

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A-213/CENIPA/2013

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PT-WMY
MODEL:	BN-2A-3
DATE:	04DEC2013



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 accident with the BN-2A-3 aircraft, registration PT-WMY, on 4 December 2013. The accident was classified as “undetermined”.

Soon after taking off, the aircraft assumed a descending trajectory, and then collided with trees in a wood area at a distance of 1 km from the runway.

The aircraft was destroyed.

The five occupants of the aircraft perished in the crash.

An accredited representative of National Transportation Safety Board (NTSB) - USA, state of engine's design, and other the Air Accidents Investigation Branch (AAIB) - UK, state of aircraft's design were designated for participation in the investigation.



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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CHETA	Airline Company Homologation Certificate
CMA	Medical Certificate
COM	Maintenance Organization Certificate
CHT	Technical Qualification Certificate
EO	Operating Specification
IAC	Civil Aviation Instruction
IAM	Annual Maintenance Inspection
IFR	Instrument Flight Rules
Lat	Latitude
Long	Longitude
MLTE	Airplane, Multi-Engine, Land - AMEL
PCM	Commercial Pilot License (airplane category)
PPR	Private Pilot License (airplane category)
PN	Part Number
RBAC	Brazilian Civil Aviation Regulation
RBHA	Brazilian Aeronautical Homologation Regulation
SERAC	Regional Civil Aviation Service
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
SBIH	ICAO location designator – <i>Itaituba</i> Aerodrome
SJNP	ICAO location designator – <i>Novo Progresso</i> Aerodrome
TPX	Non-Regular Public Transport Service/Air-Taxi
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	Model: BN-2A-3 Registration: PT-WMY Manufacturer: Britten Norman	Operator: <i>Heringer Táxi Aéreo Ltda</i>
Occurrence	Date/time: 04DEC2013 / 14:30 UTC Location: Aldeia Pykany Lat. 08°09'33"S Long. 053°27'54"W Municipality – State: Novo Progresso – State of Pará	Type(s): Undetermined

1.1 History of the flight.

The aircraft took off at 14:23 UTC from a landing strip located in the Pikany Indian village, on a passenger transport flight destined for the aerodrome of Novo Progresso (SJNP). The pilot, together with an employee of the company (coordinator) and three passengers were aboard the aircraft.

Soon after departure, the aircraft assumed a descending trajectory, and ended up colliding with tress in a wood area at a distance of 1 km from the landing strip.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	1	4	-
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.

Hours Flown	
	Pilot
Total	530:00
Total in the last 30 days	58:35
Total in the last 24 hours	01:20
In this type of aircraft	58:35
In this type in the last 30 days	58:35
In this type in the last 24 hours	01:20

N.B.: Data obtained from the company's flight-hour records.

1.5.2 Personnel training.

The pilot did his Private Pilot course (airplane category) in 2009.

1.5.3 Category of licenses and validity of certificates.

The pilot held a Commercial Pilot license (airplane category), as well as a valid AMEL technical qualification certificate and IFR rating.

1.5.4 Qualification and flight experience.

The pilot had qualification and 58 hours of flight in the aircraft model.

1.5.5 Validity of medical certificate.

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

1.6 Aircraft information.

The aircraft (SN314) was manufactured by Britten-Norman in 1973, and was registered in the category of Non-Regular Public Transport (TPX).

It had a valid airworthiness certificate (CA).

The records of the airframe, engine, and propeller logbooks were out-of-date relative to the latest flight hours, but the records of the programmed maintenance services were in accordance with the prescriptions for the equipment.

The last inspection of the aircraft ("100/50 hours" type) was done on 28 November 2013 by the workshop of *Heringer Taxi-Aéreo Ltda.* in *Itaituba*, State of *Pará*.

The IO-540-K1B5 Lycoming engines (serial numbers L-4819-48 and L-10496-48) underwent overhaul in a certified maintenance organization, and had a total of 6,539 hours and 10 minutes of operation having been operated 585 hours and 30 minutes after the overhaul.

