with the landing strip, with the very piloting of the aircraft becoming a secondary issue.

Thus, the aircraft may have reduced the speed and altitude as a result of a pilot's attention lapse which, associated with the degraded visibility, possible spatial disorientation, and presence of trees in the region, may have favored the collision of the aircraft with a natural obstacle (tree).

Despite the indications that the aircraft was at low speed at the moment of impact, it was not possible to determine whether it was in a condition of aerodynamic stall, because there are not certified data about the trajectory angle in this flight condition.

The hypothesis of engine failure cannot be ruled out, but the operation with low power corresponded to a descent flight profile.

Notwithstanding the indications of a possible spatial disorientation and the consequent loss of control in flight, the analysis section of this report also showed that the accident could have been prevented if the pilot adequately evaluated the risks involved in a context of operation for which he was not qualified.

Considering the hypothesis that the pilot, in fact, flew the aircraft into a layer of fog without being qualified for IFR flights, and below the minimum safe altitude, the understanding was that his decision resulted from an inadequate judgment of the risks involved in that context of operation.

An inadequate judgment increases the probability that further mistaken evaluations and judgments will follow suit. Therefore, the inadequate judgment of the risks consummated in the unsafe attitude of the pilot, who began to fly within a scenario for which he had never trained before.

Still in this context, the commission identified the presence of poor levels of situational awareness on the part of the pilot. He was operating in a non-visual flight condition, below the minimum safe altitude, without the aid of instruments, thus displaying a significantly compromised perception of the environmental variable influencing that operation and the risks posed by it.

It was not possible to determine the reasons which led the pilot to assume such a risky flight condition. However, there was information that flying over that region and landing on the farm was something habitual for him, and that with the aid of the GPS, he possibly knew that the aircraft was very close to the landing strip

One cannot rule out the hypothesis that the degree of familiarization of the pilot with that region increased his confidence to the point of reducing the aircraft speed and altitude, in the expectation of sighting the landing strip more easily, independently of the limited external visibility.

3. CONCLUSIONS.

3.1 Facts.

- a) The pilot held a valid Aeronautical Medical Certificate (CMA);
- b) The pilot held a valid Technical Qualification Certificate (CHT);
- c) The pilot was not IFR-rated;
- d) The aircraft had a valid airworthiness certificate (CA);
- e) The aircraft was certified for day-time VFR flights only;
- f) The airframe, propeller, and engine logbook records were destroyed in the accident;
- g) The prevailing weather conditions at the destination were not favorable for VFR;
- h) The runway on *Minador* Farm was neither homologated nor registered;
- i) The runway thresholds on Minador Farm were had, respectively, the directions 013° and 193°;
- j) The aircraft had been fully refueled for the flight;
- k) The weight of the fuel added to the weight of the occupants, allowed a maximum baggage weight of 13 kg;
- The aircraft took off from SSIE at 0956 UTC, and made the last radio call at 10:58 UTC;
- m)The first TLE signal was received at 11:05 UTC;

- n) The aircraft was configured for retracted landing gear and flaps at 10°;
- o) The charred aircraft wreckage was found at a distance of .9 nautical miles from the Fazenda Minador runway; and
- p) All aircraft occupants perished in the crash-site.

3.2 Contributing factors.

- Attention – undetermined.

It is possible that, while visually searching for the landing strip, the pilot focused his attention on this action, with little concern in relation to the flight parameters and aircraft navigation, something that may have favored the loss of speed and altitude, with a consequent impact against the tree.

- Attitude – undetermined.

Although there were alternate aerodromes to which the pilot could have diverted in face of the adverse weather conditions observed, he chose not to deviate from the bad weather, something which possibly fostered his entry in flight conditions for which he was not qualified.

- Adverse meteorological conditions – a contributor.

The presence of fog over the area in which he intended to land, made it impossible for him to conduct the flight in fully VMC conditions.

- Disorientation – undetermined.

The accelerations sustained by the aircraft may have affected the pilot's vestibular system, which, in addition to the lack of visual references, may have caused spatial disorientation.

- Flight indiscipline – undetermined.

If the pilot deliberately entered IMC conditions, such attitude would configure flight indiscipline, since he did not hold qualification for IFR flights.

The fact that the pilot had already landed on other occasions on a landing strip neither homologated nor registered constitutes flight indiscipline for being in disagreement with the RBHA 91.

Piloting judgment – undetermined.

In the hypothesis that the pilot attempted to land in IMC conditions, he may have lacked judgment to divert to other aerodromes in better meteorological conditions.

- Perception – undetermined.

The hypothesis that the pilot flew the aircraft into a layer of fog without being IFRrated would be an indication of a significantly poor perception of the environmental variables influencing the operations and the risks posed by it, mainly because he was flying in an unknown flight condition, below the minimum safe altitude, and without the aid of instruments.

Besides, the flight through thick fog without using instruments may have favored the pilot's spatial disorientation, making him lose the reference of position and angle of the aircraft in relation to the ground.

- Flight planning – undetermined.

On the internet, there were meteorological images available indicating the presence of nebulosity over the destination and, even so, the flight continued in accordance with a visual flight plan. Based on the evolution of the satellite images, it is possible to observe that the weather conditions got worse during the period of the flight.

- Decision-making process – undetermined.

The pilot's decision to proceed with the flight under meteorological conditions for which he was neither qualified nor trained, in the hypothesis he did this intentionally, reflected an inadequate judgment of the risks involved in the specific context of the operation.

- Pilot's little experience – undetermined.

According to information provided by pilots who knew the PT-NKO captain, he had a flight experience of approximately 130 hours.

Such short experience may have contributed to his inadequate evaluation of the operation in an environment which was not favorable for VFR flights.

4. SAFETY RECOMMENDATION.

A measure of preventative/corrective nature issued by a SIPAER Investigation Authority or by a SIPAER-Link within respective area of jurisdiction, aimed at eliminating or mitigating the risk brought about by either a latent condition or an active failure. It results from the investigation of an aeronautical occurrence or from a preventative action, and shall never be used for purposes of blame presumption or apportion of civil, criminal, or administrative liability.

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 November 11th 2016.