COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 561/CENIPA/2011

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-CEC**
MODEL:	**R-44 II**
DATE:	**10SEPT 2011**

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 10 September 2011 accident with the R44 II aircraft, registration PR-CEC. The accident was classified as In-flight Collision with Obstacle.

While flying between SBRJ and SBJR, the aircraft deviated to the right of the intended route, collided with a tree at the top of the terrain elevation, got uncontrolled and crashed in a valley in the Tijuca Forest.

The aircraft sustained substantial damage.

The aircraft occupants (the pilot and a passenger) were killed in the crash.

An accredited representative of the National Transportation Safety Board – NTSB, USA, was designated for participation in the investigation.

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AIC	Aeronautical Information Circular
ANAC	Brazil's National Civil Aviation Agency
BKN	Broken clouds
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CG	Center of Gravity
CHT	Technical Qualification Certificate
CMA	Aeronautical Medical Certificate
CTR	Control Zone
DCTA	Department of Science and Airspace Technology
FAA	Federal Aviation Administration
FCU	Fuel Control Unit
GPS	Global Positioning System
GRAER	Air Radio-Patrol Unit of the Goiás State Military Police
IAM	Annual Maintenance Inspection
IBAMA	Brazilian Institute of the Environment and Renewable Natural Resources.
ICA	Command of Aeronautics' Instruction
IFR	Instrument Flight Rules
IFRH	Helicopter Flight IFR rating
IMC	Instrument Meteorological Conditions
Lat	Latitude
Long	Longitude
NM	Nautical Miles
NTSB	National Transportation Safety Board (USA)
PCH	Commercial Pilot – Helicopter category
PPR	Private Pilot – Airplane category
PPH	Private Pilot – Helicopter category
RBAC	Brazilian Civil Aviation Regulation
RBHA	Brazilian Aeronautical Certification Regulation
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
TMA	Terminal Control Area
UTC	Universal Time Coordinated
VHF	Very High Frequency
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** R 44 II **Registration:** PR-CEC **Manufacturer:** Robinson Helicopter	**Operator:** Private
Occurrence	**Date/time:** 10 Sept 2011 / 23:15 UTC **Location:** Alto da Boa Vista **Lat.** 22°58'04" S **Long.** 043°17'12" W **Municipality – State:** Rio de Janeiro - RJ	**Type(s):** In-flight collision with obstacle

1.1 History of the flight.

At approximately 22:57 UTC, the aircraft departed from Santos Dumont Airport (SBRJ), destined to *Jacarepaguá* Airport (SBJR), on a passenger transport flight, with the pilot and one passenger on board.

After takeoff, the pilot requested to fly over *Marina da Glória*, and informed his intention to proceed to SBJR, via *Alto da Boa Vista* Helicopter Special Route. The aircraft performed a deviation to the right of this route, and collided with a tree at the top of an elevation.

Then, control of the aircraft was lost, and it crashed in a valley of the Tijuca Forest, located 60 meters below the point of the first impact.

1.2 Injuries to persons.

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

1.3 Damage to the aircraft.

There was no damage to the aircraft.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown	
	Pilot
Total	3,350:00
Total in the last 30 days	50:00
Total in the last 24 hours	04:00
In this type of aircraft	3,300:00
In this type in the last 30 days	50:00
In this type in the last 24 hours	04:00

N.B.: Data obtained from third parties.

1.5.2 Professional formation.

The pilot did his Private Pilot course (Helicopter category - PPH) at the *Nacional Escola de Pilotagem* in 2005.

1.5.3 Category of licenses and validity of certificates.

The pilot held a Commercial Pilot license (Helicopter category - PCH), and a valid technical qualification certificate for R44 aircraft.

1.5.4 Qualification and flight experience.

The pilot had proper qualification, and was a flight instructor, familiarized with the region where the accident occurred.

1.5.5 Validity of medical certificate.

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

1.6 Aircraft information.

The SN12504 aircraft was manufactured by Robinson Helicopter in 2008, and was registered in the Private Air Services category (TPP).

The aircraft airworthiness certificate (CA) was valid.

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

The Investigation Commission came to the conclusion that the maintenance services were being provided in accordance with the prescriptions contained in the manufacturer's maintenance program.

1.7 Meteorological information.

The 22:00 UTC SBRJ METAR referring to the hour immediately before the takeoff, informed visibility of more than 10km, a scattered layer of clouds at a height of 4,000ft (SCT – 3 to 4 oktas), and a broken layer of clouds at 9,000ft (BKN – 5 to 6 oktas).