The HC-C2YK-2CUF Hartzell propellers, serial numbers AU-715 and AU-2492, underwent overhaul in a maintenance organization, and had a total of 6,504 hours and 40 minutes of operation, being 67 hours and 55 minutes after the overhaul.

1.7 Meteorological information.

The prevailing weather conditions were VMC.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The accident occurred outside of aerodrome area.

The landing strip of the Pykany Indian village was neither registered nor approved.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The accident occurred in a jungle area, at a distance of 1 km from the landing strip from which the aircraft had taken off.

The impact with the ground occurred at a pitch-down angle of approximately 75°, with a heading of 090°, to the left of the direction of departure.

The distribution of the wreckage in the terrain was of a concentrated type. The front part of fuselage broke near the wing root, and was parallel to the plane of the wings.

The wings sustained deformation due to the frontal impact with ground. No fuel was found in the tanks since they are damaged. There were no signs of fuel leak in the area surrounding the wreckage.

The outer part of the left wing was severed upon colliding with a tree. The wing tip was located approximately 2 meters behind the central part of the wing.

The blades of the left engine propeller were at minimum pitch and had not sustained damage.

Due to the position of the aircraft, it was not possible to verify the situation of the right propeller and right engine which remained buried on the ground after the impact.

The pilot cabin was completely destroyed, and, thus, it was not possible to verify the situation of the flight instruments and the position of the levers and of the fuel selector switches.



Figure 1 – The aircraft after the impact.



Figure 2 – Location of the wreckage in relation to the landing strip.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

No evidence was found that issues of physiological nature or incapacitation might have affected the performance of the pilot.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot was hired by the company to work as a copilot in March 2013. He had been sent to *Itaituba* because He was junior to the others, who were not interested in going there. He accepted to go to Itaituba for the possibility of a quick professional growth in aviation.

He was interested in accumulating flight hours and in increasing his financial income. At the time of the accident, he used to fly 5 to 6 hours per day.

According to information, he was a pilot with little experience of the region and with little knowledge of the local reality. He started flying the accident aircraft upon being sent to that locality.

According to witness, he was considered a person with determination, who was willing to help others. He had good relationship with the workmates, and was friendly and easy to be dealt with.

The base coordinator was an experienced pilot, who had already worked as instructor, examiner, and chief-pilot for the company. He had worked at the company for 6 years, but during this period, he left and was re-hired 3 times. The reasons for his leaving on the three occasions were due to financial issues.

His last contract with the company started in November 2013, when he was hired for the function of base coordinator in Itaituba, with the responsibility of supervising the flights resulting from a consortium between the company and the Ministry of Health, in support of the Indians who lived in that region. He performed the function of a branch to the company, managing all the processes in an individual fashion. He had been working in the function for 20 days when the accident happened. At the time of the accident, the validity of his pilot qualification certificates had already expired.

According to information collected, the base coordinator had also been hired by the company to work as a trainer of the pilot. In videos shown to the investigation commission, the base coordinator appeared on the left seat, with the pilot sitting on the right seat.

The pilot did not use to question the coordinator (instructor), since he believed him, and admired him for his level of experience in aviation. The coordinator was considered kind of a mentor by the pilot.

At the time of the accident, the company had a fleet of 13 aircraft, with 18 pilots, and had plans for starting to operate helicopters. However, the number of aircraft in the fleet fluctuated, since the company imported aircraft with the intent of selling them.

On the day of the accident, the aircraft was scheduled not to fly. According to information collected, the takeoff occurred without the company being aware, due to a medical emergency.

Moreover, the commission received information that the company pilots were used to flying with minimum fuel, many times compromising acceptable safety margins.

1.14 Fire.

No signs of either inflight or post-impact fire.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

Nil.

1.17 Organizational and management information.

The air-taxi company had more than 32 years of operation, and received its Air Taxi Company Approval Certificate (CHETA) on 17 July 2002 from the First Civil Aviation Regional Service (SERAC-1).

The company's main operational base was located at *Imperatriz* Airport in the State of *Maranhão*. The company had authorization for the transport of passengers and cargo, as well as for aero medical service.

The flight in question belonged to a consortium for the transport of Indians. Heringer Taxi-Aéreo Ltda. was the company responsible for coordinating the flights operated by all the companies taking part in the consortium.

