

COMANDO DA AERONÁUTICA
CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE
ACIDENTES AERONÁUTICOS



FINAL REPORT
A - 081/CENIPA/2015

OCCURRENCE:	ACCIDENT
AIRCRAFT:	PR-ADA
MODEL:	AS 355 N
DATE:	29MAY2015



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 item 3.1, 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 29 May 2015 accident with the AS-355N aircraft, registration PR-ADA. The accident was classified as “controlled flight into terrain (CFIT)”.

The helicopter departed from a locality known as “*Aldeia Pentiaquinho*”, destined for *Tabatinga*, both *Amazonas* state, for a patient transport flight.

At about 19 nautical miles far from *Tabatinga*, between the municipalities of *Atalaia do Norte* and *Benjamin Constant*, the aircraft collided with the treetops. Subsequently, the helicopter impacted the ground and a post-crash fire occurred.

The aircraft was destroyed.

The pilot and the four passengers perished in the crash site.

A representative of the *Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile* (BEA) - French (aircraft state of design) was designated to participate in the investigation.



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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
ATS	Air Traffic Services
ATZ	Aerodrome Traffic Zone
BEA	<i>Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile</i>
CB	<i>Cumulonimbus</i> cloud
CENIPA	Aeronautical Accident Investigation and Prevention Center
CFIT	Controlled Flight Into Terrain
CTR	Control Zone
DECEA	Department of Airspace Control
ETA	Estimated Time of Arrival
GPS	Global Positioning System
ICA	Command of Aeronautics' Instruction
IFR	Instrument Flight Rules
IMC	Instrument Meteorological Conditions
METAR	Aviation Routine Weather Report
NASA	National Aeronautics and Space Administration
NM	Nautical Miles
REDEMET	Web Site of meteorological information
SAE	Specialized Aerial Services
SBTT	ICAO location designator – Tabatinga Aerodrome
SESAI	government agency which cares about indigenous health
SIGMA	Brazilian aerial movement management system
SIPAER	Aeronautical Accident Investigation and Prevention System
SISCEAB	Brazilian Airspace Control System
SN	Serial Number
SRTM	Shuttle Radar Topography Mission
TMA	Terminal Control Area
TCU	<i>Towering Cumulus</i> cloud
UTC	Universal Time Coordinated
VHF	Very High Frequency
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	Model: AS-355N	Operator: <i>Moreto Taxi Aéreo Ltda.</i>
	Registration: PR-ADA	
	Manufacturer: <i>Eurocopter France</i>	
Occurrence	Date/time: 29 MAY 2015 /23:17UTC	Type(s): CFIT
	Location: Outside aerodrome area	
	Lat. 04°29'37"S Long. 070°09'07"W	
	Municipality – State: <i>Atalaia do Norte - Amazonas</i>	

1.1 History of the flight.

At about 17:03 local time, the aircraft departed from a locality known as “*Aldeia Pentiaquinho*” to *Tabatinga* (SBTT), both *Amazonas* state, for a patient transport flight. One pilot and four passengers were onboard the aircraft.

At about 19 nautical miles from *Tabatinga*, between the municipalities of *Atalaia do Norte* and *Benjamin Constant*, the aircraft collided with the treetops. Subsequently, the helicopter impacted the ground and a post-crash fire occurred.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The aircraft sustained substantial damage.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	5,500:00
Total in the last 30 days	58:20
Total in the last 24 hours	03:30
In this type of aircraft	350:00
In this type in the last 30 days	58:20
In this type in the last 24 hours	03:30

N.B.: Data provided by the aircraft operator.

1.5.2 Personnel training.

The pilot earned his helicopter commercial pilot license in 2000.

1.5.3 Category of licenses and validity of certificates.

The pilot took a helicopter commercial pilot license and a valid technical qualification certificate for H355 aircraft.

The pilot was not rated for Helicopter IFR.

1.5.4 Qualification and flight experience.

The pilot had been flying in that area for a little more than six months, taking turns with the owner of the company, who substituted for him during the fortnightly breaks.

