COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-009/CENIPA/2022

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-NEW**
MODEL:	**R44 II**
DATE:	**19JAN2022**

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 19th January 2022 accident with the R44 II aircraft, registration marks PR-NEW. The occurrence was typified as “[UNK] Unknown or Undetermined”.

During a scenic flight near *Canasvieiras* beach in *Florianópolis*, State of *Santa Catarina*, the pilot performed an autorotation procedure and, while attempting to land at sea, his helicopter overturned.

The aircraft sustained substantial damage.

The pilot and the two passengers suffered minor injuries.

Being the United States of America the State of design and manufacture of the aircraft and its engine, the USA’s NTSB (National Transportation Safety Board) appointed an Accredited Representative for participation in the investigation of the accident.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AMOCAN	District of *Canasvieiras'* Residents' Association
ANAC	Brazil's National Civil Aviation Agency
ANP	Brazil's National Agency for Petroleum, Natural Gas, and Biofuels
APR-A	Division of Aeronautical Propulsion
AVGAS	Aviation Gasoline
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CIV	Pilot Logbook
CMA	Aeronautical Medical Certificate
CVA	Airworthiness-Verification Certificate
HMNC	Single-Engine Conventional Helicopter Class Rating
METAR	Routine Meteorological Aerodrome Report
NM	Nautical Miles
NRT	Notification of Training Completion
NTSB	USA's National Transportation Safety Board
OM	Maintenance Organization
PCH	Commercial Pilot License (Helicopter)
PIC	Pilot in Command
PPH	Private Pilot License (Helicopter)
RBAC	Brazilian Civil Aviation Regulation
RPM	Revolutions Per Minute
SAE-AN	Private Registration Category – Specialized Public Air Service - Aerial Inspection
SBFL	ICAO location designator - *Hercílio Luz* Aerodrome, *Florianópolis*, State of *Santa Catarina*
SIPAER	Aeronautical Accidents Investigation and Prevention System
TPX	Non-Regular Public Air Transport (Aircraft Registration Category)
UTC	Coordinated Universal Time
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** R44 II **Registration:** PR-NEW **Manufacturer:** *Robinson Helicopter*	**Operator:** *Icaraí Turismo Taxi-Aéreo Ltda*.
Occurrence	**Date/time**: 19JAN2022 – 20:20 (UTC) **Location:** *Praia de Canasvieiras* **Lat.** 27°25'37"S **Long.** 048°28'04"W **Municipality – State:** *Florianópoils – Santa Catarina*	**Type(s):** [UNK] Unknown or undetermined

1.1. History of the flight.

At around 20:15 UTC, the aircraft took off from the football pitch of AMOCAN (acronym for *Canasvieiras'* Residents' Association) in *Florianópolis*, State of *Santa Catarina*, for a local scenic flight, with a pilot and two passengers on board.

Approximately 5 minutes into the flight, with the aircraft flying over the sea near *Canasvieiras* beach, the Pilot in Command (PIC) initiated an autorotation procedure, for believing that an inflight engine failure had occurred.

During the ditching attempt, at a distance of approximately 20 m from the beach, the helicopter overturned.

The aircraft sustained substantial damage.

The pilot and both passengers suffered minor injuries.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	1	2	-
None	-	-	-

1.3. Damage to the aircraft.

The aircraft sustained substantial damage. The front section of the cabin was destroyed. The tail boom separated from the fuselage, and the rotor blades ended up sharply bent downwards.

Figure 1 - Picture of the PR-NEW taken approximately 20 minutes after the accident.

1.4. Other damage.

NIL.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Flight Experience	
	PIC
Total	1,430:00
Total in the last 30 days	15:00
Total in the last 24 hours	02:00
In this type of aircraft	330:00
In this type in the last 30 days	15:00
In this type in the last 24 hours	02:00

RMK: data on the hours flown obtained from PIC's reports and records of his CIV (Pilot Logbook).

1.5.2. Personnel training.

The PIC did his PPH course (Private Pilot – Helicopter) in 2014, at *Escola de Aviação Civil Asas Rotativas* (Rotary Wings Civil Aviation School.

1.5.3. Category of licenses and validity of certificates.

The PIC held a PCH License (Commercial Pilot - Helicopter) and a valid HMNC rating (Conventional Single-Engine Helicopter Class.

