COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-036/CENIPA/2020

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-SPI**
MODEL:	**AS-350 B2**
DATE:	**09MAR2020**

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 considering 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 distinct 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 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. Considering 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 09 March 2020 accident with the AS-350 B2 aircraft, registration marks PR-SPI. The occurrence received the typification of “[CTOL] Collision with an obstacle during takeoff and landing”.

On a mission for the transport of vital organs, the aircraft made an approach to land in a restricted area. The helicopter's main rotor blades collided with a lamppost.

For being France the State of design of the aircraft, the *Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile (BEA)* appointed an accredited representative for participation in the investigation of this accident.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ADE	Direct State-Administration
AFM	Aircraft Flight Manual
ANAC	Brazil's National Civil Aviation Agency
AOM	Aircraft Operating Manual
BAvPM	Military Police Aviation Base
BEA	France's *Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile*
CA	Certificate of Airworthiness
CAvPM	State of São Paulo's Military Police Aviation Command
CBA	Brazilian Code of Aeronautics
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CIV	Pilot Logbook
CMA	Aeronautical Medical Certificate
GSO	Safety Manager
HMNC	Conventional Single-Engine Helicopter Class Rating
HMNT	Turbine Single-Engine Helicopter Class Rating
METAR	Routine Meteorological Aerodrome Report
MOP	CavPM's Operations Manual
NADSO	Acceptable Level of Safety Performance
OM	Maintenance Organization
PCH	Commercial Pilot License (Helicopter)
PF	Pilot Flying
PIC	Pilot in Command
PLH	Airline Transport Pilot License (Helicopter)
PM	Pilot Monitoring
PMSP	State of São Paulo's Military Police
POP	Standard Operating Procedure
PPH	Private Pilot License (Helicopter)
RBAC	Brazilian Civil Aviation Regulation
RBHA	Brazilian Aeronautical Certification Regulation
SACI	Integrated Civil Aviation Information System
SERIPA IV	4th Regional Service for the Investigation and Prevention of Aeronautical Accidents
SGSO	Safety Management System
SIC	Second in Command
SIPAER	Aeronautical Accidents Investigation and Prevention System

SN	Serial Number
SOP	Standard Operating Procedure
TOD	Right-hand side operating crewmember
TOE	Left-hand side operating crewmember
UAP	Public Air Unit
UTC	Universal Time Coordinated
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions

1. FACTUAL INFORMATION.

Aircraft	**Model:** AS-350 B2 **Registration:** PR-SPI **Manufacturer:** Helibras.	**Operator:** *Polícia Militar do Estado de São Paulo.*
Occurrence	**Date/time**: 09MAR2020 – 19:50 UTC **Location:** *Hospital Geral de Pirajussara*. **Lat.** 23°38'24"S **Long.** 046°48'47"W **Municipality – State:** *Taboão da Serra – São Paulo.*	**Type(s):** [CTOL] Collision with obstacle(s) during take-off and landing

1.1. History of the flight.

At approximately 19:30 UTC, the aircraft took off from SBMT (*Campo de Marte* Aerodrome, *São Paulo*, State of *São Paulo*) bound for an occasional landing area located at the General Hospital of *Pirajussara*, municipality of *Taboão da Serra*, State of *São Paulo*, on a human-organ transport flight, with four crewmembers on board.

While the helicopter was descending vertically within the restricted area, the main rotor blades hit a lamppost. The crew completed the landing in the location of the mishap, and shut down the engine.

Figure 1 - View of the damage sustained by the PR-SPI at the accident site.

The aircraft sustained substantial damage, but none of the four crewmembers was injured.

A pedestrian who was passing by suffered minor injuries, whereas a motorcyclist was seriously injured.

1.2. Injuries to persons.

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

1.3. Damage to the aircraft.

The aircraft sustained substantial damage to the mast, blades and main-rotor head.

1.4. Other damage.

A lamppost was damaged. A parked car sustained damage to the windshield and to one of its side windows.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Flight Experience				
	PIC	SIC	TOE	TOD
Total	899:43	2,018:50	745:06	120:30
Total in the last 30 days	12:06	01:36	01:12	00:18
Total in the last 24 hours	00:18	00:18	00:18	00:18
In this type of aircraft	864:00	1,980:00	744:26	120:30
In this type in the last 30 days	12:06	01:36	01:12	00:18
In this type in the last 24 hours	00:18	00:18	00:18	00:18

N.B.: data provided by the Aviation Operations Division of the PMSP (State *of São Paulo*'s Military Police).

1.5.2. Personnel training.

The Pilot in Command (PIC) and the Pilot Second in Command (SIC) did their pilot training at the PMSP Public Aviation Unit Training Center in *São Paulo*, State of *São Paulo*, having started their PPH course (Private Pilot – Helicopter) in 2013 and 2006, respectively.

The Left-Hand Side Operational Crewmember (TOE) and the Right-Hand Side Operational Crewmember (TOD) began their training in the Aviation Medicine Division of the PMSP Public Aviation Unit, in *São Paulo*, State of *São Paulo*, and received the ground training provided, the in-flight training phase, and evaluated flights in 2010 and 2018, respectively.

1.5.3. Category of licenses and validity of certificates.

The PIC and SIC held PCH Licenses (Commercial Pilot – Helicopter) and had valid HMNC (Single-Engine Conventional Helicopter) and HMNT (Single-Engine Turbine Helicopter) ratings.

The TOD was a military medical doctor and the TOE was a military nurse. Both of them were duly qualified in accordance with the requirements established in the Brazilian Civil Aviation Regulation nº 90 (RBAC-90) - "Requirements for Special Public Aviation Operations" of the National Civil Aviation Agency (ANAC) for the exercise of the functions of medical support operator and health professional on board, and also in accordance with the internal requirements of the CavPM (State of São Paulo's Military Police Aviation Command).

1.5.4. Qualification and flight experience.

The pilots had qualification and experience for the type of flight.

The PF (Pilot Flying), who was effectively exercising control of the aircraft from the seat on the right, was the PIC, and had been operationally promoted to aircraft commander in the month of June of the previous year.

The PM (Pilot Monitoring), who performed the role of Second in Command (SIC), occupied the seat on the left, had more flight experience, and was hierarchically superior to the PIC.

1.5.5. Validity of medical certificate.

The four crewmembers held valid CMAs (Aeronautical Medical Certificates).

1.6. Aircraft information.

The SN 4963 aircraft was a product manufactured by Helibras in 2010, and had been registered in the Direct State-Administration Registration Category (ADE).