Pilot's operational background indicated he had never operated in the western portion of the Amazon before being hired by the operator.

1.5.5 Validity of medical certificate.

The pilot had valid aeronautical medical certificate.

1.6 Aircraft information.

The aircraft (SN AS 5648) was manufactured by *Eurocopter France* in 1998, and registered as non-regular public transport – Air Taxi.

Its airworthiness certificate was valid.

The airframe and engine logbook records were up-to-date.

The aircraft was not certified for IFR flights.

The last aircraft inspection (type 60 hours), was done by *Helistar Manutenção de Aeronaves Ltda, Formosa, Goiás*, on 28 May 2015. The aircraft flew 6 hours and 25 minutes after the referred inspection.

The last overhaul of the aircraft (type 600 hours/24 months) was done by *Helistar Manutenção de Aeronaves Ltda, Formosa, Goiás*, on 15 Aug 2014. The aircraft flew 245 hours and 20 minutes after the referred overhaul.

At the moment of the accident, the aircraft had a total of 2,258 hours and 35 minutes of flight.

1.7 Meteorological information.

At 22:00 UTC, the Aviation Routine Weather Report (METAR) of *Tabatinga* reported scattered clouds at 600 feet, and visibility of 2,000 meters in the west sector of the aerodrome, as follows:

SBTT 292200Z 33005KT 9999 2000W SCT006 BKN020 Q1009.

At 23:00 UTC, it reported better conditions of visibility, as follows:

SBTT 292300Z 34004KT 9999 BKN020 Q1010.

However, according to meteorological radar image of SBTT (provided by REDEMET), at 23:13 UTC, there were significant rain clouds at southwest sector of the aerodrome, such as *Towering Cumulus* (TCU) and *Cumulonimbus* (CB) (Figure 1).

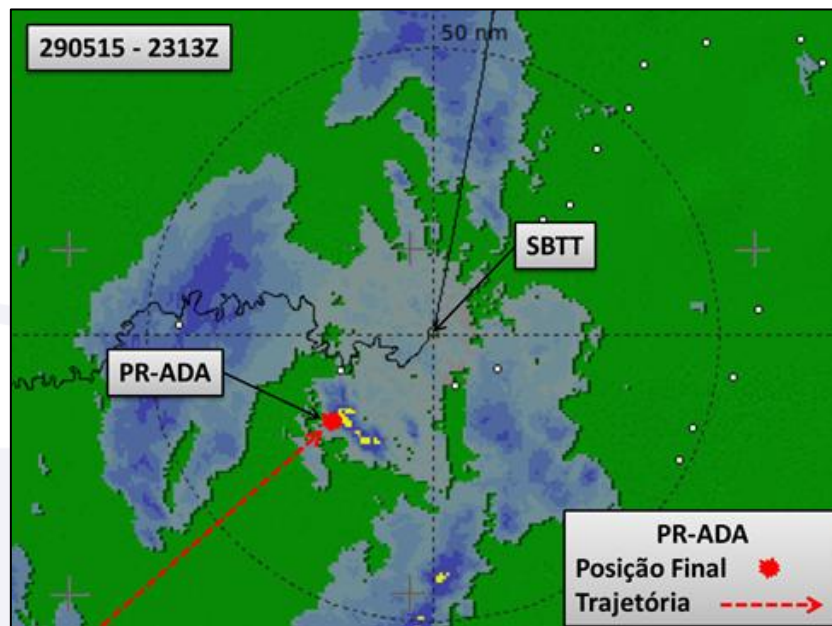


Figure 1 – Radar image of *Tabatinga* at 23:13 UTC.

According to inhabitants of a village located at a distance of 4 km from the accident site, there were also thunderstorms, gust of wind and heavy rain in the area.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The operating hours in SBTT were from 11:00 to 23:00 UTC.