The company had authorization for providing line maintenance to its fleet aircraft, in accordance with the restrictions established by the Brazilian Civil Aviation Regulation (RBAC) 43, but the *Heringer* Group owned a maintenance organization certified by the National Civil Aviation Agency - ANAC (ref. Maintenance Organization Certificate (COM) no. 8805-03/ANAC). Maintenance services of more relevance were provided by this workshop, which was also located in Imperatriz.

The fleet was composed of twelve aircraft, without counting the accident aircraft, which had registration and airworthiness certificates in the name of the operator, but was awaiting inclusion in the Operating Specifications (EO).

The company had forwarded a request to ANAC for the inclusion of this aircraft, as well as the inclusion of a secondary base of operations in the city of Palmas, State of Tocantins, in its Operating Specifications, but the process was still being analyzed by that agency.

The company possessed a structured training sector and had implemented its operational training program. There was a total eighteen pilots, two of which performed administrative functions, while the remainder participated in the flight schedule.

The accident pilot had done all the phases of the aircraft initial training, and did the practical part of the flight curriculum in a Cessna C-310R aircraft. The company did not present the pilot's records concerning his training, solo flight and flight curricula for the model of aircraft of the accident flight, as well as the records of the Training of Differences, prescribed in the Civil Aviation Instruction (IAC) 135-1002 of 20 September 2005.

Due to the fact that the aircraft was still in the process of being included in the Operating Specification (there was only a proposal of inclusion), the company's training program approved by ANAC did not contemplate the training of differences of the aircraft in question.

This issue, namely, training in different models of the aircraft operated, had already been a condition observed in a report of an Operational Safety Audit done on 22 September 2009 by SERIPA I.

1.18 Operational information.

The pilot was promoted to captain of the aircraft in November 2013. The theoretical instruction and the training program complied with at the company were not specific for the accident aircraft. The training had been done in a Cessna 310 aircraft, the performance of which is different from that of the BN-2A-3 aircraft.

According to the records presented, the first flight of the pilot in the BN-2A-3 aircraft was made 19 November without the presence of the instructor.

In the accident flight, there was an employee of the company sitting on the right seat of the pilot's cabin. According to the company management, this employee had been hired to work as base coordinator in Itaituba, State of Pará, where the aircraft in question would be based.

According to the company, the coordinator was participating in those flights in order to manage the specific situations of the beginning of operation of that aircraft.

During the investigation, the commission received information that, at least in one of the flights of this aircraft in Itaituba, the coordinator was acting as pilot in command. It was not possible to determine whether the coordinator, who was sitting on the right seat, had the aircraft controls during the accident flight.

On 3 December 2013, the aircraft took off from Itaituba Aerodrome (SBIH), destined for Novo Progresso Aerodrome (SJNP). According to accounts, a local supplier who was asked to refuel the aircraft said that he did not have the amount of fuel requested.

According to accounts, only the wing tip tanks were refueled. The refueling in SJNP was done by a non-official supplier, and no receipt of this refueling was presented.

According to the aircraft manual, each one of the tip tanks had capacity for 29.5 US Gal, equivalent to 111 liters of fuel. According to the operator, such quantity of fuel allowed approximately 1 hour of flight. Still according to the aircraft manual, it was forbidden to take off or land utilizing fuel from the tip tanks.

No records concerning the aircraft refueling and fuel consumption were presented, making it difficult to determine how much fuel was in the tanks at the time of takeoff.

After the refueling, the aircraft took off from SJNP, destined for a locality known as *Aldeia Pikany* (Pikany Indian Village), with flight time estimated in 1 hour. According to information, the objective of the flight was to transport a female Indian in labor for medical assistance in that city. The company informed that the flight was done without being authorized by the sector of operations.

Witnesses informed that they saw the left engine of the aircraft fail a few minutes after the aircraft took off from Aldeia Pikany, resuming normal operation, and then failing again.

The aircraft weight and balance diagram was not found, but considering the possibility of little fuel on board, one estimates that the aircraft was within the prescribed limits. According to the aircraft manual, the aircraft stall speed with the wings leveled would be 49 kt., considering that the aircraft was within the maximum takeoff weight limits.

