COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 146/CENIPA/2016

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PT-HYE**
MODEL:	**HB-350B**
DATE:	**08NOV2016**

NOTICE

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

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

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

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

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

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

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

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

SYNOPSIS

This is the Final Report of the 08NOV2016 accident with the HB-350B aircraft model, registration PT-HYE. The accident was classified as “[SCF-PP] Engine Failure or Malfunction – With Rotor”.

During the vertical takeoff on the side of an Inn’s swimming pool, when reaching approximately eight meters in height and applying the cyclic command ahead, the low RPM warning (horn) began to sound and, simultaneously, the helicopter lost lift.

The pilot tried to recover it, lowering the collective and applying the cyclic ahead, in an attempt to clear the swimming pool that was below the aircraft, however, it was not successful.

The aircraft crashed into the edge of the swimming pool, slid on its margin, and yawed 90° clockwise, being partially submerged.

The engine stopped abruptly and the aircraft had substantial damage.

The pilot and the passenger suffered minor injuries.

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

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AFM	Aircraft Flight Manual
ANAC	Brazil's National Civil Aviation Agency
ANP	National Agency of Petroleum, Natural Gas and Biofuels
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
FCU	Fuel Control Unit
HMNT	Single Turbo Helicopter Rating
INVH	Flight Instructor Rating - Helicopter
NR	Rotor Rotation Speed
NS	Serial Number
OM	Maintenance Organization
PCH	Commercial Pilot License – Helicopter
PPH	Private Pilot License – Helicopter
RBHA	Brazilian Aeronautical Certification Regulation
RPM	Rotations Per Minute
SERAC	Civil Aviation Regional Service
SERIPA VI	Sixth Regional Aeronautical Accident Investigation and Prevention Service
TPP	Registration Category of Private Service - Aircraft
UTC	Universal Time Coordinated

1. FACTUAL INFORMATION.

Aircraft	**Model:** HB-350B **Registration:** PT-HYE **Manufacturer:** HELIBRAS	**Operator:** Private
Occurrence	**Date/time:** 08NOV2016 - 1600 UTC **Location:** Vale da Lua - GO **Lat.** 14°10'39"S **Long.** 044°46'44"W **Municipality – State:** Alto Paraíso de Goiás - GO	**Type(s):** [SCF-PP] Engine Failure or Malfunction **Subtype(s):** With Rotor

1.1 History of the flight.

The aircraft started to take off from an Inn, in the city of Alto Paraíso de Goiás - GO, to the city of Brasilia - DF, at around 1600 (UTC), with a pilot and a passenger on board.

During the vertical takeoff, at an altitude of eight meters, the cyclic command was applied ahead and the low-speed warning (horn) (RPM - Rotations Per Minute) started to sound. After that, the helicopter lost lift.

The pilot tried to recover it, lowering the collective and applying the cyclic ahead, in an attempt to clear a swimming pool that was below the aircraft, however, it was unsuccessful. The aircraft crashed into the edge of the pool, slid on its edge and swerved 90° clockwise.

The aircraft had substantial damage.

Both occupants suffered minor injuries.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

The aircraft had substantial damage to the entire structure, breaks in the main and tail rotor blades, and in the vertical and horizontal stabilizers.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flight Hours	Pilot
Total	2.000:00
Total in the last 30 days	18:00
Total in the last 24 hours	01:00
In this type of aircraft	300:00
In this type in the last 30 days	18:00
In this type in the last 24 hours	01:00

N.B.: The data related to the flown hours were provided by the pilot.

1.5.2 Personnel training.

The pilot took the PPH course at NEP Flying School – RJ, in 2006.

1.5.3 Category of licenses and validity of certificates.

The pilot had the PCH License and had valid HMNT and INVH Ratings.

1.5.4 Qualification and flight experience.

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

1.5.5 Validity of medical certificate.

The pilot had valid CMA.