On the day of the accident, the sunset in SBTT was at 22:34 UTC.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The aircraft landing skids are thought to have collided with the tree tops, resulting in an uncontrolled steep nose down attitude of approximately 45° into the dense forest vegetation.

The main rotor collided with the treetops, so as its blades and the tail boom/tail rotor section were detached from the aircraft.

The cockpit was fragmented and distributed in a fan-shaped pattern. Lighter items, such as documents, seats and cowlings were found close to the initial impact point.

The biggest portion of the fuselage, comprised of part of the skids, floor, firewall and fuel tank, was found 30 meters far from the initial impact point, with signs of post-impact fire, which consumed the majority of the remaining structure.

The engines were found 15 meters from the cockpit. They were 5 meters apart from each other, and presented several signs of impact and torsion. The number-2 engine sustained damage likely resulted from the power turbine blade release.

The wreckage comprised of mast, main rotor and transmission assembly was found 20 meters from the engines, in high terrain. It sustained substantial damage.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Not investigated.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The pilot worked fortnightly. When he was off duty, he would either return to the state where he lived with his family, or stay in the region until his next shift.

On the day of the accident, the pilot decided to take off from *Aldeia Pentiaquinho* at 22:03 UTC, even aware he would arrive in *Tabatinga* after sunset.

The helicopter was not certified for IFR flights, and the pilot was not IFR rated.

In former events, aware about *Tabatinga* Radio operating time, the pilot had requested extension of the radio working hours, since his estimated time of arrival (ETA) in *Tabatinga* would be after the scheduled closing time. The owner of the company had already warned the pilot against such practice.

On the day of the accident, as the ETA in *Tabatinga* was 23:30 UTC, the pilot requested postponement of the radio closing time to 00:00 UTC.

1.14 Fire.

A post-impact fire occurred due to the contact of the electric system and hot parts of the aircraft with the fuel onboard. It consumed approximately 80% of the remaining structure.

1.15 Survival aspects.

All the occupants were found fatally injured near the aircraft.

1.16 Tests and research.

The air safety investigators requested the analysis of the *Arrius* 1A (SN 2251 and SN 2222) engines, which equipped the aircraft on the day of the accident. The reason for the request was the damage found on the power turbine of the SN 2222 engine, likely resulted from the power turbine blade release. The damage to the SN 2251 engine, on the other hand, had resulted from the collision with the terrain and abrupt detachment of the main gear box.

Thus, Brazil's *TURBOMECA* issued an INVESTIGATION REPORT (REF: 2015-140) with the following conclusions:

The general condition of the engines did not allow to test them before their examination.

The examination of the engines established that all damage observed were the result of the crash.

The engine N°2 free turbine blades were ruptured as a consequence of engines overspeed when the engines to MGB transmission shafts were broken under power.

All parties of the investigation agreed that further examinations were not necessary since the physical evidences were sufficient to determine that both engines were delivering power at the moment of the accident.

The report showed that both engines were operating normally, with power development for flight, in the moment of the accident. Thus, the engine failure hypothesis was dismissed.

1.17 Organizational and management information.

The company had been operating in *Tabatinga, Amazonas*, since the second half of 2014, transporting passengers in support to *Secretaria Especial de Saúde Indígena* (SESAI – government agency which cares about indigenous health).

The air taxi company had few employees, and its head office was located in *Goiânia, Goiás*, where the operator had 90% of the physical facilities, and where the company administration took place. The owner of the company was one of the pilots of the helicopter, and he was also the headman of the air operations. He and the deceased pilot operated the helicopter of the company, and they took it in turns fortnightly.

In Brazil's northern region, there was no-one responsible for the operations in owner's absence, and the accident pilot did not use to go to the head office.

The organizational process of the company was not well defined. As the helicopter was operated by only two pilots (one of them owner of the company), the formal monitoring of their operational style was not being done so as it could identify any operational pattern.

In *Tabatinga*, besides the pilot, an aircraft mechanic (responsible for the helicopter basic maintenance, refueling and post-flight services) was present.