The 22:00 UTC SBJR METAR indicated visibility of more than 10km, a scattered layer of clouds at 2000ft (SCT – 3 to 4 oktas), a broken layer of clouds at 4,000ft (BKN – 5 to 6 oktas), and sky overcast (OVC) at 7,000ft.

The 23:00 UTC SBRJ METAR indicated alteration of the clouds at 4,000ft, which became broken (BKN – 5 to 6 oktas). In SBJR, the changes were in layer of clouds at 2000ft, which became FEW (1 to 2 oktas), and dispersion of the layer of clouds at 7,000ft.

The METAR shows the height of the base of the cloud layers in relation to the aerodrome, not in relation to altitude.

At the moment of the accident, there were scattered orographic clouds in the mountainous region of the *Maciço da Tijuca* (Tijuca's Massif), forming areas of fog, especially on the south and southwest sides of the massif, on account of moist winds coming from the sea.

1.8 Aids to navigation.

In accordance with the Aeronautical Information Circular AIC-N 15, published by the Department of Airspace Control (DECEA) on 5 July 2007, the REH is an air route established with the purpose of allowing, exclusively, VFR helicopter flights under specific conditions.

Starting from *Marina da Glória*, it is possible to fly along the following REH's on the way to Jacarepaguá Airport:

1) Boa Vista REH: its limits are *Praça da Bandeira* (22°54'40"S/043°12'53"W) and PAZ position (23°00'05"S/043°19'43"W), sector SE of ATZ-JR, abeam *Supermercado Extra*, a location from which the pilot proceeds to Jacarepaguá Airport. This route has the *Estrada de Furnas* (Furnas Road) as a landmark, and the distance traveled to the destination is approximately 13 NM;

2) *Lagoa* REH / *Praia* REH: encompassing *Lagoa* position, then *Alá* position, where one intercepts *Praia* REH, proceeding to *Ponta da Joatinga* position and then *Jacarepaguá* Airport. The reference landmark for the route is the shoreline, with the aircraft flying over the beach. The distance traveled to the destination is approximately 14 NM;

3) *Maracanã* REH: its limits are *Praça da Bandeira* (22°54'40"S/043°12'53"W) and *Cidade de Deus* (22°56'59"S/043°21'40"W), from which one proceeds to *Jacarepaguá* Airport. The land mark along the route is the *Grajaú-Jacarepaguá* Highway (*Menezes Cortes* Avenue). The distance traveled to the destination is approximately 13 NM.