1.5.4. Qualification and flight experience.

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

1.5.5. Validity of medical certificate.

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

1.6. Aircraft information.

The SN 10765 aircraft was a product manufactured by Robinson Helicopter in 2005, and registered in the TPX category (Non-Regular Public Air Transport), as well as in the SAE-AN category (Specialized Public Air Service – Aerial Inspection).

The aircraft's CVA (Airworthiness-Verification Certificate) was valid.

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

The aircraft logbook was lost in the accident. Up to date aircraft flight hours were searched in the operator's inspection-and-components control map. According to the referred document, the helicopter had 2,146 hours and 12 minutes of flight TSN (Time Since New).

The last inspection of the aircraft ("100-hour" type) was carried out on 25th June 2021 at *Frisonfly* Maintenance Organization in the municipality of *Eldorado do Sul*, State of *Rio Grande do Sul*. The aircraft flew 86 hours and 12 minutes after the said inspection.

The latest overhaul of the aircraft ("12-year" type) was carried out at the *Atlântico Sul Ltda*. Maintenance Organization in the municipality of *Porto Belo*, State of *Santa Catarina*, on 18th December 2018. The aircraft flew 647 hours and 6 minutes after the referred overhaul.

According to information gathered, the operator adopted the maintenance program recommended by the aircraft manufacturer.

1.7. Meteorological information.

The METAR of SBFL (*Hercílio Luz* Aerodrome, *Florianópolis*, State of *Santa Catarina*, located at a distance of 15 NM from the accident site) contained the following information:

SBFL 191900Z 07012KT 9999 SCT025 31/25 Q1014=

SBFL 192000Z 07010KT 9999 BKN025 29/24 Q1013=

SBFL 192100Z 07008KT 9999 BKN025 29/24 Q1014=

As verified, the weather conditions were above the minimum for the flight in question, with visibility above 10 km and broken clouds (5 to 7 oktas) at 2,500 ft. The wind strength was between 8 and 12 kt.

1.8. Aids to navigation.

NIL.

1.9. Communications.

According to information, the PIC made traffic coordination with other aircraft on the free coordination-frequency of 123.45 MHz.

1.10. Aerodrome information.

The occurrence was outside aerodrome area.

The aircraft was operating from the AMOCAN* football pitch (* District of *Canasvieiras'* Residents' Association) under Visual Flight Rules. The area used for landings and takeoffs was flat and covered with grass, measuring 110 m x 70 m, without any significant obstacles in the proximity.

1.11. Flight recorders.

Neither required nor installed.

1.12. Wreckage and impact information.

The collision of the helicopter with the sea water was observed by swimmers, and filmed by a security camera from a nearby gated-community. Another security camera filmed the final approach until seconds before impact (Figure 2).

Figure 2 - View of the PR-NEW moments before colliding with the sea.

The impact against the water occurred with the aircraft in a pitch-up attitude and with a right-hand side banking. At the collision, the tail boom separated from the fuselage. After that, the aircraft came to a complete stop. There was no fire.

The impact occurred at a distance of approximately 20 m from the beach. The depth of the water at the site did not exceed 1.2 m.

Figure 3 - Picture of the PR-NEW taken by third parties approximately five minutes after the accident.

There was no evidence of a previous impact and, although the tail boom had detached from the fuselage, the debris remained concentrated.

The front section of the cabin was completely destroyed. The front seats, including the pilot's one, got separated from the aircraft structure. The rear seats remained attached to their positions.

The main rotor blades were sharply bent downwards and remained connected to the rotor head. This type of deformation was compatible with an impact in which the rotor was low on energy, indicating that it might not be being driven by the engine.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

There was no evidence that issues of physiological nature or incapacitation could have affected the pilot's performance.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

NIL.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

In their effort to get out of the aircraft, the PIC and passengers were assisted by swimmers who were close to the accident site. The pilot reported that he was not able to get free from his seat-belt by himself.

1.16. Tests and research.

The PR-NEW had an IO-540-AE1A5 six-cylinder piston Lycoming engine (SN L-30261-48A), fed with aviation gasoline. It had a total of 2,146 hours of operation, and had approximately 647 flight hours after the latest overhaul.

Figure 4 - Top view of the engine.

The engine was examined by the Investigation Committee.

Externally, it showed no apparent damage resulting from the forced landing. However, one observed oxidation and/or corrosion in all of its components, on account of the submersion in sea water. In addition, the engine was jammed.

Examination of the fuel injection nozzles showed that they did not have obstructions.