During the investigation, there were reports that the pilot had flown under night-time visual flight conditions in other occasions. It was confirmed by the log-book records showing flights ending after sunset.

The operator stated that the deceased pilot had been warned about the risks of the operation under night visual flight conditions in that region. However, even after the warning, the night flights were still taking place.

SESAI used to request the supporting flight in the afternoon. The flights usually lasted a period of time that made it necessary to complete the returning leg during night-time.

There was no company managerial supervision in *Tabatinga* other than the telephone contacts between the pilot and the owner of the company. So, the pilot was responsible for all the management and supervision of the operation.

1.18 Operational information.

The aircraft was within the prescribed weight and center of gravity parameters specified by the manufacturer.

A satellite tracking system was used to monitor the flights. The system showed the aircraft geographical position every 2 minutes. It showed also GPS altitude, direction and GPS speed information (Figure 2).

#	ID	Dispositivo	Data	Hora	Status	Mensagem	Lat	Lon	Velocidade km/h	Heading	Altitude meters
55	moreto01	H_moreto01	29/05/2015	22:03:08	Start		-6.61869	-71.87602	142.3	42	222
56	moreto01	H_moreto01	29/05/2015	22:05:09	Em Voo		-6.56873	-71.83390	232.6	41	279
57	moreto01	H_moreto01	29/05/2015	22:07:09	Em Voo		-6.51510	-71.78816	236.8	41	301
58	moreto01	H_moreto01	29/05/2015	22:09:09	Em Voo		-6.45856	-71.74348	236.3	37	299
59	moreto01	H_moreto01	29/05/2015	22:11:08	Em Voo		-6.40507	-71.69967	227.4	33	383
60	moreto01	H_moreto01	29/05/2015	22:13:09	Em Voo		-6.35052	-71.65577	235.1	41	310
61	moreto01	H_moreto01	29/05/2015	22:15:10	Em Voo		-6.29770	-71.61053	232.7	39	330
62	moreto01	H_moreto01	29/05/2015	22:19:09	Em Voo		-6.17919	-71.51614	240.7	39	335
63	moreto01	H_moreto01	29/05/2015	22:21:11	Em Voo		-6.12374	-71.46924	241.5	44	352
64	moreto01	H_moreto01	29/05/2015	22:23:10	Em Voo		-6.06753	-71.42252	249.1	39	334
65	moreto01	H_moreto01	29/05/2015	22:25:10	Em Voo		-6.00915	-71.37638	240.9	40	353
66	moreto01	H_moreto01	29/05/2015	22:27:11	Em Voo		-5.95003	-71.33160	251.8	37	370
67	moreto01	H_moreto01	29/05/2015	22:29:11	Em Voo		-5.88978	-71.28395	248.1	40	323
68	moreto01	H_moreto01	29/05/2015	22:33:10	Em Voo		-5.83187	-71.23835	240.1	39	349
69	moreto01	H_moreto01	29/05/2015	22:33:11	Em Voo		-5.77351	-71.19116	236.7	39	428
70	moreto01	H_moreto01	29/05/2015	22:35:10	Em Voo		-5.71343	-71.14766	254.3	36	375
71	moreto01	H_moreto01	29/05/2015	22:37:10	Em Voo		-5.65422	-71.10028	251.3	39	251
72	moreto01	H_moreto01	29/05/2015	22:41:10	Em Voo		-5.59796	-71.05344	246.5	36	282
73	moreto01	H_moreto01	29/05/2015	22:45:10	Em Voo		-5.47691	-70.96706	241.7	31	235
74	moreto01	H_moreto01	29/05/2015	23:03:12	Em Voo		-4.95601	-70.55209	234.9	40	353
75	moreto01	H_moreto01	29/05/2015	23:03:14	Em Voo		-4.90030	-70.50501	239.1	44	399
76	moreto01	H_moreto01	29/05/2015	23:11:13	Em Voo		-4.72684	-70.35008	247.8	43	407
77	moreto01	H_moreto01	29/05/2015	23:13:14	Em Voo		-4.67624	-70.30423	253.1	40	334
78	moreto01	H_moreto01	29/05/2015	23:15:15	Em Voo		-4.61822	-70.25568	244.0	39	288
79	moreto01	H_moreto01	29/05/2015	23:17:14	Em Voo		-4.56163	-70.20822	232.6	40	225

Figure 2 – Satellite tracking system transcription of the last moments of the flight.

