COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A - 061/CENIPA/2013

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PP-CGO**
MODEL:	**AW119 MKII**
DATE:	**8 MAY 2012**

NOTICE

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

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

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

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

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with item 3.1, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree nº 21713, dated 27 August 1946.

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

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

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

SYNOPSIS

This is the Final Report of the 8 May 2012 accident involving the AW119 MKII aircraft, registration PP-CGO. The accident was classified as inflight engine failure.

While the aircraft was on a police operation flight, an engine flameout occurred, followed by an inflight loss of control, with a subsequent crash into the ground.

The eight persons on board perished in the crash

The aircraft was completely destroyed.

An accredited representative from Italy (State of Manufacture) was designated for participation in the accident investigation by the ANSV (*Agenzia Nazionale per la Sicurezza del Volo*).

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ABNT	Brazilian Association of Technical Norms
AGL	Above Ground Level
AIS	Aeronautical Information Service
ANAC	(Brazil's) National Civil Aviation Agency
ANP	(Brazil's) National Agency of Petroleum, Natural Gas and Biofuels
APP	Approach Control
BS	Service Bulletin
CA	Airworthiness Certificate
CBMGO	State of Goias Military Fire Brigade
CENIPA	Aeronautical Accident Investigation and Prevention Center
CHE	Company Homologation Certificate
CHT	Technical Qualification Certificate
CIV	Pilot's Logbook
CMA	Aeronautical Medical Certificate
CTA	Fuel Tanker (Truck)
DA	Airworthiness Directive
DCT	Direct
DCTA	Aeronautics' Science and Technology Department
EDU	Electronic Display Units
EEC	Electronic Engine Control
FCU	Fuel Control Unit
GPS	Global Positioning System
HFAB	Air Force Hospital of Brasília
IAE	Brazilian Institute of Aeronautics and Space
IAM	Annual Maintenance Inspection
IFI	Brazilian Industrial Promotion and Coordination Institute
IML	Forensic Medicine Institute
JES	Special Health-Checkup Commission
Lat	Latitude
Long	Longitude
MPM	Maintenance Planning Manual
N2	Engine Rotation
NM	Nautical Miles
NR	Rotor Rotation
NTSB	National Transportation Safety Board (USA)
NVM	Non-Volatile Memory
OS	Service Order

P/N	Part Number
PCH	Commercial Pilot License (Helicopter category)
PMD	(Maximum Takeoff Weight)
PPH	Private Pilot License (Helicopter category)
RBHA	Brazilian Aeronautical Homologation Regulation
RELTEC	Technical Report
RFM	Rotorcraft Flight Manual
RGB	Reduction Gearbox
RPM	Revolution per minute
RSV	Flight Safety Recommendation
S/N	Serial Number
SBBW	ICAO location designator – *Barra do Garças* Aerodrome
SBCG	ICAO location designator – *Campo Grande* Intl Airport
SBCY	ICAO location designator – *Marechal Rondon* Intl Airport
SBGO	ICAO location designator – *Santa Genoveva* Intl Airport
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SIPAER	Aeronautical Accident Investigation and Prevention System
SSP/GO	State of Goias Public Security Secretariat
SWNV	ICAO location designator – *Aeródromo Nacional de Aviação*
TWR	Control Tower
UTC	Coordinated Universal Time
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** AW119 MKII **Registration:** PP-CGO **Manufacturer:** Agusta Westland	**Operator:** State of Goias Civil Police
Occurrence	**Date/time:** 08MAY2012 / 18:38 UTC **Location:** Fazenda Rancho Alegre **Lat.** 16º26'26"S **Long.** 052º00'15"W **Municipality – State:** Piranhas – Goias	**Type(s):** Inflight Engine Failure

1.1 History of the flight.

The aircraft departed from SBGO at 09:47 UTC, destined for the municipality of Doverlândia, State of Goiás, with two pilots and six passengers on board, with the objective of reconstructing the scene of a crime that had been committed on the Farm of Nossa Senhora Aparecida (Our Lady of Aparecida).