The CA (Certificate of Airworthiness) of the aircraft was valid.

The records of the airframe and engine logbooks were up to date.

The last inspection of the aircraft (type “10 hours/7 days”) was completed on 06 March 2020 by the CAvPM Maintenance Organization (OM), in *São Paulo*, State of *São Paulo*. The aircraft flew 5 hours and 30 minutes after the said inspection.

The last comprehensive inspection of the aircraft (type “600 hours/24 months”) was performed on 19 August 2018 by the CAvPM OM, in *São Paulo*, State of *São Paulo*. The aircraft flew 336 hours flown after the referred inspection.

The aircraft had approximately 2,750 total hours on the occasion of the occurrence.

One found no evidence of failures or malfunctions of the aircraft or of its components that might have contributed to the accident.

1.7. Meteorological information.

The weather conditions were found to be consistent with visual flights, with visibility above 10 km and no ceiling. The wind strength was between 08 kt and 13 kt.

On the day of the accident, the sunset was forecast for 21:28 UTC, and the accident occurred around 19:50 UTC. The position of the sun in relation to the aircraft at the time of the accident was approximately 21° above the horizon in the azimuth 275° (Figure 2).

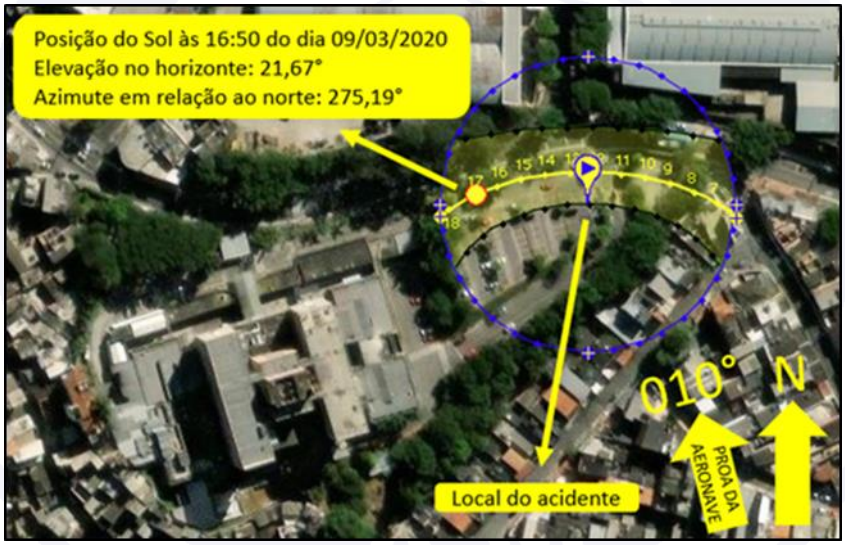

Figure 2 - Position of the sun at the time of the accident (the numbered arc represents the hours of the day and the respective position of the sun in relation to the accident site).

Figure 3 shows the position of the sun in relation to the aircraft (highlighted with a circle in yellow). This aerial photograph was taken in the area of the accident, moments after it had occurred.

Figure 3 - Aerial photograph of the sun's position taken moments after the accident.

1.8. Aids to navigation.

NIL.

1.9. Communications.

NIL.

1.10. Aerodrome information.

The accident happened outside an aerodrome area.

1.11. Flight recorders.

Neither required nor installed.

1.12. Wreckage and impact information.

The accident site used to be an occasional landing area, normally used for car parking, at the coordinates 23°38’24”S / 046°48’33”W. At the time of the accident, the exact spot chosen for the landing was free of vehicles but, besides some vegetation around, there were two lampposts nearby.

The main rotor blades collided with one of the lampposts, and all three of the blades were substantially damaged. Debris from the impact hit two passersby and a vehicle parked near the landing site (Figure 4).

Figure 4 - Accident spot and objects hit by the aircraft and its debris.

After the impact, the PIC managed to keep control of the aircraft in flight. Subsequently, the SIC took over the aircraft controls and decided to reposition the aircraft for another landing attempt. In this second attempt, the main rotor blades collided with a tree located immediately next to the affected lamppost (Figure 5).

Figure 5 - View of the PR-SPI, after collision with the public lamppost and the tree.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

There was no evidence that issues of physiological nature or incapacitation might have affected the performance of the crew.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

With respect to the crew of the accident flight, the medical doctor (TOD) was described as having a more reserved profile, while the nurse (TOE), in addition to being more experienced in aeromedical missions, demonstrated greater self-confidence.

During the preparation for landing, the TOE felt self-assured to direct the PIC to land further to the left. During the descent into the restricted area, the TOD stated that there was danger of collision to the right.

According to reports, after the main rotor hit the lighting post, the SIC took over the aircraft controls and attempted to land, moving the aircraft to the left, causing the blades to collide again, this time with a tree.

The relationship between the PIC and the SIC was friendly. They had worked together at an earlier point in their careers. In this sense, the PIC reported that he was confident in performing the mission with the SIC, despite the hierarchical difference between them.

It was necessary for the PIC to make provisions for the allocation of a SIC, a duty that would normally be accomplished by the Operations Division. As for the task of conducting external inspections of the aircraft, the PIC maintained it under his responsibility.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

The crew disembarked through the doors of the aircraft.

1.16. Tests and research.

NIL.

1.17. Organizational and management information.

Among the activities carried out by the CAvPM, the transport of human organs stands out. The shorter the duration of transport, the greater the chances of success in surgical procedures.

According to reports, the human organ transport mission had an atypical planning, since the team from the Aviation Medicine Division coordinating the incident was not the same one that accomplished the mission.

The team in charge of planning the mission had coordinated the use of a helipad near the General Hospital of *Pirajussara*, but the information did not reach the crew assigned to the mission. Therefore, the landing was made in an occasional landing area located in the hospital parking lot which had already been isolated and cleared.

According to the Standard Operating Procedure (SOP) - “Landing in a Restricted Area”, in selecting landing sites, the required space was defined as follows:

> Make sure that the space available for the aircraft to touch down has an estimated size of at least 20 x 25 meters.

The occasional landing area used had dimensions of 18 x 28 m.

For the flight of the accident in question, the crew in charge of the operation was not scheduled in advance, because on that day the PIC had been appointed as a second reserve, and the SIC, although adapted to the flight, had not been participating in the routine operational rotation of flights since May 2019. On account of his promotion, the SIC flew in the CAvPM in a sporadic fashion.