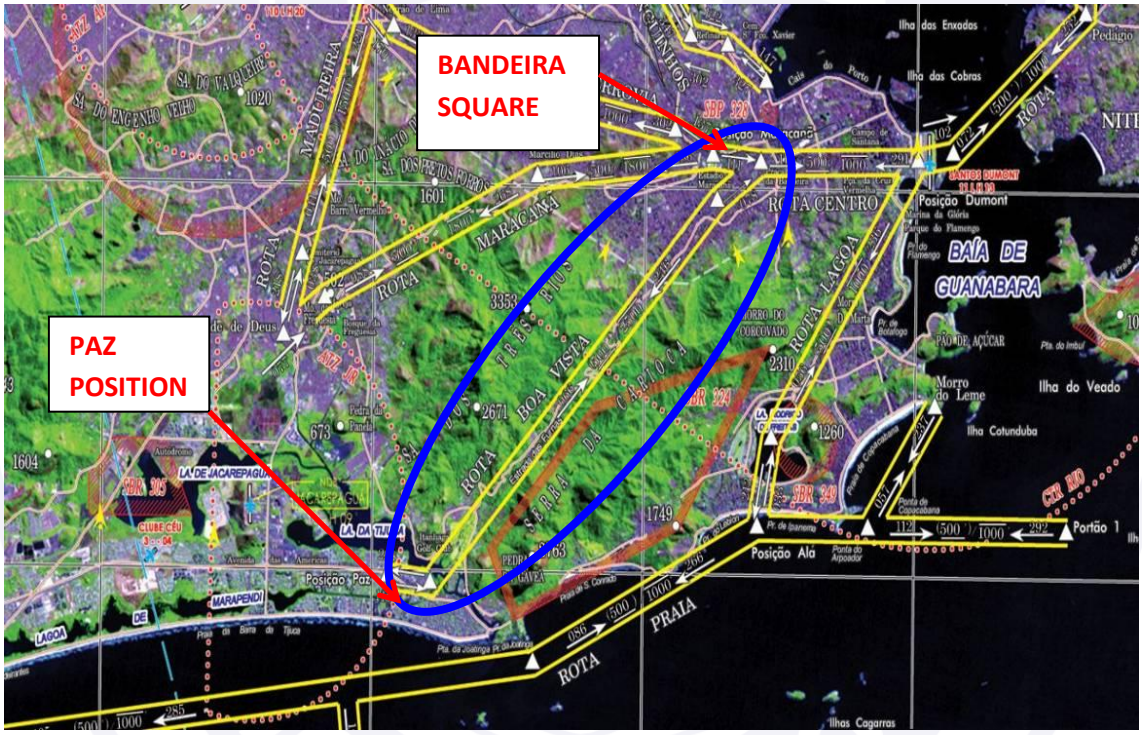

Figure 1 – Helicopter Special Routes (REH) of Rio de Janeiro Terminal, with Boa Vista REH in highlight.

The pilot of the PR-CEC chose Boa Vista REH to fly from Marina da Glória to the destination.

The vertical limits of the Boa Vista REH are 500ft AGL (lower) and 2500ft AGL (upper). Both ends of the route are at sea level. However, for the most part of the route the aircraft flies over the *Tijuca* massif, a mountain range with high peaks nearby (*Pedra do Conde* - 2,726ft high)

For keeping the Boa Vista REH corridor limits, the aircraft has to fly over Furnas Road in a valley.

The accident aircraft was under radar contact with Rio de Janeiro Terminal Area Control until moments before the accident, when it got out of the line-of-sight condition.

At the final moments, the radar showed a slight deviation to the right of the route, with the aircraft heading varying clockwise.

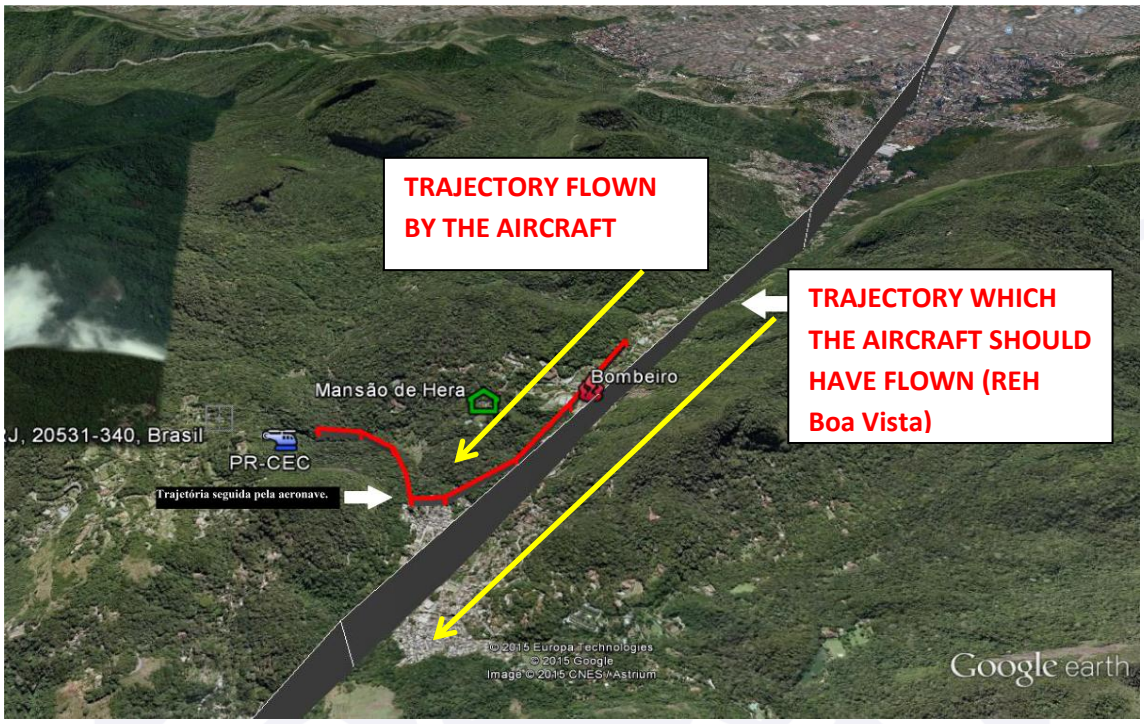

Figure 2 – Trajectory flown by the aircraft until radar contact was lost.

