COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 062/CENIPA/2021

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PP-PIT**
MODEL:	**AS 350 B2**
DATE:	**06MAY2021**

NOTICE

According to 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 by taking into account the contributing factors and hypotheses raised. Therefore, the report is a technical document reflecting 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 Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated into the Brazilian legal system by 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, using this report for any purpose other than preventing future accidents may induce 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 06MAY2021 accident with the AS 350 B2 aircraft model, registration PP-PIT. The accident was classified as “[LALT] Low Altitude Operation”.

During the inspection of power transmission grids, the main rotor blades hit a chain of insulators. After the collision, the helicopter made an emergency landing in a nearby field.

The aircraft had substantial damage.

The pilot and three passengers left unharmed.

An Accredited Representative of the *Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA)* - France, (State where the aircraft was designed) was designated for participation in the investigation.

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ANAC	Brazil's National Civil Aviation Agency
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
CVA	Airworthiness Verification Certificate
EHST	European Helicopter Safety Team
EO	Operating Specification
GPS	Global Positioning System
HMNT	Single-Engine Turbine Rating - Helicopter
MGSO	Safety Management Manual
NSCA	Aeronautics Command System Standard
PCH	Commercial Pilot License – Helicopter
PPH	Private Pilot License – Helicopter
PIC	Pilot in Command
SAE	Public Specialized Air Service Aircraft Registration Category
SERIPA V	Fifth Regional Aeronautical Accident Investigation and Prevention Service
SGSO	Safety Management System
SN	Serial Number
SIPAER	Aeronautical Accident Investigation and Prevention System
TPX	Non-Regular Public Transport Registration Category – Air Taxi
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	**Model:** AS 350 B2 **Registration:** PP-PIT **Manufacturer:** HELIBRAS	**Operator:** Helisul Air Taxi Ltd.
Occurrence	**Date/time:** 06MAY2021 - 1355 UTC **Location:** Arapoti rural area **Lat.** 24°04'01" S **Long.** 049°57'12" W **Municipality – State:** Arapoti – PR	**Type(s):** "[LALT] Low Altitude Operation" **Subtype(s):** NIL

1.1 History of the flight.

The aircraft took off from an eventual landing area, located in Vila Cerrado das Cinzas, Arapoti - PR, at around 1330 (UTC) to carry out a local inspection flight of power transmission grids with a pilot and three passengers on board.

After about twenty-five minutes of flight, the main rotor blades collided with a string of insulators on one of the towers. Subsequently, the crewmembers noticed a strong vibration in the controls and performed an emergency landing in an open area.

Figure 1 - View of the PP-PIT at the emergency landing site.

The aircraft had substantial damage.

The pilot and three passengers left unharmed.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	1	3	-

1.3 Damage to the aircraft.

The damage was limited to the main rotor blades.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	PIC
Total	6.537:06
Total in the last 30 days	20:00
Total in the last 24 hours	07:30
In this type of aircraft	2.937:00
In this type in the last 30 days	20:00
In this type in the last 24 hours	07:30

N.B.: The pilot himself declared the data relating to the flown hours.

1.5.2 Personnel training.

The PIC took the PPH course at Edra *Escola de Aviação*, Ipeúna - SP, in 2003.

1.5.3 Category of licenses and validity of certificates.

The PIC had a PCH License had a valid HMNT Rating.

1.5.4 Qualification and flight experience.

The pilot was qualified and had experience in this kind of flight.

1.5.5 Validity of medical certificate.

The pilot had a valid CMA.

1.6 Aircraft information.

The aircraft, model AS 350 B2, Serial Number (SN) 4942, was manufactured by HELIBRAS in 2010 and was registered in the SAE and TPX Categories.

The aircraft CVA was valid.

The maintenance records were updated.

On the date of the occurrence, the PP-PIT had 1,823 hours and 25 minutes of flight.

1.7 Meteorological information.

The weather conditions were favorable for the flight to take place. It was verified that there were no significant cloud formations, as can be seen in Figure 1.

The PIC reported winds incidence of 5 to 10 kt throughout the flight.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The occurrence took place out of the Aerodrome.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The impact occurred between the main rotor blades and the insulator chain of the power grid.

There was severe damage to all three main rotor blades.

Figure 2 - Damage to the main rotor blades.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

No evidence was found that problems of physiological nature could have affected the flight crew's performance.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

No evidence was found that problems of physiological nature or incapacitation could have affected the flight crew's performance.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

The pilot and passengers abandoned the aircraft by their means.

1.16 Tests and research.

No evidence was found of aircraft systems' contribution to the occurrence under analysis.