On its way back to Goiânia, the helicopter was approaching a refueling point mounted in the municipality of Piranhas, when a sudden inflight engine flameout occurred.

Before colliding with the ground, the aircraft lost one of its main rotor blades, which was later found at a distance of 150 meters from the spot where the remainder of the wreckage was concentrated.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	2	6	-
Serious	-	-	-
Minor	-	-	-
None	-	-	-

1.3 Damage to the aircraft.

The aircraft was completely destroyed.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown		
	Pilot	Copilot
Total	850:00	472:30
Total in the last 30 days	17:50	19:30
Total in the last 24 hours	02:10	02:40
In this type of aircraft	300:00	302:30
In this type in the last 30 days	17:50	19:30
In this type in the last 24 hours	02:40	02:40

N.B.: Estimated data based on the existing manufacturer's records of documents (related to the training of pilots), as well as on the aircraft documentation and on accounts by third parties. Neither the pilots' logbooks nor the aircraft logbook were not found.

1.5.2 Professional formation.

The pilot did his Private Pilot course (Helicopter category) at the Flying School of Bauru, State of São Paulo, in 2006.

The co-pilot did his Private Pilot course (Helicopter category) at the Flying School of Goias in 2009.

1.5.3 Category of licenses and validity of certificates.

The pilots had Commercial Pilot licenses (Helicopter category), and valid A119 type aircraft technical qualification certificates.

1.5.4 Qualification and flight experience.

The pilots were qualified, and had enough experience for the flight in question.

1.5.5 Validity of medical certificate.

The pilots had valid Aeronautical Medical Certificates.

1.6 Aircraft information.

The SN14768 AW119 MKII single-engine rotary-wing aircraft, with capacity for eight occupants was manufactured by Agusta Westland on 13 December 2010. The aircraft had a valid airworthiness certificate.

The main rotor had four composite-material blades, identified by markings in red, blue, yellow and white – and was fully articulated with elastomeric bearings and a system of flexible blades.

The fuselage and empennage were of the beehive aluminum type in the primary structure and of composite material in the secondary structure.

The tail rotor had two composite-material blades. The aircraft landing gear was of the ski type.

Access to the passengers' cabin was possible via two sliding doors, one on each side of the fuselage.

The passengers cabin was separated from the pilots' cockpit by a dividing wall, and contact between them was possible by means of a small opening measuring 120cm x 30cm (Figures 1 and 2).

Figures 1 and 2 – Internal configuration of the PP-CGO. The opening between the passengers' cabin and the cockpit is highlighted.

The last inspection of the aircraft (Annual Maintenance Inspection) was performed by the *Fênix Manutenção e Recuperação de Aeronaves Ltda.* workshop (CHE 0902-

61/ANAC) on 15 March 2012. After the inspection, the aircraft flew 70 hours and 40 minutes.

The PP-CGO airframe had a total flight time of 309 hours and 40 minutes.

The aircraft engine (model PT6B-37A, SN PCE-PU0172) was manufactured by Pratt & Whitney in December 2009. It was fitted with automatic fuel control, and had a total flight time of 309 hours and 40 minutes (with 336 cycles) at the moment of the accident.

According to the AW119 MKII *Maintenance Manual* (MM), Section I – *Limitations*, the following engine lubricants were recommended for use in the aircraft:

Identification	Specification
BP Turbo Oil 2380	MIL-PRF-23699
Mobil Oil Jet II	MIL-PRF-23699
Aeroshell Turbine Oil 500	MIL-PRF-23699
Turbonyooil 525-2A	PWA 521
Royco Turbine Oil 500	MIL-PRF-23699
Castrol 5000	MIL-PRF-23699

Table 1 - Lubricants recommended by Agusta. Source: *Rotorcraft Flight Manual* - Doc 109G0040A017.

According to the PP-CGO maintenance records, all the Service Bulletins and Airworthiness Directives applicable to the AW119 MKII aircraft design were complied with.