After the accident, a company representative filed an Occurrence Bulletin at the Civil Police department of Novo Progresso, claiming that fuel had been removed from the accident aircraft.

1.19 Additional information.

The PT-WMY aircraft fits in the requirements established by FAR 23, section 23.67, which considers that aircraft equipped with piston engines and whose MTOW does not exceed 6,000 lb. belong in the Normal category.

The performance required from such aircraft in a single-engine condition is described in the aforementioned section, which establishes a stabilized climb gradient of at least 1.5% at a pressure altitude of 5,000 ft. with certain configurations of landing gear, flaps, inoperative-engine propeller, and also maintaining a given climb speed.

If the aircraft is not put in these configurations, the aforementioned climb gradient will not be achieved, and under certain conditions of meteorology and speed, even a positive gradient will not be achieved.

For twin-engine aircraft operating in a single-engine condition, it is also necessary to consider the direction of rotation (clockwise or counterclockwise) in relation to the aircraft center of gravity. This will determine the existence of either a longer or shorter arm, which is formed by the force vector in the propeller traction spectrum, and the aircraft center of gravity.

When the aircraft is at an angle of attack equal to zero, the traction in the rotation spectrum of the propeller blade is uniform, both at the moment of “climb” of the blade and at the moment of its “descent”.

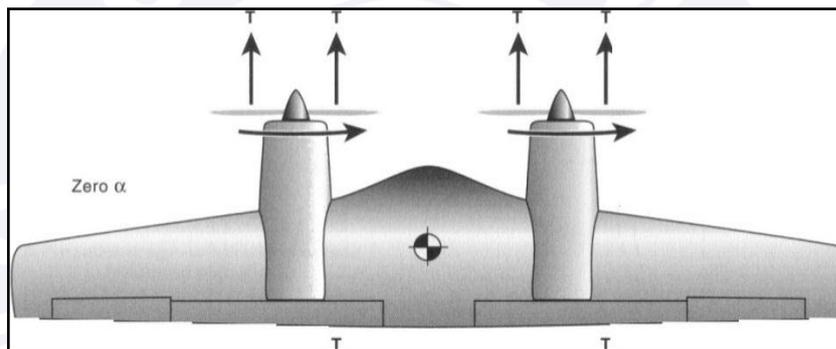


Figure 3 – Spectrum of rotation with identical traction (zero-degree angle of attack).

The relations between the angle of attack of the propeller blades and the angle of attack of the aircraft change in its spectrum of rotation as the aircraft angle of attack increases.