On the day of the accident, the first record occurred at 20:02:58 UTC, with the aircraft stopped on SBTT ground. So, the system started recording the aircraft position, every 2 minutes, by the geographical coordinate (latitude and longitude), showing the landing hour in each place. The landing at *Aldeia Pentiaquinho* was recorded at 21:51:07 UTC.

The system recorded the aircraft starting the engines at *Aldeia Pentiaquinho* at 22:03:08 UTC. After takeoff, the pilot flew toward *Tabatinga*. During the flight, the GPS altitude varied from 225 to 428 meters.

The system recorded the highest altitude achieved by the aircraft (428 meters) at 22:33:11 UTC. Then, the aircraft started a shallow descent until the altitude of 235 meters, recorded at 22:45:10 UTC.

At 23:03:12 UTC, the aircraft was at altitude of 353 meters, rising to 407 meters (achieved at 23:11:13 UTC).

At 23:13:14 UTC, the system recorded the altitude of 334 meters and its gradual reduction until the last record, at 23:17:14 UTC, when the aircraft GPS altitude was 225 meters.

According to terrain data made available by National Aeronautics and Space Administration (NASA) by means of the Shuttle Radar Topography Mission (SRTM), the terrain elevation of the last point recorded by the tracking system was 89 meters.

Considering that the area had high trees of up to 40 meters, it can be inferred that, at that moment, the aircraft was flying about 96 meters (314 feet) above the tops of the trees.

At the crash site, the terrain elevation was of 112 meters. Considering the average height of the trees, the elevation could reach a value of 152 meters.

If the aircraft had kept the flight at the last recorded altitude, it would be flying only 73m above the treetops.

During the flight, the aircraft developed an average speed of approximately 230 km/h. At this speed, the helicopter would take about 1min50sec to travel the distance between the last recorded position and the point of impact. As the tracking system recorded positions every 2min, there was no new records between 23:17:14 UTC and the time of the accident.

Considering the developed average speed, the estimated distance traveled during night-time period was about 55 NM. The pilot flew this distance under Visual Flight Rules, outside the “*Amazônica*” TMA.

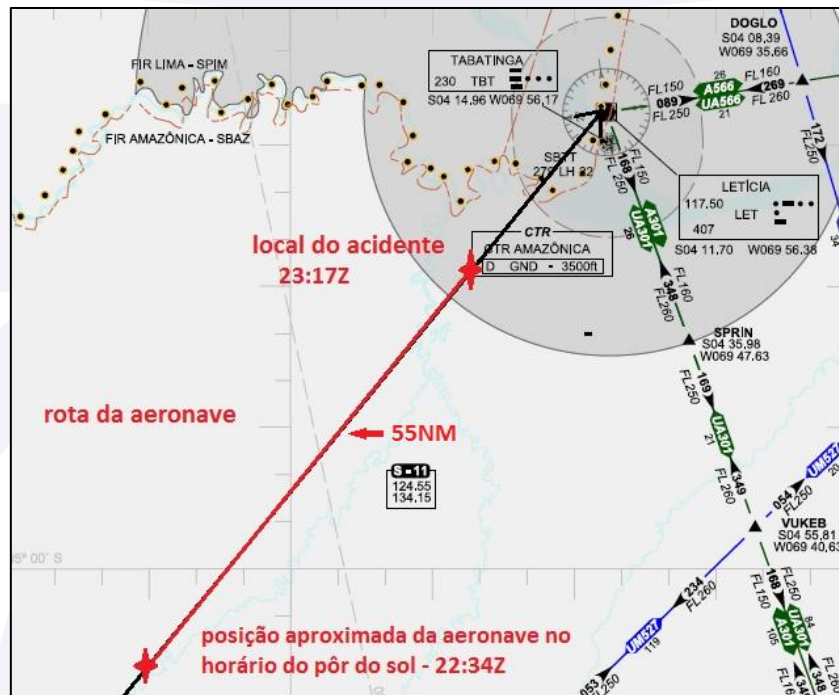


Figure 3 - Route flown by PR-ADA at night time.