Between the day the helicopter was received by the State of Goias Civil Police and the day of the accident, the helicopter maintenance services were performed by two certified companies: *Oceanair Táxi Aéreo* and *Fênix Manutenção e Recuperação de Aeronaves Ltda.* Company, as described in Table 2.

Type	Hours	Date	Maintenance provider
50 hours/60 days 50 hours/60 days 100 hours/6 months 50 hours/60 days 12 months 100 hours/6 months	54:40 58:00 62:00 72:40 165:40 199:35	02 Mar. 2011 21 Apr. 2011 22 June 2011 30 Aug. 2011 14 Dec. 2011 09 Feb. 2012	*Oceanair Táxi Aéreo*
IAM/50 hours/ 60 days	239:00	15 March 2012	*Fênix Manutenção e Recuperação de Aeronaves Ltda.*

Table 2 - Summary of the maintenance services performed in the PP-CGO. Source: Aircraft documentation.

According to the Service Orders presented by these maintenance companies, all the technical problems involving the aircraft were considered as being within normal standards of operation of the A119 MKII Koala aircraft, demanding maintenance interventions of low complexity that allowed the prompt release of the helicopter for operational activities.

In addition to the aforementioned services (the records of which had been duly entered in the aircraft engine and airframe logbooks), the investigation commission learned from interviews that the PP-CGO was received by the *Fênix Manutenção e Recuperação de Aeronaves Ltda*. workshop on 4 May 2012 for the “50 hours” Inspection.

According to witnesses, the following services were performed during the subsequent days:

Date	Services performed
5 MAY 2012 (Saturday)	Drainage and substitution of the engine oil Drainage and substitution go the tail rotor oil Washing of the main rotor transmission deck Washing of the engine
7 MAY 2012 (Monday)	Cleaning of the air filters Cleaning of the engine oil filters Engine start-up without ignition Verification of the oil level Full start-up (5 minutes duration) Engine oil drainage Feeding of the engine with Mobil Jet Oil II (substituting for the former oil – which had a 2380 specification) Repetition of the oil feeding procedures.

Table 3 - Services supposedly performed after the arrival of the aircraft at the *Fênix* company on 4 May 2012.

In addition to the interventions listed above, on 7 May 2012, at about 11:30 local time, the aircraft departed for a 17-minute test flight with one of the pilots of the Air Unit.

Later, there was drainage of the oil from the main rotor transmission system, washing of the blades, feeding of the main rotor transmission system with Mobil Jet Oil II (manufacturer's specification) and ignition-less start for the replenishing of the systems.

On the occasion, the main rotor transmission system received 11 cans of Jet Oil II, reaching the normal level of operation. Then, further three complete start-ups were carried out.

At the end of the afternoon, at about 17:45, the PP-CGO took off for SBGO, with a recommendation that, upon landing at SBGO, the level of the main rotor transmission system oil should be verified and, if necessary, replenished.

There are no formal records of the execution of the above mentioned services by the *Fênix Manutenção e Recuperação de Aeronaves Ltda.* company.

According to the professional responsible for supervising the maintenance services performed in the PP-CGO, during the months in which the aircraft was not engaged in public security operational missions (from December 2010 to 29 September 2011), the police aviation Unit performed all the manufacturer-established procedures relative to the storage of the helicopter. During this period, only "rotations on the ground" and local flights were performed, with the aircraft being utilized just as an observation platform.

1.7 Meteorological information.

On the day of the accident, the prevailing weather conditions were VMC in the aerodromes closest to the site of occurrence – SBBW, SBGO, SBCY and SBCG – at a distance of 30 NM, 193 NM, 210 NM and 235 NM, respectively.

Likewise, the meteorological information provided by means of satellite images at 18:30 UTC and 19:30 UTC indicated VMC conditions throughout the State of Goias.

1.8 Aids to navigation.

Nil.