1.6 Aircraft information.

The aircraft, serial number HB/1156-2571, was manufactured by HELIBRÁS, in 1992, and it was registered in the TPP category.

The aircraft had valid Airworthiness Certificate (CA).

The airframe and engine logbook records were outdated.

The last inspection of the aircraft, the “300 hours” type, was carried out on 24JUN2016 by the maintenance organization *Fênix Manutenção e Recuperação de Aeronaves* Ltd., in Goiânia - GO.

At the time of the occurrence, the aircraft accumulated 128 hours flown after the inspection of "300 hours", however, the records that attested the accomplishment of the inspection of the "100 hours" type, prevised by the manufacturer's maintenance program, were not presented.

1.7 Meteorological information.

The weather conditions were favorable for the visual 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 on the swimming pool of an Inn, with no evidence of previous impact. The distribution of the wreckage was of the concentrated type (Figure 1).

Figure 1 - Aircraft crash site.

The collision was witnessed by observers, who followed the entire process of boarding, starting and taking off.

After the impact, the aircraft remained on for a short time. The resistance imposed by the water in the swimming pool and its structure contributed to the abrupt stop of the engine assembly.

The place where the aircraft took off was very restricted and with several obstacles, some buildings and vegetation in the surroundings.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Nil.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Nil.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

The pilot and the passenger were removed from the aircraft with the help of people who witnessed the accident. They suffered some abrasions on the body, but managed to abandon the helicopter without great difficulties.

1.16 Tests and research.

The Investigators from the SERIPA VI conducted data collection on the wreckage with the support of a representative from HELIBRAS.

It was found that the blades of the main rotor showed signs of impact. The damage observed was characteristic of impact with power (torque and NR), as shown in Figure 2.

Figure 2 - Set of blades of the main rotor.

Analyzes of fuel samples (aviation kerosene), collected from the main tank and the fuel filter, were carried out. Both within the specifications established by the ANP (Figures 3 and 4).

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Relatório de Ensaio Nº.: CPT/OC00002/2017

PRODUTO: QUEROSENE DE AVIAÇÃO

Nº do Documento de Fiscalização: 0000000000
Data coleta: 08/11/2016
Município: BAIRRO CENTRO - bairro de Brasília/DF
Observação: Amostra retirada do dreno do tanque principal da aeronave. Acidente PT-HYE

Nº da Amostra: 000000000
Data de Entrada: 10/3/2017
UF: DF

LEGISLAÇÃO: Resolução ANP Nº 37, DE 1.12.2009 (DOU 2.12.2009) - Regulamento Técnico ANP nº 06/2009

Característica	Resultado	Especificação	Unidade	Tolerância	Método
Aspecto	Passa	CLIMS			NBR 14954
Massa Especifica a 20ºC	811,9	771.3 a 836.6	kg/m³	771 a 836.9	NBR 14065
Destilação - PIE	157,1		ºC		D 86
Destilação - 10% Recuperado	184,1	Máx 205.0	ºC	Máx 207.7	D 86
Destilação - 50% Recuperado	203,8		ºC		D 86
Destilação - 90% Recuperado	231,4		ºC		D 86
Destilação - PFE	246,5	Máx 300.0	ºC	Máx 304.2	D 86
Destilação - Resíduo	0,9	Máx 1.5	%	Máx 1.7	D 86
Destilação - Perda	0,8	Máx 1.5%	%		D 86
Teor de Enxofre	0,10	Máx. 0.30	% massa	Máx. 0.31	D 5453
Naftaleno	2,80	Máx 3.00	% vol.	Máx 3.11	D 1840
P. de Fuligem (naft. < 3,0%)	20,0	Mín. 19	mm	Mín. 16.7	D 1322

Laudo da amostra:
Amostra conforme as especificações da ANP para as características avaliadas. O valor encontrado para (Ponto de fuligem) se encontra dentro da tolerância estabelecida para a característica.