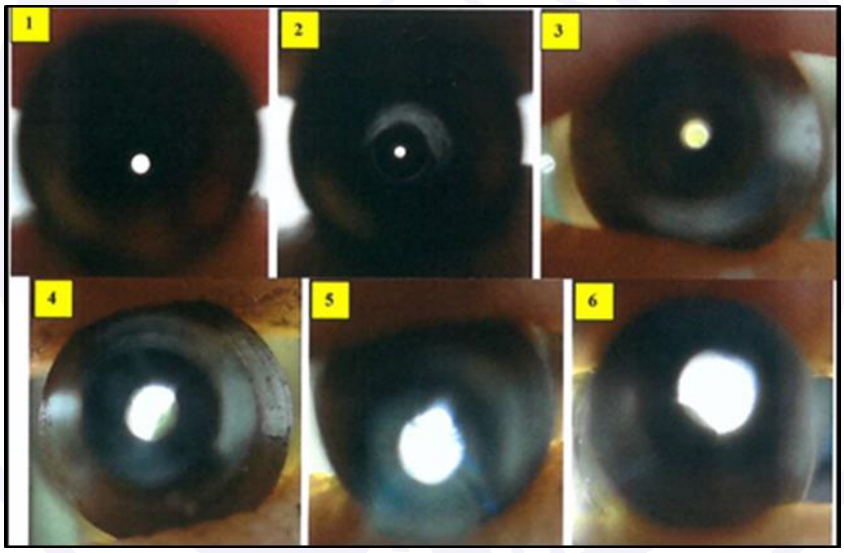

Figure 5 - View of the injection nozzles.

At the disassembly of the fuel distribution valve, corrosion was observed on the inside of its cover and on the diaphragm spring. There was presence of salt water residues in the upper part of the diaphragm.

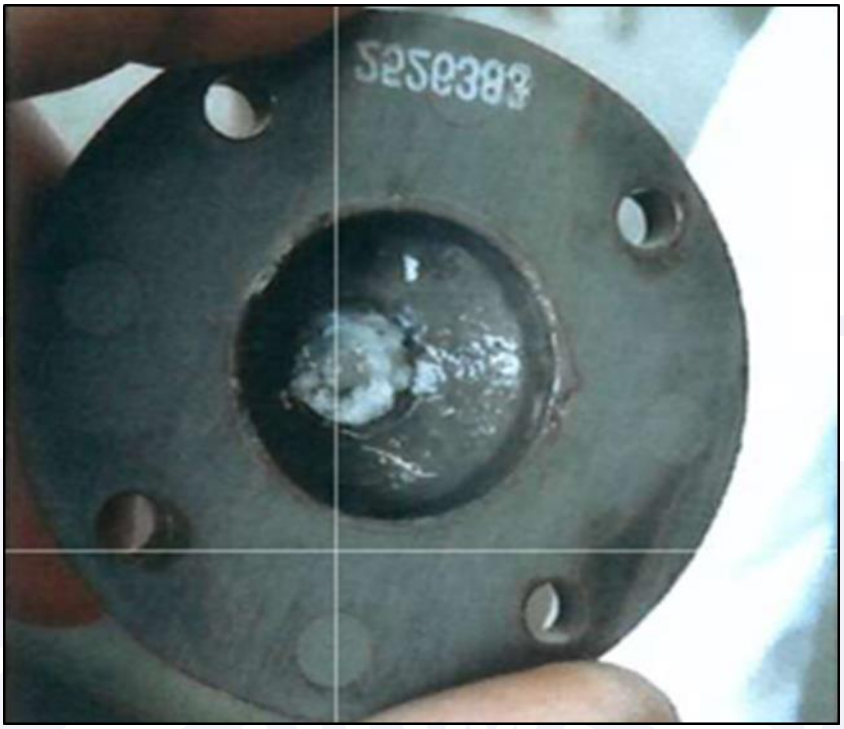

Figure 6 - View of the upper cover of the fuel distributor.

Figure 7 - View of the fuel distributor diaphragm with salt water and corrosion on its spring.

The distributor valve had an orifice of communication with the atmosphere on its upper part. Examination of the component revealed the presence of severe corrosion in the referred orifice.

Such orifice should have no obstructions in order to allow free movement and correct functioning of the diaphragm. Any obstructions would result in the blocking of the diaphragm movement, a condition that would, either partially or completely, prevent the supply of fuel to the injection nozzles.