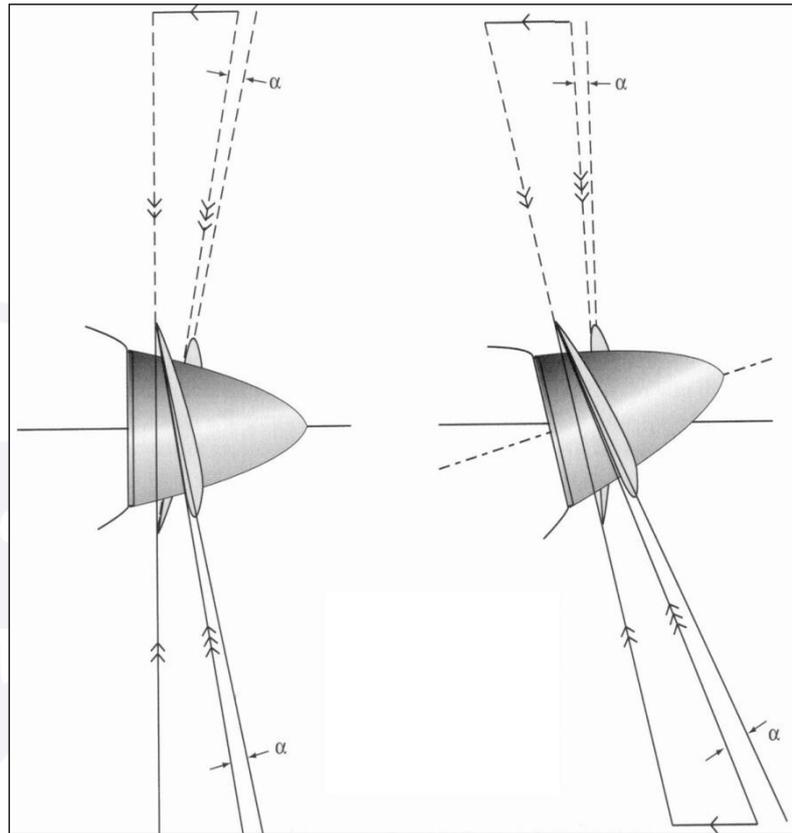


Figure 4 – Difference in the angle of attack of the blades.

On the left of the figure above, one sees an aircraft at an angle of attack equal to zero, and the angle of attack of the “climbing” blade becoming equal to the angle of attack of the “descending” blade.

On the right, one sees the aircraft at high angles of attack, and the angle of attack of the “descending” blade is approximately twice as large as the angle of attack of the “climbing” blade.

The moment of strongest traction in a propeller blade occurs when it is “descending”.

It is possible to verify that, for an angle of attack larger than zero, a contingent failure of the left engine will be the most critical situation for the pilot to control his aircraft, since the traction of the right engine is applied in a much longer arm in relation to the aircraft center of gravity.

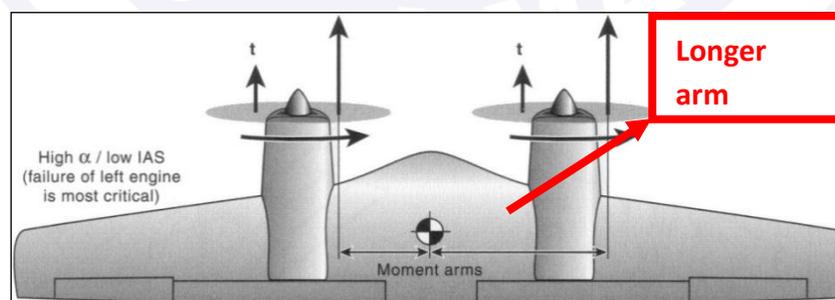


Figure 5 – Stronger traction in the right engine – positive angle of attack.

Thus, the left engine is the critical one in this aircraft, that is, that one whose failure in a situation of low speed and large angle of attack (such as at takeoff) will result in a larger amplitude in the application of the flight controls for balancing the single-engine flight.

The accident aircraft was in the above situation, that is, both propellers were turning clockwise (for an observer inside the cockpit).

On account of the position of the wreckage and of the characteristics of the crash site, it was not possible to retrieve the engines and propellers for laboratory analysis.

Utilization of a runway not approved/ not registered and transport of hazardous material

The aircraft took off from a runway which was neither registered nor approved, contrary to the prescriptions of the Law 7565 of 19 December 1986 – Brazilian Code of Aeronautics – which, in its article 30, reads:

No civil aerodrome can be utilized if it is not duly registered.

Also, the first paragraph of the same article reads:

Public and private aerodromes shall be open to traffic by means of homologation and registration processes, respectively.

The Brazilian Civil Aviation (RBAC) 135, item 135.229, Aerodrome Requirements, reads:

No certificate holder is allowed to utilize any aerodrome, unless it is registered or approved and adequate for the intent of the operation.

In the post-accident field investigation, a cooking-gas cylinder was found amid the wreckage of the aircraft. The transport of such type of material was not in accordance with the Brazilian Civil Aviation Regulation (RBAC) 175, item 175.5, letter a, which prohibits the transport in civil aircraft of substances susceptible to exploding, dangerously reacting, producing flames, or producing, in a dangerous way, heat or emissions of toxic, corrosive or flammable gases or vapors in the conditions habitually observed during the transport.

