COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 091/CENIPA/2013

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PT-HML**
MODEL:	**HB-350B**
DATE:	**08MAY2013**

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 08MAY2013 accident with the HB-350B aircraft model, registration PT-HML. The accident was classified as “[LOC-I] Loss of Control in Flight”.

During the final landing at the *Morro da Urca* helipad, the aircraft had a loss of lift and collided with a narrow area of forest near the summit of *Morro da Urca*.

The aircraft had substantial damage.

All occupants 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
BEA	Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile
CA	Airworthiness Certificate
CAVOK	Ceiling and Visibility OK
CENIPA	Aeronautical Accident Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
IAM	Annual Maintenance Inspection
ICAO	International Civil Aviation Organization
INEA	Environment State Institute
METAR	Aviation Routine Weather Report
PCH	Commercial Pilot License – Helicopter
PPH	Private Pilot License – Helicopter
SAE	Aircraft Registration Category of Specialized Air Service
SBRJ	ICAO Location Designator - Santos Dumont Aerodrome, Rio de Janeiro - RJ
SDHU	ICAO Location Designator - Morro da Urca Helipad, Rio de Janeiro - RJ
SEA	Environment State Department
SERIPA III	Third Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
TAC	Conduct Adjustment Term
TPX	Registration Category of Private Service
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** HB-350B **Registration:** PT-HML **Manufacturer:** HELIBRAS	**Operator:** Helisul Air Taxi Ltd.
Occurrence	**Date/time:** 08MAY2013 - 1530 UTC **Location:** *Morro da Urca* **Lat.** 22°57'05"S **Long.** 043°09'56"W **Municipality – State:** Rio de Janeiro – RJ	**Type(s):** "[LOC-I] Loss of Control in Flight" **Subtype(s):** NIL

1.1 History of the flight.

The aircraft took off from the Morro da Urca helipad (SDHU), Rio de Janeiro - RJ, at around 1520 (UTC), in order to perform a panoramic flight of approximately seven minutes, with a pilot and five passengers on board.

During the approach to land on the helipad, in a trajectory parallel to the cables of the Sugar Loaf cable car, which connects the Praia Vermelha to that hill, there was a loss of lift and the aircraft had a large sinking.

The helicopter remained in a downward turn with a left deviation until impact, about eight meters before the helipad, over an area of forest.

The aircraft had substantial damage.

All occupants left unharmed.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	1	5	-

1.3 Damage to the aircraft.

The aircraft had substantial damage to the main rotor, tail cone, tail rotor, perforations in the lower fairings, and wrinkling of the tail cone (Figures 1 and 2).

Figure 1 - General view of the aircraft after impact.

Figure 2 - View of the wrinkled tail cone.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Flown Hours	Pilot
Total	22.500:00
Total in the last 30 days	30:00
Total in the last 24 hours	01:51
In this type of aircraft	2.600:00
In this type in the last 30 days	12:20
In this type in the last 24 hours	01:21

N.B.: the data related to the flown hours were obtained through the pilot's report.

1.5.2 Personnel training.

The PIC took the PPH course in 1968.

1.5.3 Category of licenses and validity of certificates.

The PIC had the PCH License and had a valid H350 aircraft Rating (which included the HB-350B model).

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 a valid CMA.

1.6 Aircraft information.

The aircraft, serial number HB-1049/1642, was manufactured by HELIBRÁS, in 1983, and it was registered in the TPX and in the SAE Categories.

The aircraft's CA was valid.

The airframe and engine logbook records were not updated.

The last inspection of the aircraft, the “10 hours” type, was carried out on 01MAY2013 by the maintenance organization Helisul Air Taxi, in Foz do Iguaçu - PR.

The last more comprehensive inspection of the aircraft, the “2,500h/48 months” type, was carried out on 15MAY2012 by the maintenance organization Helisul Air Taxi, in Foz do Iguaçu - PR.

1.7 Meteorological information.

The METARs from the Santos Dumont Aerodrome (SBRJ), 2.4 NM away from the accident site and 682 ft below SDHU, provided the following information:

METAR SBRJ 081500Z 21008KT 9999 FEW020 SCT040 25/12 Q1020=

METAR SBRJ 081600Z 20008KT 9999 SCT020 26/14 Q1019=

The METARs at the Galeão Aerodrome (SBGL), 9.8 NM away from the accident site, had the following information:

METAR SBGL 081500Z 22008KT 9999 FEW020 BKN050 24/11 Q1020=

METAR SBGL 081600Z 19013KT 9999 FEW020 BKN040 24/12 Q1020=

The conditions were favorable for the visual flight.