Figure 3 - Result of the fuel analysis of the main tank.
Source: ANP.

anp

Relatório de Ensaio Nº.: CPT/OC00003/2017

PRODUTO: QUEROSENE DE AVIAÇÃO

Nº do Documento de Fiscalização: 0000000000
Data coleta: 12/11/2016
Município: BAIRRO CENTRO - bairro de Brasília/DF
Observação: Amostra coletada do filtro de combustível. Acidente PT-HYE

Nº da Amostra: 000000000
Data de Entrada: 10/03/2017
UF: DF

LEGISLAÇÃO: Resolução ANP Nº 37, DE 1.12.2009 (DOU 2.12.2009) - Regulamento Técnico ANP nº 06/2009

Característica	Resultado	Especificação	Unidade	Tolerância	Método
Massa Especifica a 20ºC	811,9	771.3 a 836.6	kg/m³	771 a 836.9	NBR 14065
Teor de Marcador	Não detectado	Não detectado	µg/kg	Não detectado	Cromatografia gasosa

Laudo da amostra:
Amostra conforme as especificações da ANP para as características avaliadas.

Figure 4 - Result of the fuel analysis of the fuel filter.
Source: ANP.

The Arriel 1B engine, Serial Number (NS) 4420, which equipped the aircraft, was analyzed at the accident site and the signs found showed that it developed power at the time of the collision.

Thus, the engine was removed and subjected to tests at the headquarters of *Turbomeca Brasil*, in Duque de Caxias - RJ.

The free turbine had rubbing marks, a fact that made it impossible to perform the functional test on a test bench.

An inspection of the lubrication system did not indicate the presence of filings in the magnetic plugs. The engine permeability test revealed that the parameters were within the maximum limit established by the manufacturer. A boroscopic inspection on the M03 module (Figure 5) did not reveal any discrepancies.

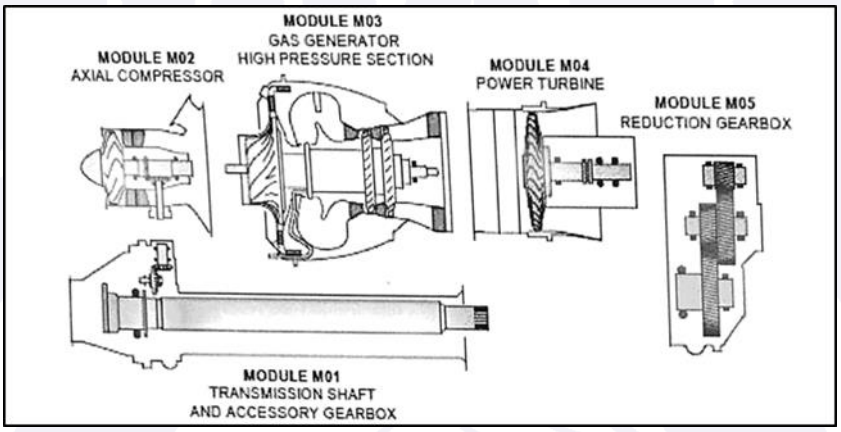


Figure 5 - Division of the aircraft engine modules.
Source: Aircraft Flight Manual (AFM).

The M05 module (Figure 5) was removed from the engine to check the alignment of the marks on the input pinion and its nut. After the removal, a misalignment of approximately 1mm was observed between these components (Figure 6).