The organ transport mission was activated through the Operations Division at the end of the administrative day, with only one pilot composing the crew. The sector had all the

necessary means to verify the personal, medical and operational availability of CAvPM pilots, and had the authority to decide on the fulfillment of the mission order in case of low availability.

However, the definition of who would be the SIC was left to the PIC. Therefore, after receiving confirmation that the mission was activated, the PIC initially attempted (to no avail) to contact two pilots to form the minimum required crew of two.

He then proceeded to the SIC's office and invited him for the flight. Initially, the pilot invited was reluctant to take part in the mission, however, as there was no one else available, he agreed to participate.

It is worth mentioning that, during the time that the PIC was trying to find a second pilot for the mission, he simultaneously carried out the external inspection to prepare the PR-SPI.

The Operations Coordinator was a function created in the CAvPM for the coordination of missions and had, among his/her duties, to keep up to date with all missions and activities scheduled at his Military Police Aviation Base (BAvPM), in addition to assisting in the preparation of the mission execution.

From a personnel and logistical point of view, he/she should receive unplanned support demands and convey existing data to the operations sector or Operations Division, as applicable, to prepare the Flight Order.

One observed that the Operations Division did not have control over the frequency of the different types of missions carried out by the Unit's crews. Therefore, one was not able to identify the number of restricted-area missions that the crew in question had accomplished before.

Regarding the role of aircraft commander, the Brazilian Code of Aeronautics (CBA) provided the following definitions:

> Art. 165. Every aircraft will have a Commander on board, a member of the crew designated by the owner or operator, and who will be his representative during the journey.
>
> Single paragraph. The name of the Commander and of the other crewmembers will be listed in the Aircraft Logbook.
>
> Art. 166. The Commander is responsible for the operation and safety of the aircraft.

In turn, the RBAC-001 - "Definitions, Writing Rules and Units of Measurement for Use in ANAC Regulations" read that:

> Pilot in Command means a person who has the final authority and responsibility for the operation and safety of the flight.

With respect to the definitions of functions on board in the CAvPM, the "Operational Crew Course Manual" described them as follows (Figure 6):

PRINCIPAIS FUNÇÕES À BORDO:

Comandante da Aeronave (1P) – Piloto responsável pela operação e segurança da aeronave. Exerce a autoridade que a legislação aeronáutica lhe atribui.
Comandante de Operações (2P) – Responsável pela coordenação da operação e comunicações. Auxilia o Comandante na operação da aeronave.
Tripulante Operacional Esquerda – Observador
Tripulante Operacional Direita - Navegador
Enfermeiro – (Tripulante esquerdo) Durante o voo será o navegador e durante o pouso em área restrita fará a função de observador, orientando o Cmt Anv no pouso.
Médico – (Tripulante direito) Durante o pouso auxilia o Cmt Anv, fornecendo informações quando em área restrita, obedecendo às regras da fraseologia.

Figure 6 - Definition of onboard functions in the CAvPM.

That said, in accordance with the criteria in the Manual, the 1P, who was performing the role of PIC/PF at the time of the accident, was the pilot sitting in the right-hand seat. It

should be noted that the pilot who occupied the left seat (2P), SIC/PM, was hierarchically senior to the PIC, and had more flight experience.

In turn, the Subpart C of the RBAC-90 - “Requirements for Special Public Aviation Operations” defined the following requisites for someone to perform a role in the Public Air Unit (UAP):

> 90.21 General crew requirements
>
> (a) For the purposes of this Regulation:
>
> (1) minimum crew: crew defined in the aircraft's airworthiness certificate; and
>
> (2) operational crew: minimum crew plus the staff required to carry out special public aviation operations.
>
> Note: aerotactical and medical support operators, although composing the operational crew, are not crewmembers (crewmen), as defined in section 90.3.
>
> (b) Except as provided in paragraphs (c), (d), (e), (h) and (i) of this section, the operational crew for helicopters shall consist of, at least:
>
> (1) a pilot in command, in accordance with section 90.23 of this Regulation;
>
> (2) a pilot second in command, in accordance with section 90.25 of this Regulation; and
>
> (3) a tactical air operator or medical support operator in accordance with section 90.31 and 90.43 of this Regulation, respectively.
>
> (c) Notwithstanding the provisions of the complementary legislation of the Ministry of Health, the operational crew for helicopters with an aeromedical configuration certified by the ANAC and with restrictions in the cockpit for the role of the pilot second in command, must be composed of, at least:
>
> (1) a pilot in command, in accordance with section 90.23 of this Regulation; and
>
> (2) a tactical air operator or medical support operator under sections 90.31 and 90.43 of this Regulations, respectively.

In turn, the Subpart A - “General”, Section 90.5, defined the following duties of the air units of public organization and entities:

> [...]
>
> (b) The responsibilities of public organizations and entities covered by this Regulation are:
>
> [...]
>
> (4) urgent and emergency medical air operations: intended for health care, including rescue, rescue and mobile pre-hospital care, of an emergency and urgent nature in accordance with specific legislation and/or regulations;

The Subpart U, Section 90.301, of the RBAC-90 contained the general requirements for landing or takeoff in a location not registered by the ANAC.

In this regard, the regulation warned that:

> [...]
>
> (b) Special public aviation operations with airplanes must be carried out at aerodromes registered by the ANAC, unless landing at or taking off from a non-registered location is strictly necessary for the conduction of the referred special public aviation operation.
>
> (c) The initial requirement for landing at or taking off from a location not registered by the ANAC is that the control of the risk inherent to the operation, including the protection of aircraft, crew, other people working on board, passengers, and third parties, is within the NADSO.
>
> (d) Regardless of the provisions of this section, the pilot in command of the aircraft may refuse any aerial operation in a location not registered by the ANAC in order to preserve flight safety.

(e) The UAP must establish in the Operations Manual (MOP) and in the Standard Operating Procedures Manual (SOP) an express provision concerning landing and/or takeoff operations in locations not registered by the ANAC.