A couple of routes usually flown by the operator had very long distances, hindering its accomplishment due to the lack of refueling stations. Thus, a 40-liter container of kerosene aviation used to be carried onboard, so as it could increase the aircraft autonomy and the safety for the pilot.

On the day of the accident, according to the satellite tracking system records, due to the late departure from *Tabatinga*, and the short period of time spent on the ground in each locality, it is possible to infer that the aforementioned refueling was not done.

During the initial examination of the accident site, a 40-liter container was found amid the wreckage, damaged by the crash, with a strong smell of kerosene near it.

In addition to the meteorological conditions prevailing at the moment of the accident, the sunset in *Tabatinga* on 29 may 2015 was estimated to be at 22:34 UTC.

1.19 Additional information.

The Command of Aeronautics' Instruction (ICA) 100-4, Special Air Traffic Rules and Procedures for Helicopters, reads:

“3.2 MINIMUM ALTITUDES FOR VFR FLIGHTS

3.2.1 Except for landing and takeoff operations, or when authorized by the regional SISCEAB organization with jurisdiction over the area intended for the operation, the VFR flight of a helicopter shall not be conducted over towns, villages, inhabited locations, or groups of people standing outdoors, at a height of less than 500 feet above the highest obstacle within a radius of 600 meters of the aircraft..

3.2.2 In locations not mentioned in 3.2.1, the flight shall not be conducted at a height lower than that which allows the aircraft to land safely in case of emergency, without posing any hazards to persons and property on the ground surface.

NOTE: The height mentioned above must be, at least, 200 feet.”

The ICA 100-4 also prescribed the following terms for VFR flights operations:

3.4.2 NIGHT-TIME PERIOD

3.4.2.1 In addition to the prescribed terms in the item 3.4.1:

- a) the pilot must be IFR-rated;
- b) the helicopter must be IFR-certified;
- c) the departure aerodrome/helipad, destination and alternate landing site must have:
 - runway/helipad lighting system in operating condition;
 - aerodrome/helipad beacon in operating condition;
 - Illuminated wind direction indicator, or ATS unit in operation; and
- d) The helicopter must be equipped with a VHF transceiver for the two-way communications with the pertinent ATS units.

3.4.2.2 The prescriptions in letters “a” and “b” of the item 3.4.2.1 are not applicable to night-time VFR flights when they are conducted entirely inside ATZ, CTR or TMA areas, including the projections of their lateral limits, or, if such air spaces do not exist, when the flights are conducted within a radius of 27 NM of the departure aerodrome/helipad.

The General Operating Manual, written by the operator, and approved by the Brazil's National Civil Aviation Agency (ANAC), prescribed procedures, operational limitations and other norms of compulsory observance by the company crews.

The item 6.3.7 – VFR flights – reads:

6.3.7.1 Minimum Altitudes

The operations of the company shall be conducted within the minimum limits established in the regulations, namely, 500 ft over gatherings of people in a radius of 600 m from the highest obstacle, and 500 ft over other locations. In the case of operations requiring flights below the minimum (SAE), authorization by the SISCEAB is necessary.

6.3.7.2. Visibility Requirements

The operations of the company shall be conducted with a ceiling condition higher than 1,500 ft, and visibility higher than 5 km. In Class B, C, D, or E airspaces, ½ statute mile during day-time, or 1 statute mile during night-time.

6.3.7.3. Operational Limits

Company aircraft shall have their operation limited, on account of meteorological conditions, to a visibility 50% higher than the pilot's field of vision, maintaining cloud separation of 1,500 m (horizontally) and 1,000 ft (vertically).