1.17 Organizational and management information.

The aircraft was operated by Helisul Air Taxi Ltd., whose operational headquarters were in Curitiba - PR.

The company had an SGSO implemented and had an MGSO accepted by the ANAC, with the last update on 30SEPT2020. The PP-PIT was included in its EO.

According to data on the internet, the company had more than 25,000 flight hours in line inspection operations, providing services to the largest companies in the transmission and power generation sector in Brazil.

The operator highlighted that the crew was experienced, with training abroad, and that they operated in the inspection of transmission lines performing the following works:

- inspection of conductors, spacers, and string of lightning insulators;
- inspection of gaps;
- control of vegetation within the strip; and
- inspection of constructions and buildings close to the conductors.

However, he informed that he did not have a specific training program for the operation of inspection of transmission lines. He used the Technical Field Manual - Aerial Inspection of Transmission Lines Using Helicopter, of July 1995, made available by the contracting company, *Furnas Centrais Elétricas* S.A.

The pilot involved in the incident was a professional hired by the operator.

1.18 Operational information.

The aircraft was within the weight and balance limits specified by the manufacturer at the time of the occurrence.

The take-off was carried out from an eventual landing area in Arapoti - PR and proceeded in the North direction, following the trajectory of PR-092, to intercept the inspection object.

Until the beginning of the line inspection, the flight was carried out keeping 500 feet. During the inspection, the helicopter maintained the height of the electrical power towers.

The PP-PIT had a high-resolution camera with image magnification.

The operation was guided by the Aerial Inspection of Transmission Lines Using Helicopter Manual published by the contracting company.

According to the PIC, during the inspection flight, in a displacement parallel to the transmission lines using a speed of 30 kt, at a distance of 10 meters from the power tower, he was surprised by a gust of wind. It made the helicopter move towards the power cables. This report was corroborated by the passengers.

Subsequently, the blades collided with the insulator chain (Figure 3).

Figure 3 - Location of the collision between the PP-PIT and the insulator chain of the power transmission grid.

According to reports, a distance of 10 meters from the building was applied to facilitate the inspection by the electric company technicians that were inside the aircraft.

After noticing a strong oscillation in the cyclic command, the PIC led the PP-PIT to an emergency landing in an open area. As can be seen in Figure 4, the flight took place in a valley.

Figure 4 - Final position of the aircraft after the emergency landing.

1.19 Additional information.

The Technical Field Manual - Aerial Inspection of Transmission Lines Using Helicopter, by *Furnas Centrais Elétricas* S.A., aimed to "provide helicopter pilots and line inspectors with the necessary subsidies for the development of the activity of Aerial Inspection of Lines of Transmission".

To this end, it contained a description of the rules and procedures that should be observed both by the helicopter pilot and the line inspector during the execution of aerial inspection services of transmission lines using a helicopter.

In this regard, Section 5, Helicopter Pilot Responsibility, defined that:

> The pilot is the main responsible for the safety of the device. He must inform himself regarding the weather conditions along the flight routes and has the final authority to cancel any flight due to mechanical problems, atmospheric conditions, and other safety conditions.

In turn, item 7.2, Safety on Inspection Flights, of Section 7, Safety Rules, stipulated that:

> 7.2.5.
>
> The height of the device concerning the ground (distance h, measured in meters) should be approximately the height of the tower. The lateral distance of the helicopter, in relation to the conductor cables (distance d), should be approximately 15.0m.

Figure 5 shows the positioning and distance of the helicopter from the transmission line.

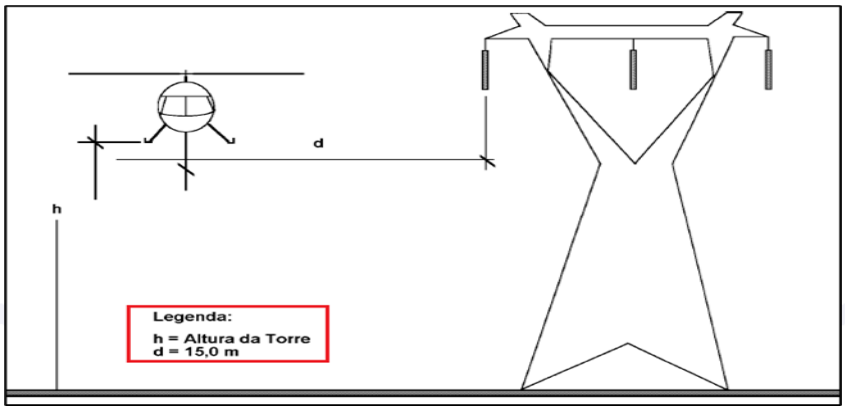

Figure 5 - Positioning of the helicopter in relation to the transmission line.