Information on training

The pilot flew a total of 58 hours and 35 minutes in the BN-2A-3 aircraft as pilot in command. According to a declaration of hours issued by the company, when he started flying as pilot in command in this aircraft, he had 471 hours and 25 minutes of flight, in discordance with the prescriptions of the RBAC 135, item 135.243 – Pilot-In-Command Qualifications -, which reads:

No certificate holder is allowed to employ a person, and no person is allowed to work as pilot in command of an aircraft operating VFR, unless such person has at least 500 hours of flight as pilot, including a minimum of 100 hours in trips, 15 hours of which at night.

The item 135.244 of the RBAC 135, which addresses the pilot-in-command's operational experience, reads:

(a) No certificate holder is allowed to employ a person, and no person is allowed to work as pilot in command of an aircraft in complementary operations as defined in the RBAC 119, unless such person, before being designated as pilot in command, has completed, in the type and basic model of the aircraft, and in the work position of pilot in command, the following experience in each type and basic model of the aircraft to be flown:

...

(2) Multi-engine aircraft with piston engines - 15 hours;

...

(b) In the obtainment of operational experience, every person must meet the following:

(1) The operational experience must be obtained after a successful completion of a solo flight and flight training program for the aircraft in question and the function to

be performed on board. Provisions approved for the obtainment of operational experience shall be included in the training program of the certificate holder.

An Operational Safety Inspection conducted by SERIPA I on 22 September 2009 revealed that in its Operational Training Program the company allowed the pilot to receive instruction in one type of equipment and do his exam of competence in another, contrary to the prescription of the RBAC 135, Section 135.293, letter (b).

The aircraft was not in the list of the company's Operating Specifications on the date of the accident, contrary to the prescription of the RBAC 119, Section 119.49, letter (b), and item (4).

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

The aircraft took off from *Aldeia Pikany*, destined for *Novo Progresso*, transporting an Indian woman who was in labor.

Wreckage analysis, and accounts made by witnesses who saw the aircraft take off, indicated that a failure occurred in the left engine after the aircraft took off.

The way the aircraft crashed into the ground and the lack of marks left in the vegetation indicated that it entered the wood area either with a pronounced-angle pitch-down attitude or at low speed.

In the Amazon rain forest, on account of the size of the trees, if the aircraft hits the top of the trees with a pronounced pitch-down attitude, it does not usually leave traces (such as visible broken branches or felled trees). The same occurs when the aircraft flies at a very low speed, since it crashes with little energy, without causing significant damage to the vegetation.

Thus, two hypotheses were raised to explain the dynamics of the accident:

Hypothesis 1: Considering that the aircraft was found with a heading that was 90° to the left in relation to the direction of departure, it is possible that, when the left engine failure occurred, the pilot made a left turn in an attempt to reach a river lying to the left of the aircraft trajectory, with the right engine still running. This traction difference may have accentuated the angle of bank to the left, causing the aircraft to lose lift, entering an abnormal attitude at low height, colliding with the trees and then with the ground. The first parts of the aircraft to collide with a tree a few meters above the ground were the left wing (whose outer portion was severed) and the upper section of the vertical stabilizer.

Hypothesis 2: The aircraft would have maintained the direction of departure, colliding with the trees at a pitch-down attitude and low speed. The outer part of the left wing was severed upon hitting a tree. Such collision would have generated a momentum which made the aircraft yaw to the left, and collide with the ground at a pitch-down attitude.

Whichever the hypothesis, due to the fact that the left engine was the critical one for the aircraft, its failure may have made it more difficult to keep control of the airplane.

While searching for the reasons capable of compromising the operation of the engine, the investigators verified that there was no fuel in the aircraft tanks, or signs of fuel leakage in the crash site.

Thus, the investigation concentrated on the pilot actions prior to the accident.

In Novo Progresso, on the day of the accident, only the tip tanks were refueled, the same ones utilized in the leg SBIH-SJNP the day before.

According to information provided by the company, the prescribed procedure was to consume the fuel from the tip tanks first, and then the fuel from the main tanks. Such procedure was in opposition to the prescriptions of the aircraft's manual of operations, which forbade landing and takeoff operations utilizing fuel from the tip tanks.

It is possible either that the pilot did not verify the main tanks in the pre-flight procedure on the day of the occurrence, for believing that they were full, or there may have been a failure of coordination between the pilot and the flight coordinator in relation to this verification, since, as afore mentioned, this coordinator also worked as a crew member.