1.9 Communications.

According to the Recording Transcript no. 007/TWR GO/2012, the aircraft made an initial radio contact with Goiânia Ground Control at 09:38 UTC, and received flight plan clearance, with destination for Doverlândia, State of Goias. The aircraft was cleared to take off from runway 14, with a right turn out to join the route, and transponder code 0603.

At 09:39 UTC, the PP-CGO started up engines, and requested taxi approval at 09:43 UTC. The runway was joined via taxiway Alpha, and, at 09:46 UTC, the helicopter was cleared for takeoff.

After the aircraft had taken off, the control tower instructed it to call Anápolis Control (APP-AN) on 129.45 MHz. The pilot read back the message.

Then, the PP-CGO crew contacted APP-AN, and was cleared to proceed with the flight as filed.

It was the last message transmitted by the helicopter.

1.10 Aerodrome information.

Not applicable.

1.11 Flight recorders.

Neither required nor installed.

1.12 Wreckage and impact information.

According to what was learned by the Initial Action team, six witnesses (none of them with any specialized aviation knowledge) had sighted the aircraft moments before it crashed into the ground. The majority of the accounts told of an aircraft on a low altitude controlled flight, when there was a sudden change in the noise made by the engine with detachment of an aircraft part, followed by a counterclockwise roll of the aircraft (around the longitudinal axis) and collision with the ground, with short forward movement and a steep angle of inclination.

The aircraft crashed in a flat area covered with native vegetation, not far from the *Fazenda Rancho Alegre* farmhouse, in the municipality of *Piranhas*, State of *Goias* (Figure 3). The wreckage had a linear distribution in the direction of movement of the aircraft (Figure 4).

Figure 3 - Clearing formed by the falling aircraft in a native forest area near the *Fazenda Rancho Alegre* farmhouse.

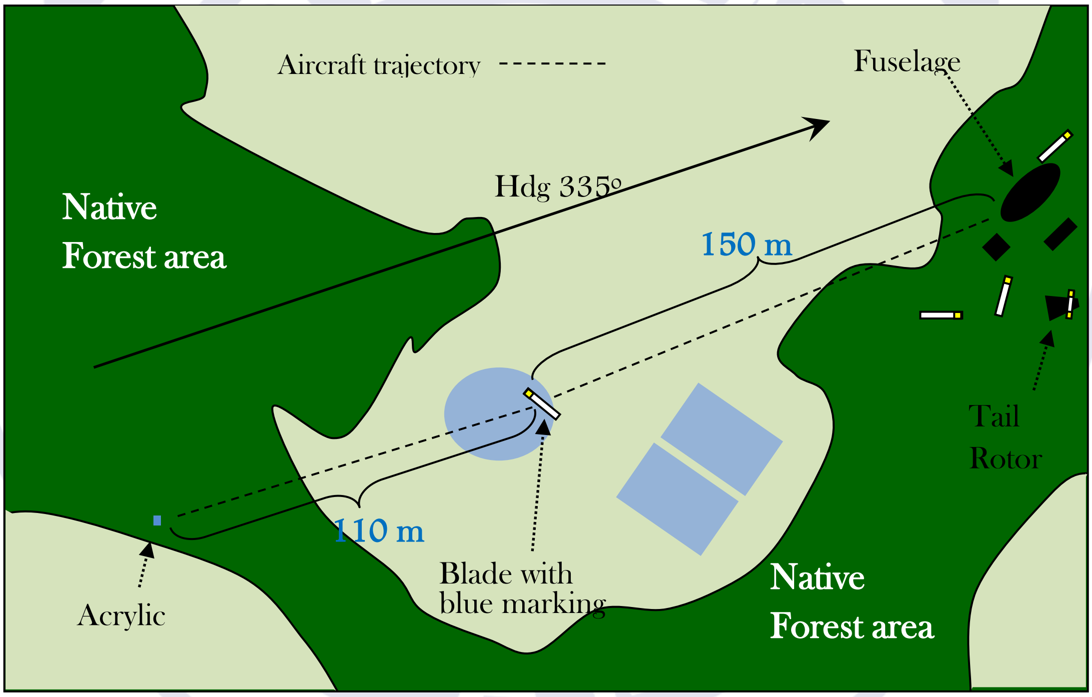
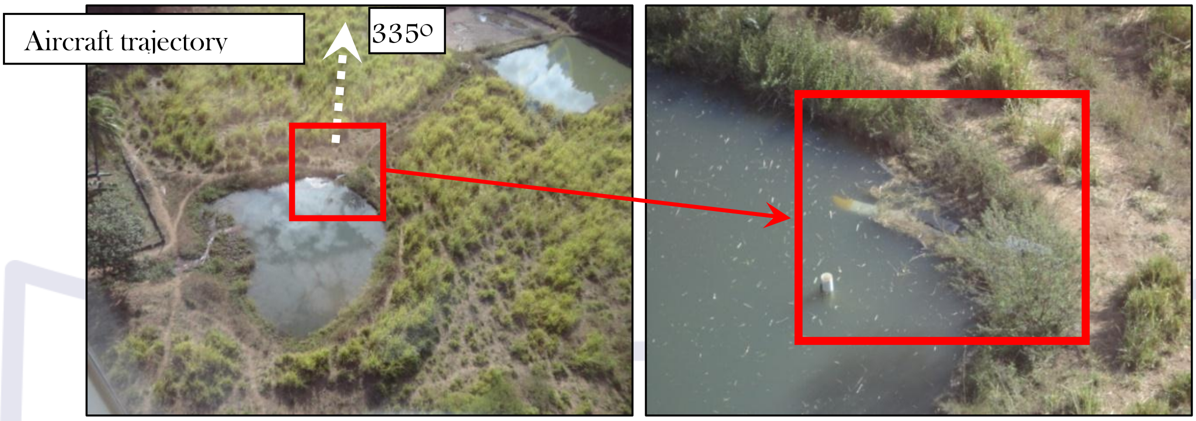