(f) The following are requirements for takeoff or landing in locations not registered by the ANAC:

(1) the location is under Visual Meteorological Conditions (VMC);

(2) the location has adequate dimensions for safe landing and takeoff in accordance with the aircraft's operational envelope and due risk management;

(3) there is assessment of the slope and nature of the terrain;

(4) the selected approach and climb routes minimize the aircraft's exposure to adverse meteorological phenomena;

(5) the load capacity (static and dynamic) of the surface on which the landing will be made has sufficient resistance to allow landing, parking and/or taxiing on the ground without damage to the aircraft, occupants, and third parties;

(6) there is assessment of the risk of collision for the rotors, propellers, or for any component of the aircraft with obstacles, people, or animals;

(7) the crew and other people working on board are properly trained for this type of operation, including curricular components to avoid collisions with wires and obstacles close to the ground;

(8) only the people involved in the operation are on board;

(9) the available margin of engine power is within the limits of the Airplane Flight Manual (AFM), including under high temperatures, high altitudes, and/or in turbulent atmosphere;

(10) the performance parameters provided for in the AFM or Aircraft Operating Manual (AOM) are maintained within the approved limits;

(11) there is assessment of the risk of the aircraft colliding with loose objects on the ground;

(12) a briefing is held with passengers on routine and emergency procedures, as well as provision of guidance on the appropriate way to board and disembark from the aircraft, if possible; and

(13) other procedures defined by the UAP are observed.

(g) The pilot in command must avoid prolonged flights within the restriction area imposed by the height versus speed diagram (dead man’s curve) provided for in the helicopter's AFM.

(h) The flight crew must establish, whenever possible, approach and takeoff ramps with emergency landing areas or free go-around trajectories, to mitigate risks in the event of a forced landing.

[...]

According to the ANAC, risk analysis was an exam for the assessment and weighing of risk indicators with the purpose of measuring dangerous situations based on their probability and severity in a qualitative and/or quantitative fashion. To this purpose, safety had to be guaranteed through a process aimed at providing control of the risks related to safety in the UAP’s activities. This process could reveal new hazards, highlight the need for new risk controls, in addition to excluding or modifying certain existing risk controls.

This organizational function of identifying and analyzing hazards, as well as evaluating and controlling the risks inherent to the UAP’s activities, was carried out through safety management, under the responsibility of a Safety Manager (GSO) designated by the public organization or entity in charge of managing the Safety Management System (SGSO) at the UAP.

The RBAC-90 was approved by the ANAC’s Resolution nº 512 (11 April 2019), which established, in its Article 2, the following transitional provisions:

I - the UAPs of public organizations and entities, as defined in the RBAC-90, will have the deadline of 12 April 2022, to comply with the provisions of Subpart B of RBAC-90;

[...]

V - the stages of the MOP implementation-plan must be completed by the following deadlines:

a) 12 April 2020, preparation of the MOP;

b) 12 July 2020, MOP approval by the UAP manager;

c) 12 October 2020, dissemination of the content of the MOP to those involved in UAP air operations; and

d) 12 April 2021, implementation by the UAP of all the procedures and policies defined in the MOP;

VI - the stages of the SOP implementation-plan must be completed by following deadlines:

a) 12 April 2020, preparation of the SOPs;

b) 12 July 2020, approval of the SOPs by the UAP manager;

c) 12 October 2020, dissemination of the content of the SOPs to those involved in UAP air operations; and

d) 12 April 2021, implementation by the UAP of all the procedures and policies defined in the SOPs;

VII - public organizations and entities must comply with the provisions of Subpart K of the RBAC-90 as of 12 April 2020;

VIII - public organizations and entities will have the deadline of 12 July 2020 to comply with the provisions of Subpart M of RBAC-90, with permission to use training programs approved in accordance with Subpart K of the Brazilian Aeronautical Certification Regulation nº 91 (RBHA-91) during the validity of this transitional provision;

[...]

1.18. Operational information.

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

The mission consisted of transporting a vital organ from the General Hospital of *Pirajussara* to the *Dante Pazzanese* Institute of Cardiology, *São Paulo*, State of *São Paulo*.

Unlike the pilots, the TOD and TOE had previously landed in the parking lot designated as the occasional landing area. Therefore, before takeoff, the PIC sought information from another crewmember to obtain more details regarding the landing site.

Furthermore, coordination had been made among the crewmembers to define the details of the operation in the location selected.

The TOE and TOD reported that they had already landed in that location, but never in that direction (aircraft facing the parking gate).

The decision to land in a direction opposite to the usual one was made in coordination with the whole crew, while they were flying over the landing site, due to several factors, such as the positioning of the ambulance on the ground, presence of passersby, and wind conditions (strength and direction).

No evidence was found that the UAP exercised formal control over the operation/training of crewmembers in restricted areas, aiming to manage the operational adaptation of crewmembers to that type of mission.

Furthermore, according to reports, one was able to verify the existence of an informal *modus operandi* in restricted-area missions, in which the most experienced crewmember on

the flight usually took the initiative to position the aircraft in the landing area in a way that would allow a greater margin of maneuver to the other less experienced crewmember.

In this sense, it was possible to identify that on flights in which there was a considerable difference in experience between the crewmembers, it was common for the more experienced crewmember to leave his side of responsibility with more restrictions of space, in order to allow a greater margin of maneuver to the less experienced crewmember.

During the dynamic of the flight, moments before the accident, the crewmember on the right-hand side informed that his side had restriction of space for landing, and the crewmember on the left-hand side informed that there was space to maneuver the aircraft and that it would be possible to continue the descent for landing.

At interviews, one verified that the definition of “restricted space” of both crewmembers in the rear seats was different, since, physically, the area available for maneuvering was considerably larger on the right-hand side of the aircraft.

In the manual of the Operational-Crew Course, the minimum distance between the aircraft and obstacles in a parking lot was defined as follows:

> Every aircraft in the parking lot must maintain a minimum separation between the tips of its wings (or blades) and those of other aircraft or obstacles. The minimum separation established for GRPAe aircraft is 3 meters.

Such information was not included in the Standard Operating Procedure (SOP), relating to restricted-area missions.

At interviews, there were reports that this distance between the helicopter and obstacles in restricted area missions was not commonly observed.

According to the crew involved in the accident, no formal briefing was held before the mission. There was just a coordination meeting to discuss details of the landing.

According to the manual of the Operational-Crew Course, the following guidelines had to be adhered to before any air mission:

> A “briefing” or “readiness action” must precede any and all air missions. The lack of a briefing, or the holding of a poor quality one, has already contributed to the occurrence of several aeronautical accidents.
>
> Holding a briefing is mandatory both with experienced crews and with passengers.
>
> In a clear, brief, and objective fashion, information must be conveyed with respect to the mission to be accomplished with the following objectives:
>
> • Identification of the functions that each individual will perform during the work shift;
>
> • Description of an emergency procedure for the aircraft being flown;
>
> • Description of Service Orders (missions) that are expected to be fulfilled on that day;
>
> • Report of an accident and/or unsafe condition that could affect the operation;
>
> • Description of an operational procedure;
>
> • Disclosure of the aircraft's status in relation to operability and/or maintenance;
>
> • Description of current and forecast weather conditions for the specific region;
>
> • Verification of the physiological and psychological conditions of the personnel involved in the mission; and
>
> • Encourage everyone to take the floor and participate actively.