The presence of salt water on the upper part of the diaphragm indicated that the fuel distributor orifice was not obstructed at the moment of the helicopter's immersion in the sea.

The servo injection valve could not be bench-tested. However, upon visual examination, one found that all its internal components were in normal working order and, also, that there was fuel inside the valve (Figure 8).

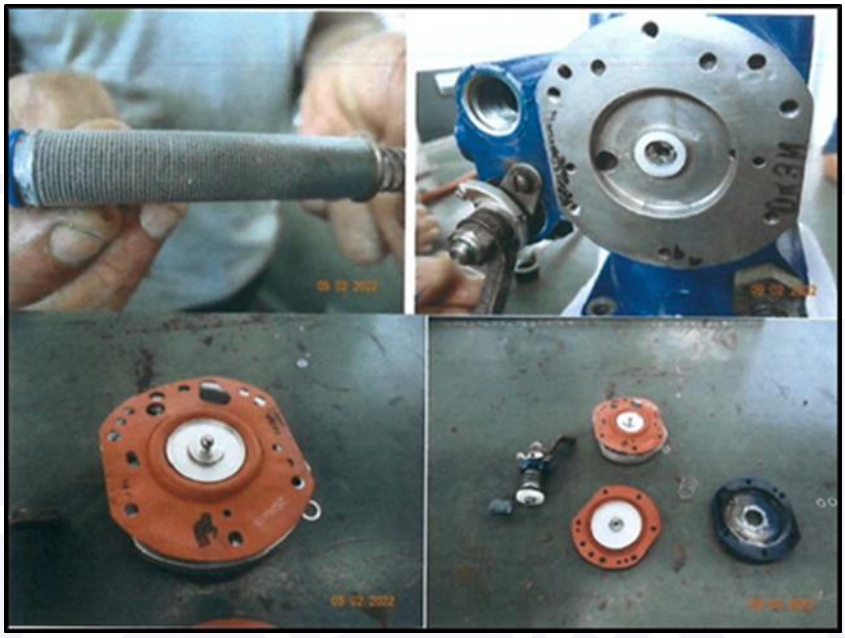

Figure 8 - View of the servo injection valve components.

The fuel pump could not be bench-tested either. The component was moved manually, and showed normal operation, characterized by the presence of fuel pressure in its exit. This situation was consistent with normal operation of its unidirectional valves.

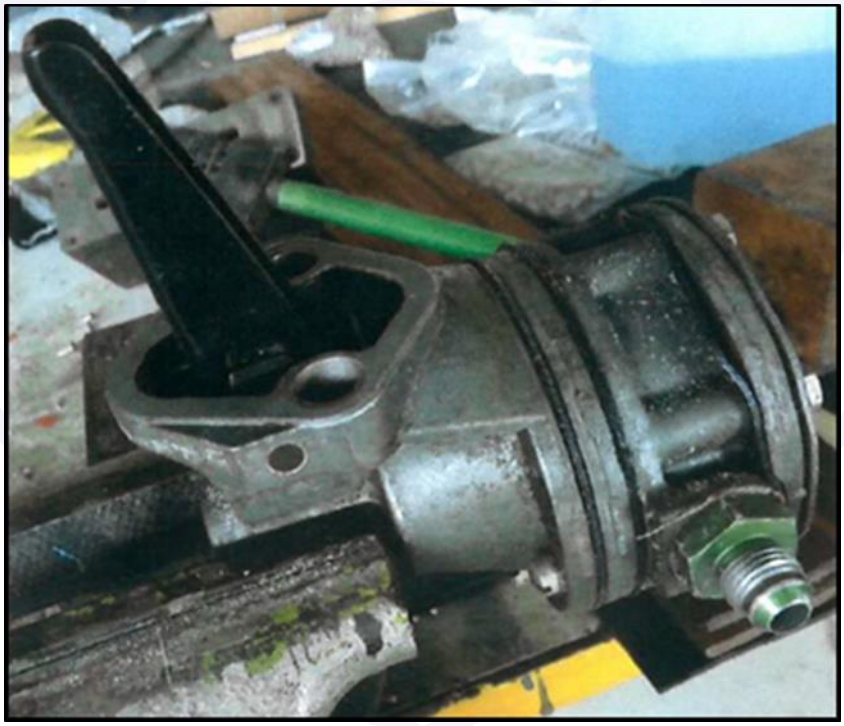

Figure 9 - View of the fuel pump.