1.9 Communications.

Nil.

1.10 Aerodrome information.

The accident occurred outside of aerodrome area.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

The drift, the rear transmission box, and the tail rotor blades were found close to the tree where the first impact occurred.

One of the tail rotor blades was severed at its root, and presented a dent with marks and residues of the tree branch ripped out at the first impact at an altitude of 1,726ft.

The wreckage was found dispersed in a linear fashion, on the west side of an elevation, along a horizontal distance of 120 meters from the point of first impact, and 60 meters below, in a northeasterly direction (a heading of approximately 040º)..

1.13 Medical and pathological information.

1.13.1 Medical aspects.

Not investigated.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Not investigated.

1.14 Fire.

No signs of either inflight or post-impact fire.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

Nil.

1.17 Organizational and management information.

Nil.

1.18 Operational information.

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

According to the flight notification, the initial plan was to take off from SBRJ, and to proceed for landing in SBJR via *Lagoa* REH and *Praia* REH. However, after takeoff, the pilot requested to fly over *Marina da Glória*, where he stayed for 10 minutes according to the records of communication with the Control Tower of *Santos Dumont* Airport. After this period, the pilot requested change of the route to *Jacarepaguá* Airport via *Boa Vista* REH, and was granted clearance.

The new route (*Boa Vista* REH) would shorten the trajectory in about 1 NM.

1.19 Additional information.

The passenger was a professional photographer, and had requested the flight for taking aerial pictures of Rio de Janeiro. His camera was found close to the cabin of the aircraft

The Brazilian Aeronautical Homologation Regulation nº 91 (Civil Aircraft General Operating Rules - RBHA 91) does not establish the requirements for night-time VFR operations, such as adequate visual references of the surface.

Nevertheless, the Brazilian Civil Aviation Regulation nº 135 (Operating Requirements: Complementary and On–Demand Operations – RBAC 135) establishes criteria for night-time flights with helicopters in its subpart D – Limitations for VFR and IFR Operations (Weather Conditions Requirements, item 135.207.

> "135.207 VFR: Surface reference requirements for helicopters.
>
> No person is allowed to conduct a VFR operation of a helicopter unless they have visual references with the ground or, if at night, illuminated visual references on the ground below the helicopter sufficient for safely controlling the flight."

In its item 3.2, the Command of Aeronautics' Instruction 100-4 (ICA 100-4 Rules and Special Procedures for Helicopters) establishes that the minimum height for a VFR flight is 200ft, provided that there is no flight over cities, settlements, inhabited locations, or groups of people outdoors, in which case the minimum height shall not be lower than 500ft.

Also, in this regulation, there is a remark that authorization from the regional unit of the SISCEAB is required for scenic flights, footage flights, etc.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

The aircraft took off from Santos Dumont Airport (SBRJ), destined for Jacarepaguá Airport (SBJR) via Lagoa Rodrigo de Freitas and Praia REH's, after filing a night-time VFR notification.

After taking off, the pilot requested to fly over Marina da Glória for approximately 10 minutes. Considering that the passenger was a professional photographer and had hired the flight for taking photographs of Rio de Janeiro City, it is probable the over-flight of Marina da Glória had the objective of allowing him to take some night photos of the region.

On account of the over-flight, it is possible that the pilot may have decided to change the route, flying along *Boa Vista* REH, with the purpose of preventing a longer delay of the landing in SBJR, although not taking into consideration the meteorological conditions in the Alto da Boa Vista region. However, the METAR is a weather report with information, not enroute information. Thus, it becomes evident that the planning of the flight was deficient, since the weather conditions en route were not considered for making the decision as to proceed via Boa Vista REH.

The region of the Boa Vista REH, on account of its mountainous characteristics, favors the formation of clouds and fog patches which can hardly be perceived by pilots during the night-time, on account of the existence of large areas poorly illuminated. In addition, the nearby elevations restrict horizontal visibility a pose a high risk of collision with obstacles.

According to witnesses' reports on the meteorological conditions prevailing at the moment of the occurrence, the pilot probably did not perceive the presence of clouds along the route and level ahead of him due to the conditions of luminosity at the moment of the accident. In such scenario, the clouds may have been mistaken with dark areas existing in the Boa Vista REH due to the discontinuity of illumination in the region, leading the pilot to inadvertently enter IMC conditions, losing visual references with the ground.