On 01MAY2014, the EHST published the document “Techniques for Helicopter Operations in Steep and Mountainous Terrains”, which warned of the fact that:

> The ability to transit, maneuver, land, and take off from steep or mountainous terrain is one of the most difficult aspects of helicopter operations. Pilots at some stage are likely to experience such a challenging environment that requires an understanding of the basic principles, threats, errors, and possible undesirable states of the aircraft to operate safely.

The document highlighted that flying in steep or mountainous terrain was particularly difficult and had already resulted in several helicopter accidents. In this sense, it proposed to present the basic techniques to be used in steep or mountainous terrain.

Regarding the wind, the publication recorded that:

> 2.1 Wind
>
> Awareness of wind speed and direction is critical in steep and mountainous terrain because it follows the surface. If the ground rises, the wind blows up a slope and is seen as the windward or windward side. If the ground descends from the direction of the wind, the wind blows downwards and is seen as the other side of the wind or leeward. When the wind blows over gentle hills and mountains, it tends to flow smoothly. When it blows over a cliff, it tends to stir on the edge, in a turbulent manner. When it is forced through an opening or gap in the terrain, i.e., along a valley, the speed is then increased due to the Venturi effect. On a downwind slope, there is rarely turbulence, and the resulting updrafts can be beneficial by producing more lift and thus requiring less power and easier maneuvering. As a result, slopes against the wind and with updrafts make operations easier and preferable. On a leeward slope, there are usually turbulences and downdrafts that can make flying dangerous and should be avoided. The area where the updraft becomes a downdraft is referred to as the demarcation line. The demarcation line between the updraft and downdraft air typically becomes steeper and moves towards the edge of the face to the downwind side with increasing wind speed.

When flying along a valley, it is preferable to fly close to the downwind slope to take advantage of updrafts rather than down to the center of the valley or windward. The leeward slope should be avoided because of downdrafts and a potential loss of lift (Figure 6).

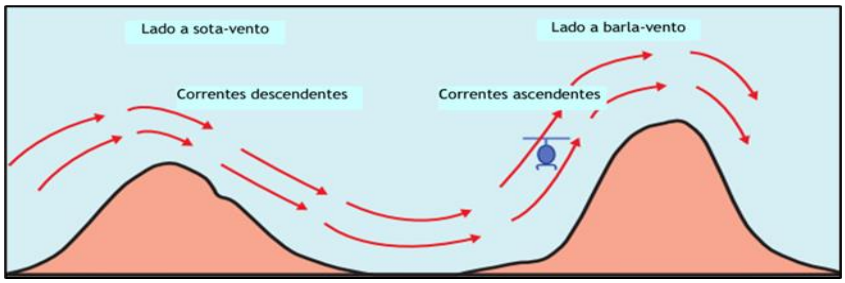

Figure 6 - Flight along a valley. Source: Techniques for Helicopter Operations in Steep and Mountainous Terrain from the EHST.

In the end, the document enunciated a series of recommendations, as follows, for the operation in mountainous terrain:

- be aware of the aircraft's performance and limitations;
- make a flight plan and notify someone of your intentions;
- study the navigation charts carefully; do not trust the GPS;
- get up-to-date weather information for a decision to go or not;
- do not go when the winds are more intense than 25 kt;
- fly at a safe altitude;
- be aware of wind direction and speed;
- monitor the signs of climate change;
- be aware of the psychological and physiological effects of flying over mountains;
- always plan an escape route;
- be aware of wind shears and recovery actions to be taken; and
- **Before flying in steep or mountainous terrain, receive appropriate training from a qualified flight instructor, who is experienced in mountain flying techniques.** (our emphasis)

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was an inspection flight of transmission lines at the service of the company *Furnas Centrais Elétricas*, taking off from an eventual landing area in Vila Cerrado das Cinzas, Arapoti - PR. After about 25 minutes of flight, the aircraft collided with a chain of insulators and landed in an open area.

The aircraft maintenance records were updated, and no evidence was found of the systems' contribution to the occurrence under analysis.

The PIC was qualified and experienced in the type of flight.

It was found that the weather conditions did not prevent the operation from being carried out, although they made it difficult to fly close to the power transmission system.

According to the PIC's report, during the inspection flight, in a displacement parallel to the transmission lines using a speed of 30 kt, at a distance of 10 meters from the power tower, he was surprised by a gust of wind that caused the helicopter was moved towards the power cables. Subsequently, the blades collided with the insulator string.

After the collision, the PIC maintained control of the helicopter and landed in an open area.