The magnetos showed severe corrosion. For this reason, they were not submitted to a bench test. However, the measurement of the coils' resistance in both magnetos presented values within the limits specified by the manufacturer.

The bearings of the magnetos were in good condition. The gears of the distributors were intact and showed no damage. There was neither oxidation on the cable terminals nor excessive play on the armature bushings.

The contact points also showed severe corrosion, a fact that precluded the analysis of their operating conditions.

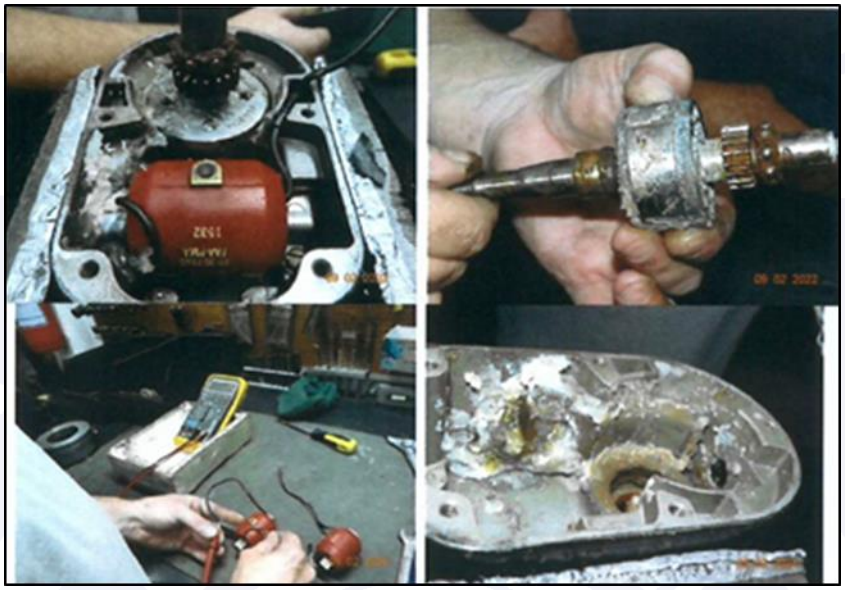

Figure 10 - Images of exams and tests of the right-hand magneto.

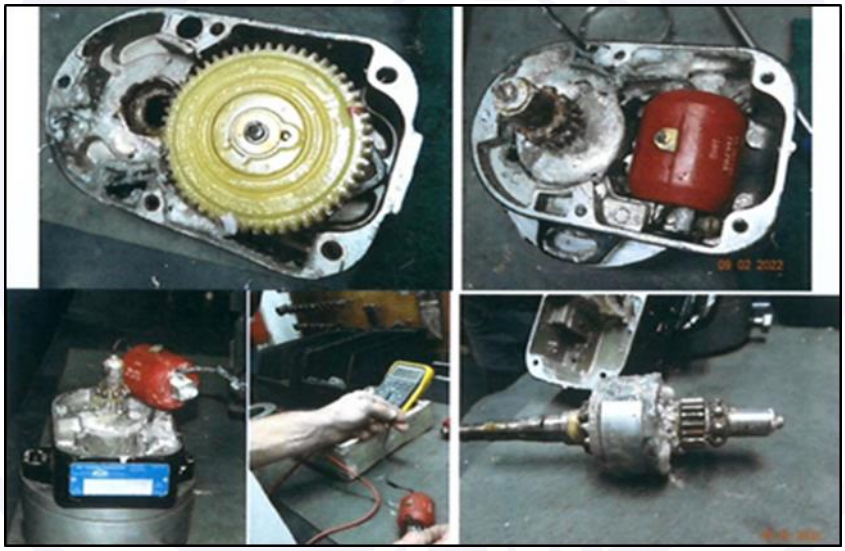

Figure 11 - Images of exams and tests of the left-hand magneto.

The engine oil pump showed normal operating movement.

The primary oil filter had no signs of contamination, and there was no evidence of filings on the main oil filtering element. No signs of abnormal wear of internal engine components were found.

The engine crankcase showed contamination resulting from the mixture of seawater and lubricating oil.

All engine cylinders were oxidized due to contact with sea water. The cylinders were jammed. Their removal from their respective housings was made difficult by the oxidation caused by contact with salt water. However, the tests did not identify abnormalities that could compromise the functioning of these components.