Figure 4. PP-CGO wreckage distribution pattern.

During the Initial Action, the investigation team found out that the aircraft part that was seen detaching in flight was one of the main rotor blades (the one with a blue marking), which came to rest at a distance of 150 meters from the crash-spot (Figures 5 and 6).



Figures 5 and 6 – spot where the blue-marking blade was found, at a distance of approximately 150 meters from the main pont of impact.

Except for the blue-marking blade, the wreckage was found concentrated. The tail boom broke at the junction with the main structure due to the forces of torsion and impact inertia, and was found at a distance of 7 meters from the remainder of the fuselage. It was the most preserved component when compared with other parts of the helicopter.

The collision of the PP-CGO with the terrain made a big hole, which contained most of the fuselage, as well as seven of the eight bodies (Figure 7). The eighth body was found a few meters away from the wreckage concentration.

Other parts of the helicopter were found randomly distributed around the point of impact, with the majority of them located in the direction of their horizontal movement.

Figure 7 – Aircraft fuselage after the crash.

Figure 8 – Removal of the aircraft fuselage and corpses by Goias State military firefighters.

The exam of the damage sustained by the main and tail rotor blades showed that, at the moment of the collision with the ground, the PP-CGO rotors were turning at a very low speed, just on account of aerodynamic and inertial forces.