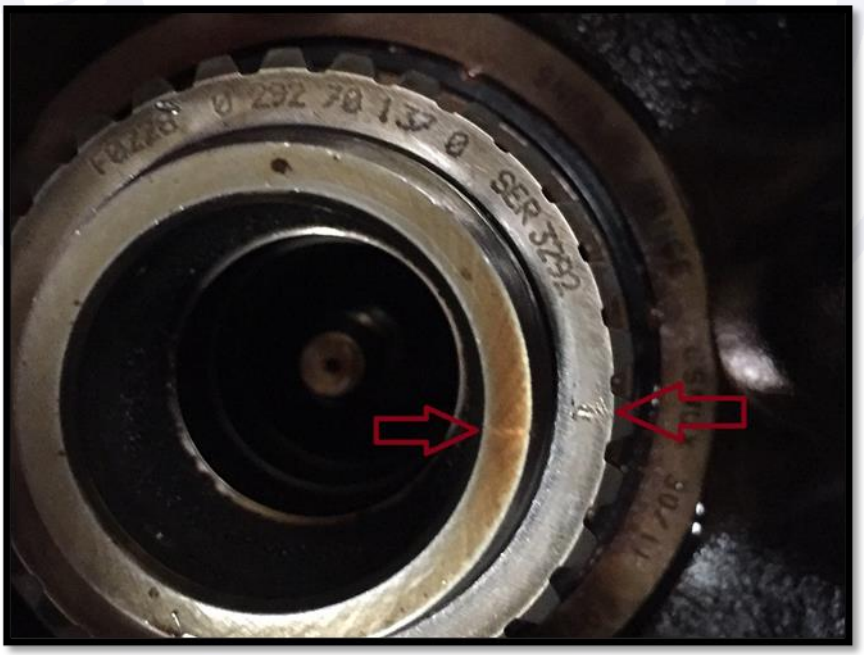


Figure 6 - Displacement of the nut from the engine's M05 module.

After consulting the engine manufacturer, it informed that, for the nut to move, the torque would necessarily have to be, at least, twice the nominal torque applied in its final

assembly. Therefore, this condition was an indication that the engine developed power at the moment of impact.

The tachymeter box, removed from the aircraft, had its seal and safety label violated, as well as an annotation in its structure with the inscription “intermittent” (Figure 7).

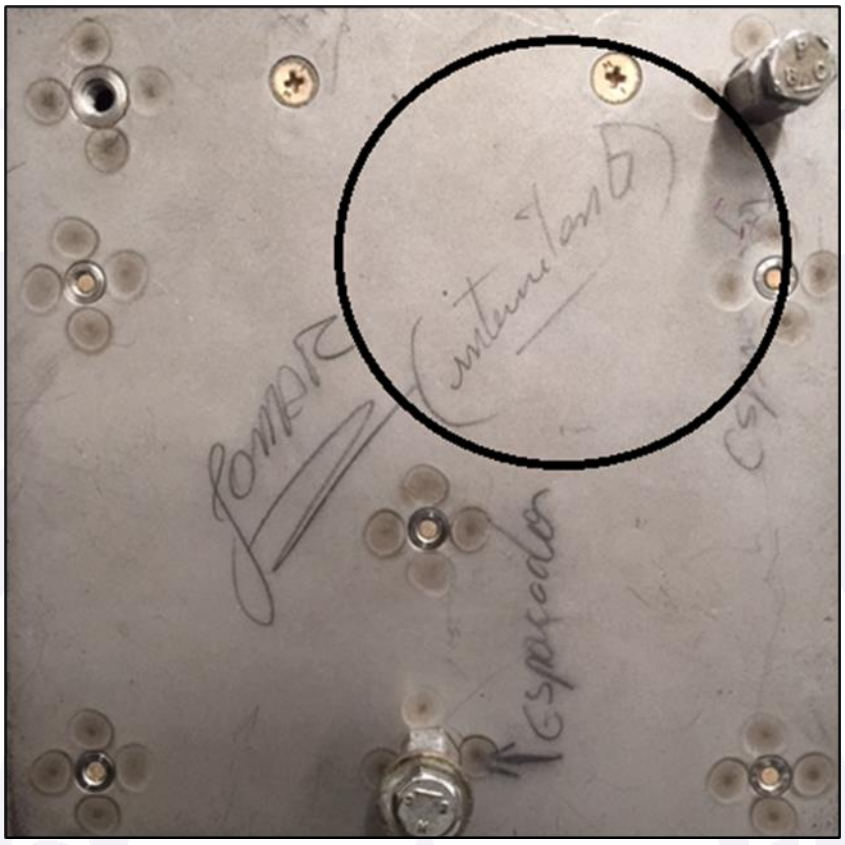


Figure 7 - Tachymeter box with the inscription “intermittent”.