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

On the day of the accident, the aircraft took off from *Tabatinga, Amazonas* at 20:05 UTC for indigenous patients transport from *Aldeia Penticuinho* to *Tabatinga*. At 22:03 UTC, the aircraft departed *Aldeia Penticuinho* with destination of *Tabatinga, Amazonas*, with one pilot, one SESAI nurse, two indigenous pregnant patients and another indigenous who was accompanying.

As the estimated flight time was about 01h30min, the forecast landing at the destination would be at 23:27 UTC, almost one hour after the sunset in *Tabatinga*, which occurred at 22:34 UTC.

Being aware of fuel restrictions and time limitation regarding the sunset, the pilot may have chosen to fly direct to the destination. On route, adverse meteorological conditions for visual flight may have forced the pilot decision to fly at lower height to keep visual contact with terrain.

Risks for aerial operations rise significantly in low flying, especially in night-time flights, adverse meteorological conditions, and at high speed (all situations that were found in this accident).

Considering the restricted visual references, the low flying, the fact that the pilot was not IFR-rated, and the fact that the aircraft was not certified for IFR flights, it is possible that the pilot could not have kept an appropriate visual contact for orientation. Most importantly, the aircraft was flying VFR during night-time when the conditions along the route were not compatible with visual flight rules.

By opting to maintain the VFR flight, at night, outside the “*Amazônica*” TMA, the pilot did not comply with the instructions of ICA 100-4 of the Command of Aeronautics, especially in the following terms:

3.4.2.1 In addition to the prescribed terms on 3.4.1:

- a) the pilot must be IFR-rated;
- b) the helicopter must be certified for IFR flights;

3.4.2.2 The prescriptions in letters “a” and “b” of the item 3.4.2.1 are not applicable to night-time VFR flights when they are conducted entirely inside ATZ, CTR or TMA areas, including the projections of their lateral limits, or, if such air spaces do not exist, when the flights are conducted within a radius of 27 NM of the departure aerodrome/helipad.

By analyzing the aircraft logbook records, it was noticed that the pilot had been flying at night time gradually. The departures had been done before the sunset and the landings after the sunset. The pilot was getting used to flying at night-time. It probably increased his self-confidence to do so. This fact reinforces the human natural tendency of seeking support on earlier successful experiences in order to justify future similar attitudes.

As the pilot had already flown VFR at night-time successfully, it is possible that such experience made him feel safe towards repeating the action, even in adverse meteorological conditions. This fact influenced his judgment capacity to assess the risks, culminating in his non-observance of the operation rules.

As the operations were done with pilot’s complete independence, without the company control, this behavior could be repeated, and nothing would be done to avoid it. This way, it was noticed failure in the organizational process of the company, where the

lack of company control of the performance and operational criteria adopted by the crews reinforced the conduction of flights outside of safe operational standards.

So, this accident have typical signs of Controlled Flight Into Terrain (CFIT), an occurrence in which an aircraft under pilot control, is unintentionally flown into the ground, a mountain, a body of water or an obstacle. In this scenario, the crew is unaware of the impending disaster until too late.

The loss of situational awareness is the main characteristic of CFIT occurrences. Planning and judgment failures associated with adverse meteorological conditions and psychological characteristics favor the loss of situational awareness.

The presence of flight indiscipline observed in the lack of compliance with some of ICA 100-4 terms alerts to possible failures related to the pilot's training formation and operational life monitoring.