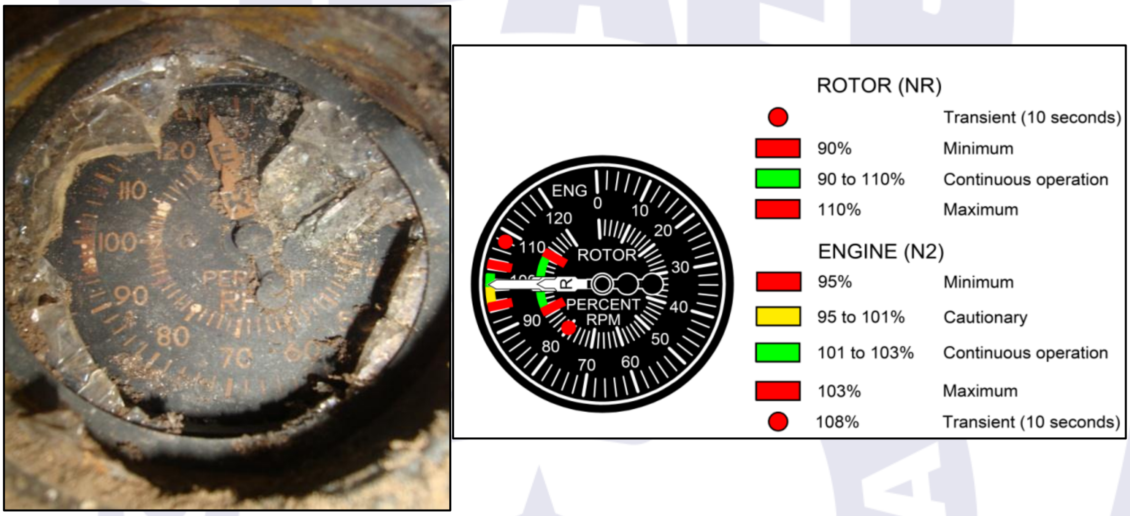
In the parts of the wreckage that were not charred, no marks were found either on the paint or metal that could indicate contact of the main or tail rotor blades with another surface of the aircraft or obstacle.

In the instrument panel (Figure 9), which had been buried into the ground (at a depth of more than one meter, it was possible to identify the EDUs 1 and 2 (primary and secondary), the ASI, the dual tachometer, the clock and the altimeter.


Figure 9 – Panel of the PP-CGO.

The clock and the altimeter had de-configured on account of the impact of the aircraft with the ground, and so their indications were not dependable. The speed indicator pointer was stuck at the speed of 174kt (figures 10 and 11), while the tachometer indicated NR and N2 equal to zero (Figures 12 and 13).

Figures 10 and 11 – ASI of the PP-CGO indicating 174kt. The figure on the right shows the same instrument, after removal of the glass broken in the impact.



Figures 12 and 13 – On the left, the pointers E (indicator of N2) and R (indicator of NR) appear at an intermediate position between 120 and 0 (indication not to scale). On the right, one can see the marks of the instrument, according to the aircraft manual.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

The three last reports issued by the Special Health-Checkup Medical Board (JES) containing information on the pilots did not present any evidence of health alterations that could be of relevance for the accident.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

The aircraft captain had a Goias State Civil Police Chief since the year 2000. His certification for helicopter operation was granted in 2006, a time in which the State Government still hired helicopters for public security organizations.

He concentrated his efforts on his professional improvement as a rotary-wing aircraft pilot, and on the establishment of a Civil Police Air Unit as an independent entity, after spending three years as commander of the Third Tactical Group (GT-3), an elite organization of the Goias State Civil Police.

Before the Civil Police received its own aircraft and it became operative, the captain flew helicopters which belonged to the Traffic Department of the Federal District (DETRAN-DF), to the Civil Police of the State of Santa Catarina, and to the National Force, as a way to gain more training and flying hours.

His personal and professional profile was described by his family and workmates as characteristic of an extrovert, dedicated, perfectionist, well-organized, detailed, and programmed individual. He would assume a determined corporatist posture within his work institution.

Despite his spontaneous profile, he would sometimes be perceived by some of his fellow workers as a methodical, systematic and unrelenting professional.

He had a structure that was considered active physically and healthy in emotional terms.

In the professional field, he was seen by the group as a safe and competent worker in aviation. He had a zeal for the aircraft as if it belonged to him.

Among the AW119 MKII Koala aircraft operators in the region, the captain was renowned for the high level of his technical knowledge of the aircraft, being consulted by others on technical issues.