The takeoff and the flight en route stages evolved within normal operating standards, with the TOE informing, along the way, having already landed several times in the selected location.

With the hospital in sight, the PIC reduced the speed, so that the crew could open the doors of the aircraft's cargo cabin, as prescribed in the POP 08.04.15 of 15 September 2001.

In order to check the area, the pilot made a right and a left turn overhead the landing site.

Watching a flag on the mast of a market close to the landing site, the PIC concluded that there was light wind.

Initially, the direction selected for landing would be upwind. However, the SIC advised approaching downwind, since the approach ramp would then have fewer obstacles, and the wind was light at that time. In the opposite direction, there was a high-voltage transmission line.

Subsequently, the crew performed cabin coordination, and everyone agreed with the SIC's suggestion.

In order to perform an operational verification of the piloting conditions before landing, the PIC carried out a “power check” out of ground effect, making sure that all flight and engine parameters were within the operational limits.

With the helicopter in hovering flight, the crew made gestures to the ground team, requesting the ambulance to move further away from the landing area.

At that moment, the PIC informed to be joining the final approach to the restricted area, flying the aircraft toward the vertical of the landing point, and the SIC reduced the volume of the communication radios, in accordance with the prescribed procedure.

The Standard Operating Procedure (POP) 08.04.15 prescribed the following:

> 13. The Aircraft Commander shall inform with respect to the location selected and the circuit defined;
>
> 14. After selection of the area by the Aircraft Commander, the two crewmembers shall guide the landing, indicating the necessary maneuvers for keeping the aircraft clear of obstacles.

It’s worth highlighting that there was no documentary information delimiting the sectors around the aircraft so that each crewmember might have a delimitation of their own field of vision, observing more closely their referenced sector during descents in operations within restricted areas.

Hovering over the landing spot, the PIC reported that the aircraft was “in position”, and was given information from the crew saying that the aircraft was free to begin the vertical descent.

During the first phase of the descent, one observed that the TOE moved his head in all directions, including downwards, showing to be aware of the surroundings on his side of the aircraft.

At a certain point of the descent (Figure 7), the TOD, positioned on the right-hand side of the aircraft, informed that his observation area was restricted, and requested movement to the left.

The TOE authorized the pilot to move the helicopter to the left, and requested him to turn the tail slightly to the left for a better positioning of the aircraft over the landing spot. After this repositioning, the descent was resumed.

By means of video recordings made by witnesses on the ground and at the hospital, it was possible to observe that the aircraft was at times making forward displacements while descending, namely when hovering outside ground effect, as well as when hovering over the landing site up to the moment of collision against the obstacle.

The CavPM's basic instruction manual contained the following information related to movements within a restricted area:

> Requests and instructions to the Aircraft Commander shall follow a logical sequence, with one movement at a time.
>
> After the helicopter reaches the desired position, the crew will request the aircraft commander to descend. If, during the maneuver, there is a change in the position of the helicopter's longitudinal axis or an involuntary movement forward or backward, the aircraft commander will be informed by one of the crewmembers.
>
> Trip Op: helicopter moving left (right) or forward (backward), maintain position.

By means of video images recorded by an observer, it was possible to notice a forward movement concomitantly with a vertical descent when the helicopter was overhead the intended landing site (Figures 7 and 8).

Figure 7 - Image of the PR-SPI captured as it was hovering outside of ground effect. Source: Image captured from video provided by an observer of the accident.

Figure 8 - Moment subsequent to the previous image, referencing the forward displacement in relation to the terrain. Source: Image captured from video provided by an observer of the accident.

At the moment depicted in Figure 8, the PIC was carrying out a more prolonged hovering flight, in which there was cabin coordination to check the position of the lamppost located in the left-hand front sector of the aircraft.

At that moment, the SIC requested a displacement to the right, but the TOD did not authorize it, due to restrictions of space on that side. As a result, the SIC requested to move backwards, however the TOE also reported restrictions for movement in that sector.

On the occasion, the TOE emphatically stated that the position was good and that vertical descent was free from that position. The SIC then requested the PIC to not deviate to the left in any way, due to close proximity with the obstacle. That said, the PIC questioned again whether the descent was cleared, having received authorization from the TOE to resume descent.

Six seconds after the helicopter restarted descent, the main rotor blades collided with the lamppost earlier observed by the SIC.

By means of video recordings made by two observers from different perspectives, one could notice again that, after such restart of the descent, the helicopter moved forward considerably.

In Figures 9, 10, 11 and 12, it is possible to observe this forward movement simultaneous with the descent.

Figure 9 shows the moment at which the PIC restarted descent after having performed a prolonged hover and after the crew performed cabin coordination relative to the positioning of the aircraft in the restricted area. The crewmember on the left-hand side was looking at the obstacle.

Figure 9 - Restart of descent. Source: Video image captured by an observer of the accident.

Figure 10 shows, just seconds after the preceding image, the exact moment of the first collision of the main rotor against the lamppost. The figure depicts the forward movement of the aircraft and the crew member's gaze at the tail of the aircraft at the moment of the impact.

Figure 10 - Precise moment of the first collision of the main rotor against the lamppost.
Source: Image captured from video provided by an observer of the accident.

From the perspective of another camera located at the hospital, Figure 11 shows the moment in which the PIC performed a prolonged hover, and the crew did the cockpit coordination on the position of the aircraft in the restricted area.

Figure 11 – Moment at which the PIC was performing a prolonged hover. Source: Image captured from a video provided by an observer of the accident located at the hospital.

Figure 12 also shows the moment of the collision of the main rotor blades against the lamppost.

Figure 12 - Moment of collision of the main rotor with the lamppost. Source: Image captured from video provided by an observer of the accident located at the hospital.

In fact, after the prolonged hover, one could observe that the TOE no longer moved his head downwards, and kept just looking at the aircraft's tail and at the lamppost. At the time of the first hits of the main rotor against the obstacle, the crewmember on the left-hand side was looking at the tail of the aircraft.

Shortly after the accident, a video was recorded where one can see that the sun was positioned on the left-hand forward sector in relation to the aircraft (Figure 13).

Figure 13 - Position of the sun relatively to the aircraft, immediately after the accident.

After the collision with the lamppost, the SIC took over the flight controls and quickly landed the aircraft, without comprehensive guidance from the crew, making the helicopter's main rotors collide with a small tree located to the left of the aircraft.