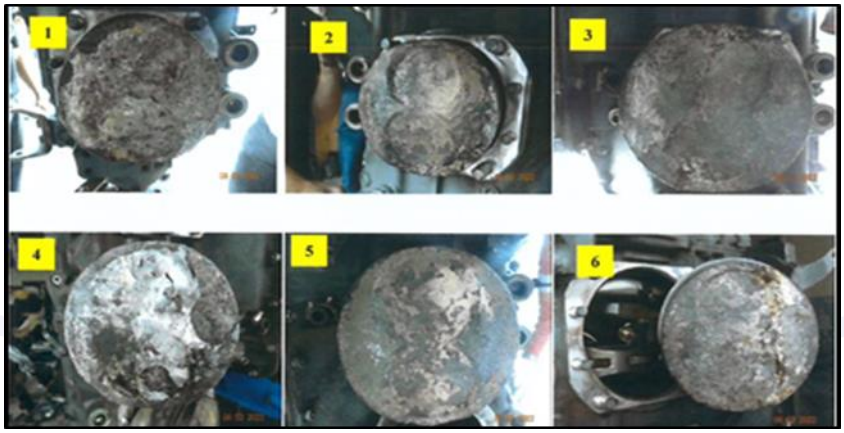

Figure 12 - General view of the pistons.

After the removal of the cylinders, one found that the crankshaft and valve timing shaft were functioning normally, rotating freely and in synchrony. Despite the existence of severe corrosion on the semi-carcasses, these components were rotated in different directions, without presenting resistance to motion.

The bearing supports and the bearings of the crankshaft and connecting rods were also in good working condition.

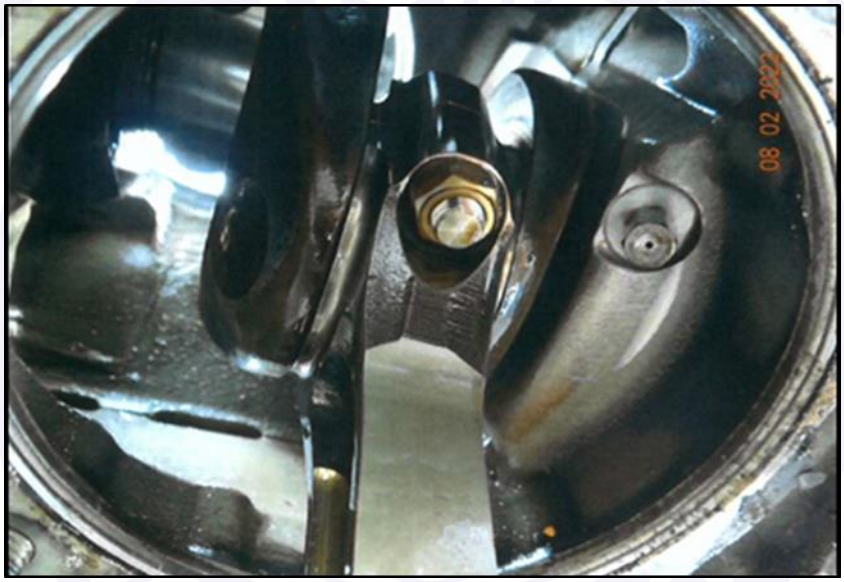

Figure 13 - General view of one of the connecting rods.

Exams of the engine showed that all the components submitted to full analysis had characteristics compatible with normal operation.

The magnetos, the fuel pump, and the servo injector could not be bench-tested, due to severe corrosion resulting from contact with seawater.

Although visual examination of the above components suggested normal functioning, it was not possible to verify their operational performance without submitting them to bench tests.

On account of the total immersion of the aircraft in salt water, the fuel remaining in the tanks was contaminated. Therefore, no samples were collected for laboratory analysis.

The immersion in salt water caused contamination of the fuel system components, including the filtering elements. Thus, laboratory analysis would be of no use for the identification of contamination prior to the immersion of the aircraft in seawater.

According to accounts provided by employees of the operating company, the helicopter's refueling between flights was performed at the AMOCAN's football pitch.

The aviation gasoline used in these refuelings was purchased from suppliers certified by the ANAC, and was transported to the AMOCAN football pitch in white common-use plastic gallons. There referred gallons were possibly translucent.

On the occasion of the initial field investigation action, those containers were not in the location from which the helicopter was operating. Employees of the operating company reported that the containers had been collected by the operator.

Therefore, the investigators could not verify the physical characteristics of the gallons, nor collect samples of the fuel remaining inside the containers for laboratory analysis.