On the day of the occurrence, there was a windsock installed near the helipad area, over the cable car station that linked Morro da Urca to Praia Vermelha.

However, its location was sheltered from winds coming from the South, due to a set of antennas close to the anemometric station of the cable car (Figure 3).

Figure 3 - View of the helipad and the location of the occurrence.

The Pão de Açúcar cable car's operator had a wind intensity monitoring system at Morro da Urca for safety purposes in the cable car operation.

The records of this system showed that, close to the time of the occurrence, the wind intensity was approximately 25 kt.

The wind record was presented in the form of a graph, which showed all wind directions and intensities in the last 48 hours, cumulatively.

This condition made it impossible to identify the precise direction of the wind that hit the top of Morro da Urca at the time of the accident.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The SDHU helipad was located near the top of Morro da Urca, at an altitude of 692 ft. It was private and operated under VFR day and night, having two approach surfaces: 19/28.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The impact occurred in an area of forest, about 8 meters away from the helipad.

The aircraft had damage along almost its entire length, caused by the force of the impact against the forest.

The damage observed to the main rotor and the trailing edges of the blades was typical of an engine developing power and applying collective at the moment of impact.

The shock against the ground was cushioned by the vegetation (Figures 4 and 5).

Figure 4 - Damage to the main rotor head.

Figure 5 - Main rotor blade broken at the trailing edge.

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.

Nil.

1.16 Tests and research.

Nil.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

It was a non-scheduled public air transport operation (Air Taxi), to transport personnel for a panoramic flight in the city of Rio de Janeiro - RJ, with a pilot and five passengers on board. The aircraft weighed approximately 1,934 kg at the time of the occurrence and was within the weight and balance limits specified by the manufacturer.

During operations at SDHU, the pilots of the aircraft operating company used information on the direction and intensity of the wind from the Santos Dumont Aerodrome (SBRJ). On the day of the occurrence, the aircraft complied with the procedures stipulated in a TAC, signed between state agencies and the company operating the aircraft, in order to avoid overflights at the Urca district.

The pilot and the operational representative of the company Helisul Air Taxi Ltd. stated, during the interviews, that the overflight of the Urca neighborhood was avoided at all costs by all pilots, as there was fear of a new interdiction of the helipad, a fact that had already occurred on 28MAY2012.

The aircraft took off to perform the panoramic flight as planned and without any technical problems, following the procedures established in the TAC, which were detailed in the company's "Standard Procedures Manual - Panoramic Rio de Janeiro".

The pilot of the aircraft noticed, at the end of the panoramic flight, during the approach for landing at the SDHU helipad, that the aircraft "sank" too much. Then, he tried to reduce the rate of descent, applying more power using the collective but was unsuccessful.

According to the pilot, it was possible to identify that the engine developed more power, as requested by applying more collective, but he noticed that the aircraft remained with an excessive descent rate.

Noting that there was no response from the aircraft when pulling the collective, the PIC decided to make a go-around procedure with a left turn. However, the aircraft remained in a downward curve, with a deviation to the left, until impact, about eight meters before the helipad, over an area of forest.

1.19 Additional information.

Vortex stall is an aerodynamic phenomenon typical of rotary-wing aircraft, which causes loss of lift and sinking of the aircraft:

> A helicopter that is hovering outside of the ground effect produces a lift equal to its weight. For this purpose, spiral-shaped descending vortex rings are formed at the tips of the blades. In addition, on slow vertical descents or with low forward speed, a small region appears where the airflow is upward, close to the root of the blades.
>
> If the collective control lever is commanded down, the lift decreases and reaches a value less than the weight of the aircraft. The helicopter begins a descent, seeking a balance between weight and lift. At low or moderate rates of descent, the upward flow of air decreases the angle of attack and increases the lift values in the middle and outer sections of the blades, keeping the helicopter at a constant rate of descent.
>
> Blade tip vortices consume engine power but do not generate lift. While these vortex rings are relatively small, the impact on the lift generated by the main rotor is almost nil, imposing only a decrease in its efficiency. As the rate of descent increases, the angle of attack on the inner sections of the blades reaches very high values, which can lead to stalling of this part of the rotor disk. Secondary vortex rings form near the root of the blades, at the intersection of the upward flow of air and the downward flow of induced air.
>
> If the rate of descent continues to increase, the secondary vortex rings formed are larger and larger and the rotor blades get closer and closer to these descending vortex rings (turbulent air below the helicopter) until the helicopter reaches a point at that most of the power generated by the engine will be wasted to accelerate the vortex rings. In practice, the helicopter will fly within its downwash, that is, in turbulent

air. The inner section of the rotor disk will be “stopped”. The symptoms felt by the crew are increased vibration, pitch and roll movements, and increased rate of descent, even with the upward collective application.