1.19. Additional information.

NIL.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was an organ transport flight under the responsibility of the Aviation Command of the State of São Paulo's Military Police.

The mission involved transporting a vital organ from the General Hospital of *Pirajussara* to the *Dante Pazzanese* Institute of Cardiology located in *São Paulo*, State of *São Paulo*.

The gathering of initial information from the Health Division was usually the job of the team engaged with the flight. On that day, however, it was initiated by members of the Aviation-Medicine Division and, at a given moment, the information collected was passed on to the doctor taking part in the flight.

According to accounts, the use of a private helipad near the hospital had already been coordinated before the aircraft took off, but the information was not passed on to the crew.

For not having received the pertinent information, the mission's TOD and TOE coordinated the use of the hospital parking lot for the landing, and therefore, the occasional landing area had already been authorized for the helicopter to land.

In this manner, one observed that there was inadequacy in the interaction and mutual collaboration between the different agents of the operation, since not all pieces of information collected were transmitted to the flight crew, evidencing the existence of flaws in the team's integration.

In coordination with the Aviation-Medicine Division, the Operations Division authorized the activation of the mission. Nonetheless, on that day, the task of designating a second pilot for participation in the flight was left to the PIC.

Such fact hampered the preparation of the mission, because the PIC, in addition to coordinating the landing in the selected location with the crew, had to prepare the aircraft, and find a second pilot for the operation.

For that matter, one observed that the PIC performed the external inspection with his attention still partially focused on finding a second pilot for the mission.

The Operations Division had all the necessary means to verify the personal, medical, and operational availability of the CAvPM pilots, and had authority to decide on the fulfillment of the mission order in case of low availability.

Furthermore, the investigation commission verified that the mission was activated at the end of the administrative day, a condition that may have contributed to the observed difficulty in designating the second pilot for the mission. That circumstance prolonged the time necessary for finding another pilot and, consequently, reduced the time available to the PIC for mission planning.

After the team that would carry out the flight was designated, no formal briefing was held covering all aspects provided for in the CAvPM documentation. There was only a meeting to define the details of the landing in the hospital parking lot. Such fact was confirmed when the investigation commission verified that the crew, on their way to the destination, talked about their landing experiences in that location.

Still in this respect, one observed informal practices characteristic of the organization, such as the search for information about possible landing areas from other members of the CavPM, instead of formal references, such as a previously established database.

That said, it would be fundamentally relevant to comply with the risk control requirement stipulated in the RBAC-90 (Subpart U, Section 90.301 - General requirements for landing or takeoff in a location not registered by the ANAC).

Despite the fact that, at the time of the accident, compliance with the provisions set out in the respective regulation were still in the phase of implementation, control of the risk inherent to landing or take-off operations in a location not registered by the ANAC, including protection of the aircraft, crew, and third parties, would be essential for maintaining an acceptable level of safety performance.

In the case in question, the recommendable application of risk analysis and management would be able to identify that the location lacked the appropriate dimensions for a safe landing. Similarly, one would be able to verify whether all people working on board were duly trained for that type of operation.

The risk analysis was an exam to evaluate and weigh any risk indicators with the purpose of measuring dangerous situations related to the operation based on their probability and severity, in a qualitative and/or quantitative way.

One observed that the Operations Division did not have control over the frequency of the different types of missions accomplished by the Unit's crewmembers, thus making it difficult to identify the performance and number of restricted-area missions previously accomplished by the UAP's crewmembers.

The flight procedures from the takeoff until the hover flight out of ground effect over the accident site were uneventful.

The crew performed cabin coordination to decide on the direction of approach to the location, and made visual signals to the ambulance so that it stayed clear of the aircraft's landing site. During such coordination process, according to reports, the team acted cohesively.

During the vertical descent at the landing site, a discrepancy was observed in the concept used for the definition of "restricted sector for landing" by the cargo-cabin crew. The TOE, on account of his extensive operational experience, accepted smaller margins of space for aircraft maneuver, while the TOD was more cautious and restrictive.

Furthermore, one could identify a work-group culture in relation to the attitude assumed by crewmembers in situations of significant difference in operational experience. The more experienced crewmember naturally sought to leave the opposite side of the aircraft with greater room for maneuver for any errors made by the less experienced crewmember.

On more than one occasion, one observed that the aircraft made simultaneous movements of vertical descent and forward longitudinal displacement. However, the forward motion was done unintentionally and without any guidance from another crewmember.

According to the prescribed operational standardization, movements not commanded by the crew within a restricted area should have been informed or even stopped by the crew in the rear seats through the use of standard phraseology, which was not adequately used after the hover flight over the site of intended landing.

Although the Operational Crew Course Manual established that the aircraft in the parking area should maintain a minimum separation of 3 meters between the tips of its wings (or blades) and obstacles, or the wingtips or blades of other aircraft, such information was not included in the Standard Operating Procedure (POP) relative to restricted-area missions.

When choosing restricted-area locations, the SOP in force specified that the crew should ensure that the estimated dimensions of the landing site were at least 20m x 25 m. In this sense, the crew landed in an area measuring (18m x 28 m). This difference of 2 meters or less on one side of the landing area contributed to the blades' collision with the obstacle.

Moreover, one observed that the crewmember on the left no longer moved his head downwards after being asked about the position of the aircraft in relation to the lamppost.

His head movements indicated a primary concern with the rear sector of the aircraft and the lamppost itself. In view of that, moving his head downwards could sharpen his perception of the longitudinal displacement of the aircraft, since the landing area had restrictions in the four sectors around the helicopter.

After the last prolonged hover, there was coordination on the part of the crew. However, during such management, one verified that the aircraft had restrictions in all sectors, in a way that each crewmember reported that their own sector had movement restrictions.

The SIC's concern in telling the PIC not to move the aircraft to the left demonstrated how restricted the left frontal sector of the aircraft was. An assertive and effective cabin management in that condition would suggest a vertical ascent of the helicopter followed by a go-around to reassess the landing area and the direction of approach.

From the accounts, it was possible to conclude that, in the last prolonged hover, the cabin coordination process revealed uneasiness on the part of the crew, but none of the crewmembers suggested a go-around from the location.

Upon completion of the cabin coordination, the TOE was emphatic in stating that the aircraft was in position to restart the descent, and the PIC proceeded accordingly. This fact did not take into account possible adversities, such as the forward longitudinal displacement of the helicopter, which culminated in the collision of the main rotor blades against the lamppost, six seconds after the descent was resumed.