1.17. Organizational and management information.

The aircraft was operated by *Icaraí Turismo Táxi-Aéreo Ltda*. Company and, on the date of the occurrence, the PR-NEW aircraft was part of the company's Operating Specifications. The company had an implemented Safety Management System, as well as a Safety Management Manual accepted by the ANAC.

According to its Operating Specification, the company had been granted authorization to operate, and was in a regular situation for operations under the requirements established by the Brazilian Civil Aviation Regulation nº 135 (RBAC-135), Amendment 12, addressing public air transport operations with airplanes with a maximum certified passenger seating configuration of up to 19 seats and a maximum paid cargo capacity of up to 3,400 kg (7,500 lb.), and helicopters.

The operating company's certification authorized it to carry out the following aerial activities: aerial cinematography, aerial photography, aerial inspection, aerial advertising, aerial reporting, and air taxi.

The crewmember involved in the occurrence was a pilot hired by the operator to fly R44 II aircraft, normally engaged in non-scheduled public transport missions.

The operating company handed in to the Investigation Committee its Training Program approved by the ANAC, and the Training Completion Notification (NRT) relative to the PIC of the aircraft.

According to reports collected, the PIC had complied with the required rest period, and its recent experience was consistent with the operation proposed by the company.

1.18. Operational information.

It was a scenic flight conducted under the requirements of the RBAC-135.

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

The company that operated the aircraft was based in the municipality of *Araucária*, State of *Paraná*, but was making use of the PR-NEW aircraft on scenic flights over the north coast of the city of *Florianópolis*, State of *Santa Catarina*.

One of the operator's employees provided ground support to the aircraft, its pilot and passengers. The accident flight was the fourth scenic flight of the day. On board the helicopter were the pilot, in the front right-hand seat, and two passengers, occupying the two rear seats.

Routinely, the aircraft would take off from the AMOCAN's football pitch, climb out still in the takeoff path, and, after reaching a safe height, would normally make a turn to the left towards the coastline. Upon reaching the coastline, the helicopter would start flying over the sea, in a trajectory parallel to the coast at a distance between 50 and 100 meters.

As a rule, the duration of the flight varied from 20 to 30 minutes. The profile of the accident flight is shown below (Figure 14).

Figure 14 - Croquis indicating the route taken by the PR-NEW.

According to PIC's reports, while flying over the sea at a height of 500 ft. and at a distance of 100 m from the beachfront, he noticed the helicopter's nose yawing to the left, together with a drop of the RPM, illumination of the low-RPM warning light, and activation of the audible alert (horn) indicative of low RPM.

Interpreting the pieces of information as an indication of engine failure in flight, he initiated an autorotation, a procedure for emergency landing in case of failure related to loss of engine power in helicopters.

With that in mind, he lowered the collective control lever and made a left turn, with the intention of bringing the aircraft closer to the beach.

During the ditching in autorotation, at a distance of approximately 20 m from the beach, the helicopter overturned.

1.19. Additional information.

The AVGAS (aviation gasoline) sold in Brazil and regulated by the ANP (National Agency for Petroleum, Natural Gas and Biofuels) was of the type 100 LL (Low Lead).

With regard to the precautions necessary for maintaining the quality of the gasoline, technical information prepared by the Petrobras' Management of Product Development[1], made available on the Internet, included, among others, the following considerations:

> 6 - PRECAUTIONS FOR MAINTENANCE OF QUALITY
>
> [...]
>
> Do not expose AVGAS to sun, heat, or light (transparent containers)
>
> Exposure to light and temperature accelerates the aging of the product, and sunlight decomposes the octane improver, as well as the dye, generating deposits of insoluble material.

By definition, translucency is the state of transparency of a physical body or object. In other words, a translucent object is one that allows light to pass through, but through which objects cannot be clearly seen.

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[1] Available at https://petrobras.com.br/data/files/08/83/94/3C/5A39C710E2EF93B7B8E99EA8/Manual-de-GAV.pdf. Access on 18/Sept/2023.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was a scenic flight conducted under the requirements established by the RBAC-135, with a pilot and two passengers on board.

METARs of SBFL (located at a distance of 15 NM from the accident site) showed that the meteorological conditions were above the minimums for the flight. Therefore, the meteorological aspect was not considered a contributing factor in the occurrence.