The operation was guided by the Technical Field Manual - Aerial Inspection of Transmission Lines Using Helicopter, published by the contracting company.

According to the PIC, in the moments before the collision, the helicopter was at a distance of 10 meters from the building. This removal was intended to facilitate inspection by the electric company technicians present inside the aircraft.

However, this differed from the provisions of item 7.2, Safety in Inspection Flights, of Section 7, Safety Rules:

> 7.2.5.
>
> The height of the device concerning the ground (distance h, measured in meters) should be approximately the height of the tower. The lateral distance of the helicopter, in relation to the conductor cables (distance d), should be approximately 15.0m.

This approach increased the risk of a collision by reducing the safety margin of the operation. Likewise, there was a decrease in the response time required for the PIC to avoid the impact, as it was found that, when hit by a gust of wind, the pilot was not able to avoid the collision with a chain of insulators.

Regarding the report of wind that fell on the helicopter and moved it towards the transmission line, the publication Techniques for Helicopter Operations in Steep and Mountainous Terrains, by the EHST, highlighted that, for a pilot to transit in steep or mountainous terrain, it would require understanding the basic principles, threats, errors, and possible undesirable states of the aircraft in order to operate safely.

In this sense, the guide presented the basic techniques to be used in this type of operation. Thus, when flying along a valley, it would be preferable to fly close to the downwind slope to take advantage of the updrafts rather than down to the center of the valley or windward. The leeward slope should be avoided because of downdrafts and a potential loss of lift.

In its conclusion, the publication enunciated a series of recommendations for the operation in mountainous terrain. Among them was one that directed the pilot to receive appropriate training from a qualified flight instructor who was experienced in mountain flying techniques. Thus, no evidence was provided that the PIC had this training.

The operator informed that it did not have a specific training program for the operation of inspection of transmission lines and that it used the Technical Field Manual - Aerial Inspection of Transmission Lines Using Helicopter.

Although it described the aspects of an inspection operation using helicopters, this manual was considered outdated by the Investigation Team for not considering technological advances, both in aircraft and in the methods of checking power transmission towers.

The aircraft was manufactured in 2010, about 15 years after the issuance of the Field Technical Manual and had a high resolution camera that allowed for image enlargement.

3. CONCLUSIONS.

3.1 Facts.

a) the pilot had a valid CMA;

b) the pilot had a valid HMNT Rating;

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

d) the aircraft had a valid CVA;

e) the weather conditions were favorable for the flight;

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

g) maintenance records were updated;

h) no evidence of contribution from the aircraft systems was found;

i) the operator reported not having a specific training program for the inspection of transmission lines;

j) the Technical Field Manual prevised the lateral distance of the helicopter in relation to the conductor cables of approximately 15 meters;

k) during the inspection flight, the PIC kept a distance of 10 meters from the power tower, in a displacement parallel to the transmission lines, using a speed of 30 kt,

l) after a gust of wind, the blades collided with the insulator chain;

m) after the collision, the PIC maintained control of the helicopter and landed in an open area;

n) the aircraft had substantial damage; and

o) all occupants left unharmed.

3.2 Contributing factors.

- **Control skills – a contributor.**

After the gust of wind, the PIC could not avoid the collision of the helicopter's blades against the chain of insulators of the transmission line.

- **Training – undetermined.**

The operator did not have a specific training program for the inspection of transmission lines and used the Technical Field Manual - Aerial Inspection of Transmission Lines Using Helicopter of July 1995, made available by the contracting company, *Furnas Centrais Elétricas* S.A., which did not contain all the necessary information for the operation.

No evidence was presented that the PIC had received training in mountain flying techniques.

- **Flight planning – undetermined.**

It is possible that inadequate preparation for the flight occurred when the wind intensity was not considered for the type of operation close to large obstacles, in mountainous terrain.

- **Support systems – undetermined.**

The Field Technical Manual - Aerial Inspection of Transmission Lines Using Helicopter of July 1995, made available by the contracting company, did not contain all the necessary information for the operation.

4. SAFETY RECOMMENDATION.

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

In consonance with 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 Brazil's National Civil Aviation Agency (ANAC):

A-062/CENIPA/2021 - 01 **Issued on 03/23/2023**

Disclose to Helisul Air Taxi Ltd. the lessons learned in this investigation so that the operator, in coordination with the company Furnas Centrais Elétricas, seeks to update the Technical Field Manual for Aerial Inspection of Transmission Lines Using Helicopters, especially concerning the use of technologies that can contribute to operational safety, and also carry out internal activities to promote operational safety, using the EHST publication Techniques for Helicopter Operations in Steep and Mountainous Terrains.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On March 23th, 2023.