For this reason, it is probable that the pilot, upon perceiving the inadvertent entry in IMC, may have reduced the horizontal speed, and attempted to return in a direction opposite to the direction of intended flight, that is, Jacarepaguá – Tijuca.

This hypothesis is corroborated by the trajectory of the aircraft detected by the APP-RJ radar, showing that the aircraft joined a corridor between the mountains, and, at the final moments of the flight, made a slight deviation to the right of the route.

The last position of the aircraft detected by the radar was near the crash site, and radar contact was lost on account of discontinuation of the line of sight condition. Therefore, it is suspected that the pilot believed in the corridor in an opposite direction. However, he made a turn of just 90º to the right, and the tail rotor collided with a tree located at the top of an elevation.

The RBHA 91 does not establish requirements of visual reference with the ground for night-time VFR operation with helicopters, in contrast with what is already established in the item 135.207 of the RBAC 135. Such requirement would increase the pilots' situational awareness to the possibility of inadvertent entry in IMC conditions, and a possible lack of attention in this respect, or even the lack of a detailed and specific regulation on the theme, may have contributed to the pilot's decision to the change the originally planned route, without considering the meteorological conditions.

However, the requirement contained in the RBAC 135 addresses the theme in a subjective manner, without concrete parameters for the definition of which illuminated reference is sufficient for controlling the flight with safety.

3. CONCLUSIONS.

3.1 Facts.

a) The pilot held a valid Aeronautical Medical Certificate (CCF);

b) The Pilot held a valid Technical Qualification Certificate (CHT);

c) The pilot had qualification and enough experience for conducting the flight;

d) The aircraft had a valid Airworthiness Certificate (CA);

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

f) The airframe, engine, and rotor logbook records were up-to-date;

g) The aircraft departed from SBRJ, destined for SBJR, after filing a night-time VFR flight notification, via Lagoa Rodrigo de Freitas and Praia Helicopter Special Routes;

h) Both the aerdrome of departure and the destination aerodrome were operating VFR at the time of takeoff;

i) After the takeoff, the pilot requested to fly over Marina da Glória, and informed that he would proceed to SBJR, via Alto da Boa Vista REH;

j) At the moment of the accident, there were scattered orographic clouds in the mountainous region of the Tijuca Massif, with formation of fog patches, especially on the south and southwest sides of the mountain range, on account of the moist winds coming from the sea;

k) For keeping the aircraft wthin the limits of the Boa Vista REH corridor, it is necessary to fly in a valley over Furnas Road;

l) At the final moments of the flight, the APP-RJ radar showed a slight deviation of the aircraft to the right of the route;

m) The tail rotor of the helicopter hit a tree located on top of na elevation, causing the aircraft to lose control and fall in a valley on the east side of the referred elevation;

n) The aircraft sustained substantial damage; and

o) The passenger and pilot suffered fatal injuries.

3.2 Contributing factors.

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

The meteorological conditions on top of the mountain range were decisive for the pilot inadvertently entering IMC.

- **Flight planning – a contributor.**

The pilot's decision to deviate from the route without taking into account the meteorological conditions in the Boa Vista REH, with the probable intention of seeking a faster path to the destination, contributed for the aircraft inadvertently enter IMC.

- **Other – undetermined.**

The lack of a detailed and specific regulation in the RBHA 91 concerning the requirement of ground references for the conduction of night-time VFR flights in helicopters may have contributed to the accident, in the hypothesis that it may have reduced the pilot's situational awareness of inadvertently entering IMC, leading him to him to change the original route without considering the meteorological conditions.

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 Air Space Control Department (DECEA):

A-561/CENIPA/2011 - 01 **Issued on 18/03/2016**

Establish helicopter night-time VFR-flight requirements in the RBHA 91 with the purpose of restricting operations to the situations in which the pilots are able to guarantee visual reference with the ground during the whole flight, including illuminated references in the night-time period.

To the Department of Airspace Control (DECEA):

A-561/CENIPA/2011 - 02 **Issued on 18/03/2016**

Analyze the possibility of restricting the operation in the *Boa Vista* REH to the day-time period, with the purpose of preventing the possibility of inadvertent entry in IMC due to the meteorological and geographical characteristics of the region, and the consequent navigational disorientation in a mountainous area.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On March 18th 2016.