3. CONCLUSIONS.

3.1 Facts.

- a) The pilot had valid Aeronautical Medical Certificate;
- b) The pilot had valid Technical Qualification Certificate;
- c) The aircraft had a valid Airworthiness Certificate;
- d) The aircraft was within the weight & balance limits;
- e) The airframe and engine logbooks records were up-to-date;
- f) The pilot requested extension of the aerodrome operating hours until 00:00 UTC;
- g) The pilot was not IFR rated;
- h) The aircraft was not certified for IFR flights;
- i) The pilot flew under Visual Flight Rules, during night-time, outside the TMA;
- j) In the final moments previous to the impact, the helicopter was at a height less than 500 ft above the highest obstacle within a horizontal radius of 600 m of the aircraft;
- k) Meteorological radar image of SBTT depicted significant rain clouds at southwest sector of the aerodrome, near to the accident site;
- l) The aircraft collided with treetops;
- m) Both engines operated normally, with power development for flight, in the moment of the accident;
- n) The aircraft was destroyed; and

The pilot and the passengers perished at the crash site.

3.2 Contributing factors.

- Attitude – a contributor.

The non-observance of the prescriptions contained in the ICA 100-4 gave rise to a type of operation for which the pilot was not certified, reflecting a complacent attitude toward the regulations in force.

Such attitude may have been influenced by the pilot's self-confidence in conducting night-time VFR flights, whose departures would take place during day-time, but the landings were made more and more during the night-time.

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

From the analysis of both the information on the aircraft provided by the GPS tracker and satellite images of the moment of occurrence, it is possible to infer that the pilot encountered adverse meteorological conditions along the route. Such conditions (confirmed by local dwellers) indicate that the presence of rain restricted visibility for the pilot.

Since the aircraft was not certified for flying Instrument Meteorological Conditions (IMC), the pilot chose flying at low altitude in an attempt to keep visual contact with the terrain.

The reduction of the vertical separation with the ground drastically diminished the safety margins for the conduction of a safe flight, and the situation got even worse when horizontal visibility was further reduced by the falling rain.

- **Flight indiscipline – a contributor.**

By opting to maintain a VFR flight during night-time outside of the “*Amazônica*” TMA, the pilot went against the prescriptions of the ICA 100-4.

- **Perception – undetermined.**

Considering the weather conditions, in which the external visual references were limited, while flying at low altitude, with an aircraft not certified for IFR flights, it is possible that the pilot was not able to maintain awareness of his position in relation to the surrounding obstacles, and ended up colliding with the trees.

- **Flight planning – a contributor.**

The lack of accurate previous information on the mission to be accomplished led the pilot to respond to the SESAI’s summoning in an inappropriate manner.

Considering the available time for preparation of the aircraft after the summoning, one verifies that such time was too short, to the point of hindering an adequate planning of the flight.

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

The decision to take off from *Aldeia Penteiaquinho* at 17:03 local time, being aware that the landing in *Tabatinga* would take place well after the sunset, significantly increased the risks of the operation.

Upon choosing to fly over a large area of rain forest without any visual references during night-time with an aircraft not certified for IFR flights, the pilot ignored the minimum margins of safety for the operation, something that in conjunction with the degradation of the meteorological conditions contributed to the accident.

- **Organizational processes – a contributor.**

The company showed to possess faulty organizational processes, in which the lack of monitoring of the crews operational profile and performance favored the repetition of modes of operation and behavior that were not in accordance with the required standards.

- **Managerial oversight – undetermined.**

The lack of adequate oversight aiming at compliance with the required minimums for safe operations, with the clearance limits for the pilot in command, and the basic operating routines, may have contributed to the pilot operating outside of the established safety standards, leading him to fly the aircraft in marginal conditions in a region that was different from the one he was accustomed to.

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 Department of Airspace Control (DECEA):

A-081/CENIPA/2015 - 01

Issued on 26/05/2017

Evaluate the feasibility of including, in the electronic flight plan system (SIGMA) a logic capable of identifying and blocking VFR plans whose operation is scheduled to occur during night-time and outside of ATZ, CTR, or TMA limits, or still, if the air spaces just mentioned do not exist, when the flight is to take place within a radius of 50 km (27 NM) from the departure aerodrome or helipad.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

The operator discontinued his operations in the region until the establishment of a minimum operating structure in accordance with regulations so as to allow safe operation of the company's helicopters.

On May 26th, 2017.