Increasing the collective pitch strengthens the action of the blade tip vortices and decreases the angle of attack and lift on the outer sections of the rotor disk. The consequence will be an increase in the stall condition in the inner section of the rotor disk and a decrease in the lift coefficient at the tip of the blades. The helicopter entered a vortex stall or state of vortex rings (LÍRIO, 2012).

This type of phenomenon occurs most often during approaches and landings, especially during wide-angle and tailwind approaches.

Figure 6, below, shows the trajectory performed by the aircraft on approach to land on the helipad, with a strong tailwind throughout the maneuver. A strong tailwind can be one of the trigger conditions for the vortex stall.

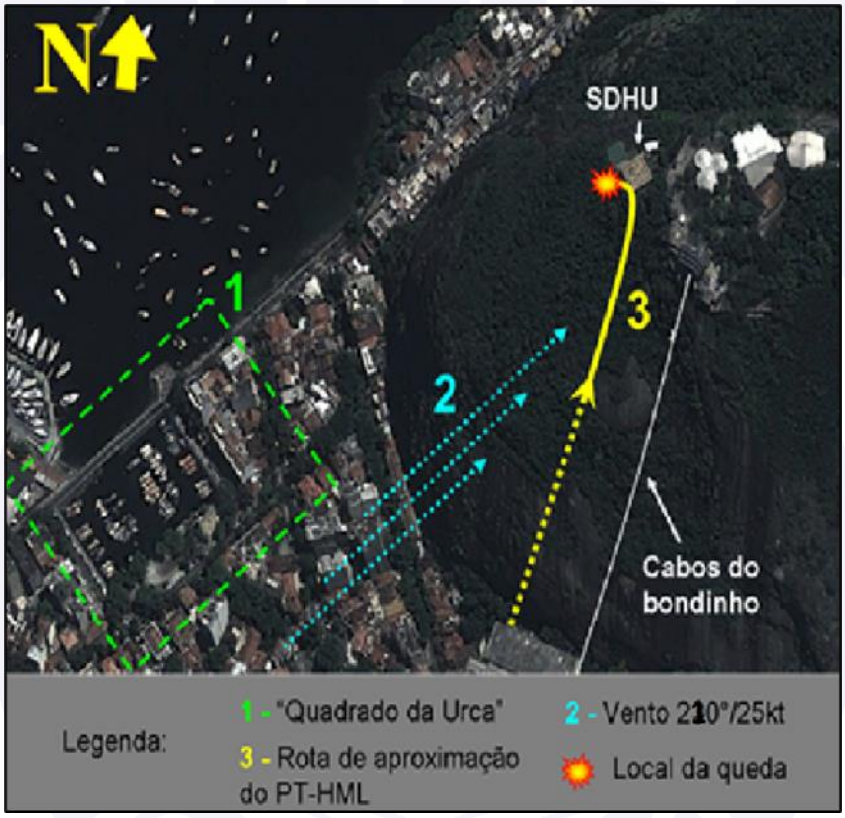

Figure 6 - Aircraft trajectory until impact.

The correct technique for regaining control of a helicopter in a vortex stall situation is to reduce the collective pitch and bring the cyclic forward, to increase forward speed and exit the turbulent air region or, still, enter autorotation if there is sufficient height.

However, in general, pilots tend to initiate recovery by acting on the collective upward command, in an instinctive attempt to decrease the rate of descent, before taking the cyclic forward. This tendency is even greater when the helicopter is close to the ground.

However, this attitude causes the opposite effect to the intended one, as it increases the angle of attack of the blades and, consequently, the stall area of the rotor disc, further increasing the aircraft's rate of descent.

Regarding the TAC, on 28MAY2012, the SEA and the INEA carried out an inspection action on the SDHU helipad, which resulted in its temporary closure on the grounds that the operation of helicopters in that place would be generating noise pollution in the neighborhood of Urca, located at the base of Morro da Urca.

To allow the return of operations, a TAC was carried out between the aforementioned agencies and the operating company, which prevised changes in the take-off, approach, and landing routes of the helicopters operating at SDHU.

The TAC foresaw the use of approach surface 19, which was practically parallel to the cables of the Pão de Açúcar cable car. The approach surface 28 was suspended to prevent the noise caused by the aircraft from reaching the Urca district.

The changes were included in the company's "Standard Procedures Manual - Panoramic Rio de Janeiro", and disclosed to pilots through a circular note, defining the general and specific procedures for each of the helipads used in the panoramic flights.