As for the dynamic of the occurrence as reported by the PIC, the yaw of the helicopter to the left, together with a drop in the RPM, the illumination of the low RPM warning light, and the activation of the audible alert (horn) indicating low RPM would constitute observable conditions indicative of an engine failure in flight on the R44 II helicopter model.

Among other factors, such failure might be related to non-conformities of the fuel supplied to the aircraft's engine.

Before ruling out such hypothesis, it would be necessary to examine the fuel present both in the helicopter's tanks and in the place of storage of the gasoline utilized in the refueling conducted at the site of the operation.

The total immersion of the aircraft in salt water resulted in the contamination of the gasoline remaining in its tanks.

As verified in the technical information prepared by the *Petrobras'* Management of Products Development, the exposure of aviation gasoline to the sun, heat, or light can result in accelerated aging of the fuel, as well as in the decomposition of the octane improver and of the blue dye, producing an insoluble material that would compromise the operation of the engine.

Accounts that the gallons used for the transport and storage of the fuel were ordinary common-use ones, white in color, raised the possibility that they were translucent, favoring conditions for the deterioration of the AVGAS, as pointed out in the technical information made available on the cautionary measures necessary for maintaining the quality of the product.

The presence of contaminants in the aviation gasoline would produce detectable evidence in the fuel system's filtering elements. However, the immersion of the helicopter in salt water made it impossible to analyze these components in terms of the existence of residues of any nature in the fuel used to feed the engine.

Furthermore, the fact that, at the time of the initial field investigation action, such containers were not in the location from which the helicopter was operating, made it impossible for the investigators to verify the physical characteristics of the gallons, as well as to collect samples for laboratory analysis.

Thus, the contribution of possible non-conformities related to the fuel that powered the aircraft engine for the occurrence of a failure could neither be refuted nor confirmed.

Although the observed deformations in the main rotor blades (which were sharply bent downwards and remained attached to the rotor head) indicated an impact in which the main rotor was low on energy and not being propelled by the engine, the examinations showed that the engine components had characteristics consistent with normal operation, and no evidence was observed that could corroborate the occurrence of failure.

It should be noted that, due to the contact with salt water, the high degree of corrosion in practically all the parts examined, compromised the reliability of the findings presented in this final report.

Taking into account the dynamic of the occurrence reported by the PIC, the recommended action would be the one he declared to have adopted, that is, start an autorotation procedure and look for a place for an emergency landing.

In the specific context of this accident, the fact that the landing was forcibly performed in the sea, a type of surface that does not allow controlled forward movement during the touchdown, resulted in the overturn of the helicopter and in the damage received in that situation.

Nonetheless, the investigation did not detect non-conformities in the actions performed by the PIC that could have worsened the consequences of a real autorotation procedure for landing in the sea.

All in all, the available elements of the investigation did not allow one to identify the factors that contributed to the accident.

3. CONCLUSIONS.

3.1. Findings.

a) the pilot held a valid CMA (Aeronautical Medical Certificate);

b) the pilot held a valid HMNC rating (Conventional Single-Engine Helicopter Class);

c) the pilot had qualification and experience for the type of flight;

d) the aircraft had a valid CVA (Airworthiness-Verification Certificate);

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

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

g) the meteorological conditions were consistent with the type of flight;

h) the PIC reported that, while flying over the sea at a height of 500 ft. and at a distance of 100 m from land, he noticed a yaw of the helicopter's nose to the left, together with a drop in RPM, low RPM warning light illumination, and activation of the audible alert (horn) indicating low RPM;

i) the PIC reported that he interpreted such information as an indication of engine failure in flight, and initiated an autorotation procedure;

j) during the ditching in autorotation, at a distance of approximately 20 m from the beach, the helicopter overturned;

k) employees of the operating company reported that the helicopter refueling between flights was performed at the AMOCAN’s football pitch;

l) employees of the operating company reported that the AVGAS used for refueling the helicopter was transported to the AMOCAN’s football pitch in common-use white plastic containers;

m) due to the total immersion of the aircraft in salt water, the fuel remaining in the tanks was contaminated;

n) it was not possible to verify the physical characteristics of the gallons containing AVGAS, nor to collect samples of the fuel remaining inside such containers for laboratory analysis;

o) the examination of the engine showed that all the components submitted to complete analysis had characteristics compatible with normal operation;

p) the aircraft sustained substantial damage; and

q) the pilot and passengers received minor injuries.

3.2. Contributing factors.

Undetermined.

4. SAFETY RECOMMENDATIONS

None.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On May 24th, 2024.