The company also filed an Occurrence Bulletin, claiming that a removal of fuel would have occurred, but it was not possible to confirm whether this really happened, nor whether the alleged removal would have occurred in Novo Progresso.

In addition to these facts, the investigation commission received reports that the company used to not comply with the legislation in relation to the minimum fuel required for the operations, and this reinforces the possibility of engine failure on account of fuel exhaustion.

The investigation commission verified that the accident aircraft, in spite of being registered in the category of Non-Regular Public Transport Service – Air-Taxi (TPX) – was not listed in the company's Operating Specifications, and, so, in theory, was flying under the rules of the Brazilian Aeronautical Homologation Regulation (RBHA) 91, which governed the operations of any civil aircraft, i.e., this aircraft could not be used for the paid transport of passengers.

Still according the Brazilian Civil Aviation Regulation (RBAC) 135, the pilot had to possess at least 500 hours of flight as captain, and, at the moment at which he started flying this aircraft, the pilot had a total of approximately 471 flight hours.

Onboard the aircraft, there was another employee of the company, hired for the function of coordinator, sitting on the seat to the right of the pilot's. The commission verified that this employee was a pilot with more than 10,000 hours of flight, and that he possessed several qualifications (all of which expired). The information received by the team of investigators led to the hypothesis that this employee would, in fact, be working as an unofficial flight instructor. In reality, the pilot in command had been hired initially as a copilot in the company, but would have accepted to fly the aircraft in the base of Itaituba, under the promise of a future promotion to the position of captain in the company.

Considering that the coordinator was used to delivering training to the pilot, and even worked as pilot in command despite his expired qualifications, it is possible to observe lack of adherence to regulations, which could be reinforced by the informal actions existing in the company.

The motivation of the pilot to earn his operational promotion may have contributed to his acceptance of the informal instructions received, as well as to his acceptance of flying without being coordinated by the company.

Thus, considering the different level of experience between the pilot in command and the other employee, and the instructor-student relationship created between them, it is possible that the latter took over the aircraft controls during the emergency.

So, the company was utilizing an aircraft not included in its operating specifications for the paid transport of passengers, making use of a landing strip which was neither registered nor approved, with a pilot who, initially, did not possess the amount of flight hours required for a captain, being monitored by an instructor whose qualification certificates had expired, and neither of the two had the training required by the Operational Training Program of the company for the aircraft in question (training of the differences in the case of the pilot, and initial training in the case of the instructor).

The above aspects reveal an organizational culture based on certain values and attitudes detrimental to flight safety that defined the informal *modus operandi* of the employees.

By the same token, the investigation commission verified a lack of supervision on the part of the organizations which contract air transport services offered in the way described in the above paragraph.

3. CONCLUSIONS.

3.1 Facts.

- a) The pilot held a valid Aeronautical Medical Certificate (CMA);
- b) The pilot held a valid AMEL technical qualification certificate;
- c) The pilot was had 58 hours of flight in the aircraft model;
- d) The pilot did not have the training of differences for the aircraft model;
- e) The aircraft had a valid airworthiness certificate (CA);
- f) The records of the airframe, engine and propeller logbooks were out-of-date;
- g) The aircraft was not listed in the Operating Specifications of the company;
- h) It was not possible to verify whether the aircraft was within the weight and balance limits prescribed by the manufacturer;
- i) The seat on the right was being occupied by the base coordinator, who had already worked as a pilot for the company;
- j) The validity of the base coordinator's technical qualification certificates had already expired;
- k) The aircraft collided with the trees;
- l) The aircraft collided with the ground at a pitch-down angle of 75°;
- m) The left engine propeller had minimal damage on the impact;
- n) No remaining fuel was found in the tanks;
- o) No evidence of fuel leak was found in the crash site;
- p) The aircraft was destroyed; and
- q) All aircraft occupants perished in the crash site.

3.2 Contributing factors.

- **Organizational culture – a contributor.**

The utilization of an aircraft not included in the Operating Specifications and of a runway neither registered nor approved, with a pilot who did not have the amount of hours necessary nor specific training, disclose a culture based on informal practices, which led to operation below the minimum safety requirements.