For restricted-area missions, there was no documentary information delimiting the responsibility of sectors around the aircraft, so that each crewmember was committed to delimiting their own field of view.

There was only information that, after the hovering flight out of ground effect, before starting the descent onto the area, the two crewmembers in the rear seats would guide the aircraft's landing, indicating the necessary maneuvers for obstacle avoidance, with the understanding that each person would need to take care of their own side of the aircraft, corresponding to 180º of amplitude from the tail to the frontal sector.

It is worth mentioning that the position of the sun in relation to the aircraft at the time of the accident may have influenced the perception of the TOE when looking at the lamppost. The sun was approximately 21° above the horizon and to the left of the aircraft, a condition that may have generated a false perception of the obstacle's depth for the TOE and/or a possible glare condition for his eyes.

Although the SIC had more flight experience and was hierarchically senior to the PIC, the former was sitting in the left seat (2P), fulfilling his functions as a SIC, assisting the PIC, but without effectively making decisions on the mission, until the moment of the accident.

Such situation was caused by misinterpretation of the PIC’s and SIC’s roles in an operation. At that time, it had already been established that the role on board had to do with the seat being occupied, regardless of hierarchy or experience in the aircraft/operation.

Hence, shortly after the blades hit the lamppost, the SIC took control of the helicopter and, from that moment on, all decisions were made by him. This fact resulted directly from the experience and hierarchical position of the SIC relatively to the PIC.

Although the pilots demonstrated that they knew what their roles on board were, it became clear that the hierarchy and flight experience inside the cabin stood out at the time of the emergency, in a way that the pilot who had seniority and more flying experience took control of the situation at that moment.

Therefore, one concluded that, during the emergency, the concept of Aircraft Commander adopted at the time was not used properly, since the SIC, a more experienced and hierarchically senior pilot, took control of the helicopter.

Nevertheless, in the moments before the first collision of the main rotor blades, for respecting the PIC's decisions, the SIC quit being more assertive and did not recommend to abort landing in a dangerous condition that was presenting risks to the operation.

Thus, it was possible for the investigation commission to verify that the “Pilot in Command” concept was not well established among the CAvPM pilots, given that hierarchy was sometimes seen as an influential factor in decision-making onboard the aircraft. This lack of clarity may have contributed to the poor cabin coordination during the flight that resulted in the accident.

The fact that a formal briefing was not held before takeoff, detailedly covering possible emergency procedures for that mission, and defining the functions on board, may have influenced the crew's decisions throughout the process that culminated in the collision.

Thus, in a landing site with restricted dimensions, the complexity of the operation required the crew to manage numerous variables in order to make a decision.

Organ transport operations tend to involve a high level of motivation to accomplish the mission aimed at saving human lives, as the shorter the duration of transport, the greater the chances of success in surgical procedures. This impulse can cause self-imposed pressure that eventually leads the team to operate with reduced safety margins.

Finally, in this type of operation, cognitive functions, such as attention, perception and decision-making require high operational standards, which demand training to develop technical capabilities, as well as the cognitive skills associated with them.

3. CONCLUSIONS.

3.1. Findings.

a) the four crewmembers held valid CMAs (Aeronautical Medical Certificates);

b) the pilots held valid HMNC (Single-Engine Conventional Helicopter) and HMNT (Single-Engine Turbine Helicopter) ratings;

c) the crew in the rear seats had authorization from the CAvPM to carry out restricted-area missions;

d) the four crewmembers had qualification and experience for the type of flight;

e) the aircraft had a valid CA (Certificate of Airworthiness);

f) the aircraft was within the weight and balance limits specified by the manufacturer;

g) the records of the airframe and engine logbooks were up to date;

h) no evidence of failure or malfunction of the aircraft or its components was found;

i) the meteorological conditions were consistent with the flight;

j) the SIC was not scheduled by the pertinent administrative sector;

k) the operator did not carry out official control over the operational adaptation of crewmembers in restricted-area missions;

l) the SIC was hierarchically senior to the PIC and had greater flight experience;

m) no formal briefing was held before the mission;

n) no information about the coordination of another helipad for landing was passed on to the mission crew;

o) the place of occurrence was an occasional landing area, intended for car parking;

p) there was no formal information or database detailing the risks of the operation in the location where the landing took place;

q) the PIC and SIC had never landed in the location;

r) the TOD and TOE had already landed in the location, but never in that direction;

s) the dimensions of the landing area were smaller than those prescribed in the UAP's SOP;

t) the aircraft performed simultaneous descent and forward movements within the restricted area;

u) during the helicopter's vertical descent onto the occasional landing area, the aircraft's main rotor blades collided with a lamppost;

v) after the first strike of the blades against the obstacle, the SIC took control of the aircraft and performed the landing;

w) during the landing made by SIC, the aircraft's main rotor blades collided with a tree;

x) a passerby suffered minor injuries and another one was seriously injured;

y) none of the four crewmembers was harmed; and

z) the aircraft sustained substantial damage**.**

3.2. Contributing factors.

- **Attention – a contributor.**

Due to the restriction of space within the landing area, in the moments before the accident, the rear crewmembers showed selective attention, in that they were not able to identify the longitudinal movement of the aircraft, which was simultaneously moving downwards, in time to warn the pilots and avoid the collision.

- **Attitude – a contributor.**

There was overconfidence on the part of the TOE, who emphatically stated that the position was good, and cleared the aircraft for the vertical descent from that position.

The possibility of aborting the mission due to the restricted space for landing was never considered.

- **Crew Resource Management – a contributor.**

The use of the human resources available to operate the aircraft was inefficient, due to inadequate management of the tasks assigned to each crewmember during the attempt to land.

According to operational standardization, uncommanded movements in a restricted area should have been informed or even stopped by crewmembers of the rear seats through the use of standard phraseology, which was not appropriately utilized when the helicopter was hovering over the landing area.

- **Work-group culture – undetermined.**

One could identify a work-group culture concerning the attitude incorporated by the crewmembers in situations in which there were significantly different levels of operational experience. The more experienced ones naturally sought to leave the opposite side of the aircraft with greater room for maneuver for any errors made by the less experienced crewmembers. This practice may have contributed to the helicopter getting too close to the lamppost, which was located on the left, the same side as the SIC and TOE, who were crewmembers more experienced in their tasks.

- **Piloting judgment – a contributor.**

There was inadequate assessment of parameters related to the operation of the aircraft, especially those related to the approach and to the hovering in a location whose dimensions were smaller than those required for a safe landing.