Among the specific procedures for operating at the SDHU, the "Standard Procedures Manual - Panoramic Rio de Janeiro" prevised the suspension of approach surface 28 and the use of approach surface 19 only.

The Manual detailed that all flights should depart from Praia Vermelha, keeping the *Forte do Leme* on the right, and that the return would be by the reverse circuit, carrying out, whenever the aircraft's performance allowed, takeoffs and landings with ramps parallel to the cable car cables, in order to avoid as much as possible, the overflight in the region known as “*Quadrado da Urca*”.

The "*Quadrado da Urca*" was the pier for mooring boats of a fishing colony on which the INEA installed a microphone to measure ambient noise for two months. At the end of this period, the measurement microphone was removed from the site.

The accident occurred one month after the noise measuring instrument was removed.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

It was a non-scheduled public air transport operation (Air Taxi), in order to transport personnel for a panoramic flight in the city of Rio de Janeiro.

The pilot of the aircraft and the operational representative of the Helisul Air Taxi Ltd. company stated, during the interviews, that the overflight of the Urca neighborhood was being avoided at all costs by all pilots, as there was fear of a new interdiction of the helipad, based on the sound measurement records of the INEA microphone.

On the day of the occurrence, the aircraft took off as planned, without any technical problems, following the procedures established in the Standard Procedures Manual - Panoramic Rio de Janeiro.

Flight time was estimated to be approximately seven minutes and the aircraft was within the weight and balance limits specified by the manufacturer.

At the end of the panoramic flight, the pilot approached for landing on the SDHU helipad through approach ramp 19, parallel to the cables of the Sugar Loaf cable car.

Despite the emphasis given by the Standard Procedures Manual - Panoramic Rio de Janeiro, that the parallel approach to the cable car cables would be performed whenever the aircraft's performance allowed, it was inferred that the pilot's greatest concern, as well as that of all pilots flying from SDHU, was to avoid overflying the area, regardless of the direction and intensity of the wind.

With this, it was concluded that decisions at the level of managerial supervision have led to a shift of attention from operational, meteorological, and aircraft performance aspects to issues of a different nature from the operational ones, which may have influenced the

pilot's judgment when proceeding with the approach. to SDHU, in a trajectory parallel to the cable car cables.

This decision could have been re-evaluated if the pilot had access to accurate wind information from SDHU. However, there was no meteorological station near SDHU to inform the pilots about wind direction and intensity conditions. As a result, the pilots always used the wind information from SBRJ, where, in the moments closest to the time of the occurrence, the wind presented a direction of 200° to 210° and an intensity of 8 kt.

Considering the distance of 2.4 NM to the SDHU, as well as the existence of artificial and natural obstacles, it is possible that the direction and intensity of the wind in SBRJ were not the same as those existing at the place of occurrence.

Furthermore, it was identified the existence of a windsock installed near the helipad area, on the station that connected Morro da Urca to Praia Vermelha, which would allow the pilot to have an idea of the wind intensity.

However, a wind from the South may have been influenced by the antennas installed in the vicinity of the windsock, interfering with the precise information of direction and intensity to the pilot.

Additionally, data from the anemometric system for monitoring the wind intensity at Morro da Urca were analyzed, which showed a wind intensity of approximately 25 kt, and it was not possible to specify the exact direction of the wind that hit the top of the Morro da Urca at that time.

It corroborates the possibility of higher wind intensity than that presented in the METARs, the high location of the SDHU (692 ft), as well as the incidence of winds, free of interference from obstacles.

Thus, an approximate wind of 210º with an intensity of approximately 25 kt was estimated.

It is noteworthy that a strong tailwind is one of the conditions that can initiate the vortex stall phenomenon.

During the approach, the pilot of the aircraft noticed that the aircraft “sank” too much. This sinking probably originated from an excessive descent rate, which may have started the vortex stall of the main rotor blades, when the air vortexed by the rotor itself begins to pass over the rotor disk, in the region where the angular speed is lower.

In addition, the low forward speed during the approach-to-landing descent, associated with the tailwind, may have placed the aircraft in an even more critical vortex stall condition, since, in this condition, there is no horizontal displacement of the swirling air out of the main rotor area.

Trying to reduce the rate of descent, the pilot applied more power using the collective but was unsuccessful. According to the pilot, it was possible to identify that the engine was developing power, corresponding to the application of collective, but he noticed that the aircraft remained with an excessive descent rate.

This attempt may have worsened the situation, because by applying more collective, the power was increased, but also the angle of attack of the main rotor blades.