The tachymeter box has the function of piloting the bleed valve and in doing so it allows the engine to operate correctly (without stall).

The pilot of the aircraft reported that, after the identification of a previous failure, the aforementioned equipment had been sent by the operator for maintenance at the company NAVTEC.

A consultation on the ANAC’s website revealed, however, that there was no certification issued by the Brazilian civil aviation authority for the company NAVTEC to act as a Maintenance Organization (OM).

Tests were performed on the tachymeter box and on the bleed valve, in a test bench, which were installed on an auxiliary engine. However, the results found were not able to reproduce the failure conditions reported by the pilot in the flight of the occurrence.

1.17 Organizational and management information.

The aircraft operated under the rules of the Brazilian Aeronautical Homologation Regulation n°91 (RBHA 91).

In spite of the pilot having reported to the Investigation Team that, in previous flights, the audible warning (horn) had sounded in conditions similar to the accident, there were no records of abnormalities in the aircraft logbooks.

Also, there were no records of maintenance interventions in the tachymeter box.

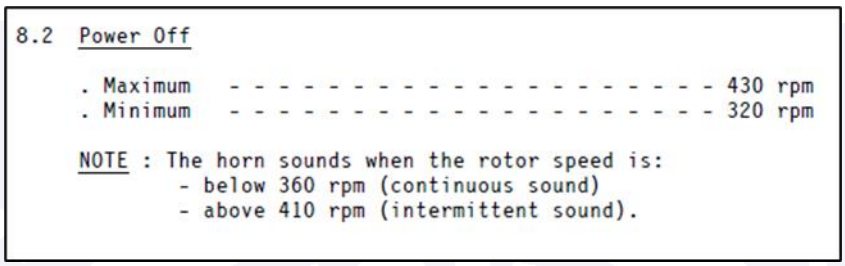
1.18 Operational information.

The aircraft was within the weight and balance limits specified by the manufacturer.

On a second interview with the aircraft commander, it was informed that, approximately one month before the accident, after a take-off, the occurrence of a failure similar to that described in this accident was observed.

At that time, the low RPM horn started to sound, but, because it was not repeated in later takeoffs, no maintenance or checking was performed on the aircraft.

The AFM, Chapter 2 - Operating Limitations, item 8.2, provided the following information about the audible warning (Figure 8).


8.2 Power Off

. Maximum - 430 rpm
. Minimum - 320 rpm

NOTE : The horn sounds when the rotor speed is:
- below 360 rpm (continuous sound)
- above 410 rpm (intermittent sound).

Figure 8 - AFM Item 8.2, Chapter 2 - Operating Limitations.

1.19 Additional information.

Regarding the area used for the operation of a helicopter, the RBHA 91, valid at the time, said the following:

> 91.327 - HELICOPTER OPERATION IN LOCATIONS NOT HOMOLOGATED OR REGISTERED.
>
> (a) Notwithstanding the provisions of paragraph 91.102 (d) of this regulation, helicopter landings and take-offs from locations that are not approved or registered may be carried out, as an occasional operation, under the operator's full responsibility (in the case of operations according to the RBHA 135) and / or pilot-in-command, as applicable, provided that:
>
> (1) there is no prohibition on operating at the chosen location;
>
> (2) the owner or person in charge of the site has authorized the operation;
>
> (3) the helicopter operator has taken reasonable steps to ensure the safety of the operation, the aircraft and its occupants and third parties;
>
> (4) the operation does not become routine and / or frequent;
>
> (5) if in a controlled area, the operation is conducted in bilateral radio contact with the Air Traffic Control;
>
> (6) be notified to the SERAC of the area, as soon as practicable, any abnormalities occurring during the operation; and
>
> (7) the selected location necessarily meets the following physical characteristics:
>
> (i) landing area: the landing area must be sufficient to contain, at least, a circle with a diameter equal to the largest dimension of the helicopter to be used;
>
> (ii) safety area: the landing area must be surrounded by a safety area, free of obstacles, with a surface level not higher than that of the landing area, extending beyond the limits of that area for half of the total compliance with the helicopter to be used;
>
> (iii) approach and take-off surfaces: the approach and take-off surfaces must have an angle of at least 90º between them, with ramps of at most 1:8; and
>
> (iv) transition surfaces: in addition to the surfaces defined in paragraph (a) (7) (iii) of this section, and not coinciding with them, there must be transition surfaces,

beginning at the limits of the safety area, extending to up and out of these limits with a maximum ramp of 1:2.

(b) For landing and take-off operations in areas not approved or registered in order to attend scheduled events such as popular parties, festivals, concerts, sports competitions, filming, etc., in addition to the rules established by paragraph (a) of this section, it is compulsory to obtain prior authorization from the SERAC of the area.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a passenger transport flight, which would take off from an Inn located in the city of Alto Paraíso do Goiás - GO, and continue on a cruise flight to Brasília - DF.

During the vertical take-off, when applying the cyclic command to the front, the low RPM warning (horn) started to sound and, simultaneously, the helicopter lost lift.

The results of the exams, tests and researches showed that the aircraft's engine developed power at the moment of impact.

In view of the information collected, in view of the reports of previous failures of the tachymeter box, associated with the lack of records that would guarantee the traceability and adequacy of any maintenance interventions, the hypothesis of the occurrence of a momentary failure of the tachymeter box was considered, which it may have resulted in a temporary loss of the engine power and a variation of the helicopter's main rotor rotation.

Thus, in the case of an intermittent operation of this equipment, there may have been a loss of rotor rotation and the consequent loss of support.

The probable inadequacy of the aircraft maintenance interventions may have resulted in its operation with equipment that was not in perfect airworthiness.

In addition to the points above, there was an inadequacy in the evaluation of the operating location, since the area did not meet the requirements demanded in the aeronautical legislation in force at the time of the accident, with respect to section 91.327 of the RBHA 91, notably in the specified in item (a) (7).

3. CONCLUSIONS.

3.1 Facts.

a) the pilot had valid CMA;

b) the pilot had valid HMNT and INVH Ratings;

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

d) the aircraft had valid CA;

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

f) the airframe and engine logbook records were outdated;

g) there was no record of the aircraft's “100 hour” inspection;

h) the tachymeter box had its safety label breached;

i) there was a report that the tachymeter box would have been subjected to maintenance in a non-certified location to perform such a service;

j) the weather conditions were favorable for the flight;

k) the take-off location did not meet the requirements demanded by the aeronautical regulations in force at the time of the accident;

l) when starting to move the aircraft, the low rotor rotation alarm sounded;

m) there was a loss of lift on the helicopter;

n) the aircraft crashed into the edge of a swimming pool;

o) the aircraft had substantial damage; and

p) the pilot and the passenger suffered minor injuries.

3.2 Contributing factors.

- **Aircraft maintenance – undetermined.**

The probable inadequacy of the aircraft's maintenance interventions may have resulted in its operation with equipment that was not in perfect airworthiness conditions, implying intolerable risks to the flight.

- **Other (lack of adherence to rules or regulations established by the Brazilian civil aviation authority) – a contributor.**

The aircraft's take-off location was very restricted and with several obstacles that compromised the safety of the operation, not meeting the requirements described in the RBHA 91.

4. SAFETY RECOMMENDATION.

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

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

Nil.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On September 17th, 2021.