- **Pilot's forgetfulness – undetermined.**

It is possible that the pilot forgot to verify the quantity of fuel in the tanks of the aircraft before takeoff.

- **Training – undetermined.**

The lack of specific training for the pilot and for the coordinator who, possibly, assumed the function of instructor may have compromised their operational performance during the preparation and conduction of the flight, since they were not effectively prepared for the activity.

- **Flight indiscipline – undetermined.**

It is possible that the pilot failed to comply with the prescriptions of the legislation relatively to the minimum amount of fuel required for the flight leg.

The operation of the aircraft by a pilot with expired qualifications and without the required training goes against the prescriptions at the time, but it was not determined whether this pilot (coordinator) was in the aircraft controls at the moment of the accident.

The transport of a cylinder onboard the aircraft also configures flight indiscipline, since it goes against the legislation which prohibits the transport of such material.

- **Instruction – undetermined.**

The lack of training of the differences may have contributed to the forgetting to verify the fuel tanks, a procedure that is prescribed in the aircraft manual.

Likewise, lack of training may have deprived the pilots from acquiring proficiency for the operation of the aircraft in a single engine condition.

- **Memory – undetermined.**

The fact of conducting a flight to provide assistance in an emergency situation may have contributed to the pilot having forgotten to check safety parameters, such as the amount of fuel necessary.

- **Motivation – undetermined.**

The pilot's intention to earn his operational promotion may have stimulated him excessively, to the point of disregarding the minimum safety requirements for the operation. In addition, the emergency nature of the flight request possibly added to the motivation of the pilot and the coordinator.

- **Insufficient pilot's experience – undetermined.**

It is possible that, due to having little total experience either both of flight and in the aircraft, the pilot lost control of the aircraft when faced with the situation of in-flight engine failure after the takeoff.

- **Decision-making process – undetermined.**

It is possible that the pilot and the coordinator prioritized the emergency requirement of the situation, failing to evaluate other aspects relevant for the safety of the flight, such as planning, for example.

- **Managerial oversight – a contributor.**

The lack of control on the part of the company's management in relation to the flights operating outside of the main base allowed the pilot and the base manager to conduct a flight without the operating sector authorization.

The lack of supervision of the air transport service provision by the contracting organizations allowed the company to provide services without the minimum conditions required by the legislation.

Such conditions exposed the passengers to the risks of an irregular operation.

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”.

Recommendations issued at the publication of this report:

To the National Civil Aviation Agency (ANAC):

A-213/CENIPA/2013 - 01

Issued on 11/11/2016

Take the necessary measures before *Heringer Táxi-Aéreo Ltda.*, in order to guarantee that it only utilizes aircraft listed in its Operating Specifications for the execution of air transport contracts.

A-213/CENIPA/2013 - 02

Issued on 11/11/2016

Take the necessary measures before *Heringer Táxi-Aéreo Ltda.*, in order to guarantee that it only utilizes pilots who have the training required by the Operational Training Program and who have up-to-date qualifications for the execution of air transport contracts.

A-213/CENIPA/2013 - 03

Issued on 11/11/2016

Take the necessary measures before *Heringer Táxi-Aéreo Ltda.*, in order to guarantee that it only utilizes runways which are approved or registered for the execution of air transport contracts.

A-213/CENIPA/2013 - 04

Issued on 11/11/2016

Verify whether air transport contracts celebrated between air transport companies and government organizations (IBAMA, FUNAI, ANS, municipal govts, etc.) are being complied with in accordance with the prescriptions of the applicable aeronautical legislation.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

In December 2013, SERIPA I did a Flight Safety Technical Visit of the *Heringer Taxi-Aéreo Ltda.* main office in *Imperatriz*, State of *Maranhão*. The conditions observed were informed to the Manager responsible for the implementation of the mitigating measures recommended.

In June 2014, a Flight Safety Seminar was delivered by SERIPA I to employees, crews and directors of the company, addressing the characteristics of air-taxi operation in the Amazon region and the prevention or aeronautical accidents.

On November 11th, 2016.