The corrective maneuver in vortex stall situations highlighted the need to lower the collective and bring the cyclic forward, even with the loss of height, to increase the speed ahead of the aircraft and remove the aircraft's main rotor from the turbulent air generated by itself.

It is possible that the pilot tried to perform a go-around procedure, realizing that the aircraft was not reducing the excessive rate of descent, but only did so with the left cyclic command, instinctively keeping the collective pulled.

This hypothesis is supported by the damage to the trailing edge of the main rotor blades and by the final trajectory to the left taken by the aircraft until the impact on the forest area, to the left of the helipad.

3. CONCLUSIONS.

3.1 Facts.

a) the pilot had a valid CMA;

b) the pilot had a valid H350 aircraft type Rating;

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

d) the aircraft had a valid CA;

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

f) the airframe and engine logbook records were not updated;

g) the weather conditions were favorable for the flight;

h) the aircraft took off from SDHU to perform a panoramic flight of approximately seven minutes, with one crewmember and five passengers;

i) during the approach for landing at SDHU, there was a loss of lift and the aircraft had a large sinking;

j) the helicopter remained in a downward turn with a deviation to the left until the impact, about eight meters before the helipad, over a forest area;

k) during operations at SDHU, the pilots of the aircraft operating company used the information on wind intensity and direction from SBRJ;

l) on the day of the occurrence, the aircraft complied with the procedures stipulated in a TAC, signed between the INEA and the company operating the aircraft;

m) the TAC prevised changes in the take-off, approach and landing routes of helicopters operating at SDHU;

n) the TAC only prevised the use of approach surface 19, which was practically parallel to the cables of the Pão de Açúcar cable car;

o) the modifications to the TAC were included in the company's “Standard Procedures Manual - Panoramic Rio de Janeiro”, and disclosed to the pilots through a circular note;

p) the aircraft did not present any technical problems during the flight;

q) the damage observed in the main rotor and in the trailing edges of the blades was typical of an engine that developed power and application of collective at the moment of impact;

r) the aircraft had substantial damage;

s) the pilot and passengers left unharmed.

3.2 Contributing factors.

- **Control skills – undetermined.**

The approach with an excessive rate of descent may have initiated the main rotor blades vortex stall.

Then, when trying to reduce the rate of descent, the pilot applied more power using the collective, aggravating the situation by further increasing the angle of attack of the main rotor blades.

- **Attention – undetermined.**

The Standard Procedures Manual - Panoramic Rio de Janeiro, highlighted that the parallel approach to the cable car cables should take place whenever the performance of the aircraft allows. However, according to the reports obtained, the pilot's main concern was to avoid overflying the area, despite the direction and intensity of the wind.

With this, it was inferred that the decisions, at the managerial level, may have caused a deviation of attention from operational, meteorological, and aircraft performance aspects to issues of a different nature from the operational ones, which may have influenced the pilot's judgment when proceeding approach.

- **Adverse meteorological conditions – undetermined.**

There was no accurate wind direction and intensity information on SDHU available to pilots. As a result, wind information from SBRJ was used, which was different from those existing at the place of the occurrence, due to the distance and the existence of artificial and natural obstacles between them, culminating in a tailwind approach that can have contributed to the occurrence.

- **Airport infrastructure – undetermined.**

Although there is a windsock installed close to the helipad area, on the station that linked Morro da Urca to Praia Vermelha, it is possible that a wind of 210º direction was whirled by the antennas installed in the vicinity of the windsock and interfered in the imprecise information about its direction and intensity provided to the pilot.

- **Piloting judgment – undetermined.**

The approach to the helipad with tailwind may have contributed to the vortex stall condition and to the outcome of this occurrence.

- **Managerial oversight – undetermined.**

Decisions at the managerial supervision level may have led to a deviation of the pilots' attention on operational aspects, which may have influenced the decision to proceed with the approach to SDHU in a parallel trajectory to the cable car cables, according to the procedure prevised in the Standard Procedures Manual - Panoramic Rio de Janeiro, regardless of wind direction and intensity.

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.

The following corrective actions were taken by the operator:

- implantation of an additional windsock at the end of the access ramp to the helipad;

- implementation of an additional windsock in the sales booth at *Mirante do Morro da Urca*;

- implementation of a weather station in the sales booth at *Mirante do Morro da Urca*; and

- installation of two monitors/receivers with information from the weather station in real-time, updated every 2 minutes.

In addition, during the investigative process, the Investigators highlighted, as a recommendation to the operator, the need to ratify to the pilots the importance of faithfully observing the operational and performance aspects of the aircraft, as well as the existing meteorological conditions, despite issues of a different nature than operational.

On September 21th, 2022.