- **Motivation – undetermined.**

Organ transport operations tend to involve high motivation in accomplishing a mission aimed at saving human lives. This impulse can cause self-imposed pressure that eventually leads the team to operate with reduced safety margins.

- **Perception – undetermined.**

There was possibly a loss in the crew's ability to determine the correct distance between the lamppost and the aircraft, due to a glare condition caused by the position of the sun relatively to the aircraft at the time of the accident.

- **Flight planning – a contributor.**

There was inadequacy in the work of preparation for the flight, as the dimensions of the landing site were not properly taken into account.

Initially, the helicopter was expected to land on a private helipad located near the General Hospital of *Pirajussara*. However, this fact was not brought to the attention of the crew, who chose to land in the hospital parking lot where the accident occurred.

- **Management planning – undetermined.**

There was inadequate planning at a managerial level, especially with regard to the allocation of human resources for the conduction of the operational activity, with the PIC being left with the task of scheduling the mission's SIC (pilot second-in-command). This condition reduced the PIC's availability of time to adequately plan for the mission, something that may have contributed to his failure to hold a briefing and to the non-observance of the landing site restrictions.

- **Support systems – undetermined.**

There was no organizational support allowing the implementation of a mapping of the areas that might be used as landing sites. Such mapping would facilitate risk management, as well as reduce the crew's workload, contributing to the success of the operation.

Despite the fact that the Operational-Crew Course Manual prescribed that aircraft operating in the parking lot had to maintain a minimum separation of 3 meters from obstacles, or between the tips of its wings (or blades) and those of other aircraft, the aforementioned prescription was not included in the Standard Operating Procedure (SOP) for restricted-area missions.

- **Managerial oversight – undetermined.**

There was inadequate supervision of the planning activities and mission execution, as the sector responsible for the pilots' scheduling delegated the task to the PIC.

4. SAFETY RECOMMENDATIONS

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 consonance with the Law n°7565/1986, recommendations are made solely for the benefit of 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".

To Brazil's National Civil Aviation Agency (ANAC):

A-036/CENIPA/2020 - 01 **Issued on 02/28/2024**

Spread the lessons learned in this investigation to the State of São Paulo's Military Police Aviation Operations Command, in order to promote safety within the referred organization.

Spread the lessons learned from this investigation to other Public Air Units that operate in accordance with the requirements established in the RBAC-90, in order to promote safety during internal events of those Units.

5. CORRECTIVE OR PREVENTATIVE ACTIONS ALREADY TAKEN.

Several corrective measures were taken by the State of São Paulo's Military Police Aviation Command, including the publication, in November 2022, of the new CAvPM Operations Manual (MOP), in which various pieces of information on operations of their aircraft were compiled.

Among the pieces of information contained in the manual, another definition of *aircraft commander* was given, as follows, bringing to light issues such as hierarchy and flight experience:

> Aircraft Commander: a PMESP officer from the "*João Negrão*" CAvPM, duly trained and qualified in accordance with the technical upgrading process defined by the Air Unit. S/he is responsible for the safe operation of the aircraft, and exercises the authority assigned by the legislation and/or civil aviation regulations, in joint compliance with the military legislation, especially regarding hierarchical issues, when dealing with professionals with the same technical qualifications. Regardless of the seat s/he occupies, the Aircraft Commander is considered to be the one of highest seniority and, eventually, when a person of lower seniority is more qualified technically-wise from an aeronautical standpoint, s/he must assume the seat of Aircraft Commander and must be respected as such. The same as *Pilot in Command* (PIC).

As for the ideal position of a helicopter within a restricted area, the revised Operating Procedures for such type of mission highlighted the following:

> The crew, following the "Aircraft in Position" call out, with the aircraft hovering, assumes coordination (a situation normally conducted by the Trip Op Observer or Flight Nurse, with participation of everyone, always making use of standard phraseology) and guides the Aircraft Commander for a safe landing free of obstacles in the location defined for this purpose, always seeking to keep the aircraft in an equidistant position.

Also, issues regarding the crew's overconfidence were mentioned, as follows:

> Possibility of Errors
>
> Excessive confidence on the part of the Aircraft Commander leading to neglect of safety aspects of the flight considered to be the simplest ones.
>
> Overconfidence on the part of the Crew, wrongly estimating the distances involved.

Similarly, the definition of restricted area was clarified in the Standard Operating Procedure contained in the MOP:

> Restricted Area: any area not having certification for helicopter landing or takeoff operations granted by aeronautical agencies. They may feature obstacles that make an aircraft approach difficult, requiring procedures different from the standard traffic circuit and the normal approach. Operation in a restricted area must be occasional, and the responsibility lies entirely with the operator. Its dimensions must be sufficient to contain, at least, the aircraft in its entirety, whether for a full stop landing or for low height disembarking/embarking. It has approximate dimensions of 20m x 25m.
>
> 2. Occasional Area: differs from the Restricted Area only in terms of dimensions, which are approximately 40 m x 40 m.

Also, a mobile-application group called "safe landing" was created, aiming at making the Unit's crews aware of the different possibilities of landing in a restricted area. The application showed the following guidelines listed in the MOP:

The Aircraft Commander photographs the aircraft at the landing site, at a distance and at an angle allowing observance of the area and the distances in relation to obstacles. Such photograph must be sent as quickly as possible, with the aircraft still on the ground, as long as there is connectivity, through a multiplatform instant messaging application for smartphones, to the “Safe Landing” group, along with the location; and

It is up to the Trip Op Observer/Nurse, when possible, to take a photo of the aircraft at the landing site and send it to Aircraft Commander, so that s/he can proceed as per subitem 2.1.9.

Among other measures, safety bulletins were created, aiming to make crews aware of events related to flight safety in restricted areas.

In June 2022, a Risk Analysis Report was made for the new landing site concerning operations of assistance for the benefit of the General Hospital of *Pirajussara*.

In September 2022, an Aviation Safety Recommendation was issued, aiming at guiding crews in relation to the new landing location, during operations of assistance in favor of the General Hospital of *Pirajussara*.

Additionally, in October 2022, an Instruction Note was published, with the purpose of promoting and regulating the development of monthly practice training with CAvPM aircraft, covering the years 2022 and 2023, demonstrating that the referred unit now controls the preparation of its crewmembers in a systematic fashion.

Finally, the possibility of controlling the number of missions per pilot was added to the CAvPM digital mission-management system, providing the necessary control for unit managers to track the adaptation of their crewmembers to the various missions accomplished by them.

On February 28th, 2024.