As an accredited member of the SIPAER, he was seen by workmates and other operators in the region as a professional with a strong attitude towards flight safety, and someone who had a truly operational profile.

According to reports made by crews of the air unit, the captain was not a venturous person, and would not take risks while flying. His maneuvers were smooth, and were conducted in accordance with the procedures laid down in the manual.

He was used to operating the aircraft at higher altitudes, believing he would then have more time to react in emergency situations.

In the weeks prior to the accident, the captain had already been giving daily air support to the investigations conducted by the Civil Police and, according to testimonials, did neither report any unsafe condition relative to the operation of the accident aircraft nor did he identify any irregularity involving the aircraft.

The copilot was also a Civil Police Chief. He reported for work at the GT-3 in 2009, and then took up a helicopter pilot course.

Members of his family and coworkers defined him as a stable individual, always in good mood, who was very organized and careful, particularly with respect to piloting processes.

His professional profile was more flexible, and had a role that was perceived in the work as "reliever of adversity."

In the time preceding the accident, he was living an intense phase of studies focused on aviation and on the English language necessary for the flying activity.

On the day before the accident, the copilot carried out a test flight following the completion of maintenance services provided by the Fênix Manutenção e Recuperação de Aeronaves Ltda. Company. No abnormality in the aircraft was detected by him.

On the day of the accident, the captain and the copilot took off early from Santa Genoveva Airport. According to accounts of the Civil Police staff, while the work of crime reconstitution was being done at the farm, the captain was resting, and the copilot was studying English.

At around noon, there was a flight (which apparently was not planned in advance, according to members of the civil police) from Fazenda Nossa Senhora Aparecida to downtown Doverlândia, State of Goias.

The captain had a bond of friendship, trust and rapport with his work team, being respectful and open to communication.

For some, however, his methodical, procedural, and, sometimes, inflexible profile as a pilot would now and then result in difficulty for his interpersonal relationships.

According to accounts, he exhibited a centralizing posture in relation to the activities and problems of the Air Unit, despite his efforts to keep the group updated.

The copilot, in turn, was regarded as a good companion and a friend by the work team. Noticed by his more informal relationship and partnership with the group, he was seen as one who had a differentiated interaction of the boss/subordinate relationship, marked not only by good mood, but also professionalism.

According to reports, the captain used to inform his work team and the Fênix Manutenção e Recuperação de Aeronaves Ltda. company on any maintenance needs of the aircraft.

On the Friday before the accident, the Fênix Manutenção e Recuperação de Aeronaves Ltda. company received the helicopter from the captain. Despite the fact that the maintenance company's activities had been suspended by the ANAC, the Civil Police was never informed about the suspension.

However, there were accounts that, on the following Sunday, the captain received calls from the State of Goias Judiciary Police Superintendent (who would later be one of the victims in the accident), asking him about the completion of maintenance in the aircraft.

There is information that, on the occasion of the arrangements with the Fênix Manutenção e Recuperação de Aeronaves Ltda. company, the possibility that the aircraft might not be delivered on the requested date led the captain to consult both the Military Police and the Goias State Military Firefighting Department on the contingent lending of their aircraft to perform the mission for the Civil Police. Both organizations denied the possibility of accommodating the request.

Although the captain told the Fênix Manutenção e Recuperação de Aeronaves Ltda. company of the need to use the aircraft in the following week, and despite the fact that he was informed about the impossibility of completing the maintenance job within such deadline, the company stated that it had not been pressed by the pilot, who told them to perform all the necessary maintenance activities.

Nevertheless, the helicopter was delivered by the company in the following week, as had had previously requested by the captain, after a negotiation with one of the company owners. It was not possible to confirm whether such negotiation had the direct participation of the captain or involvement of other professionals of the Civil Police.

According to information provided by members of the Civil Police, the use of the aircraft the following week was justified by a strike which foreseen to begin at that period.

Still according to accounts, it was for this reason that the Civil Police staff had been willing to provide support to that case investigation, in a way that it could be completed before the onset of the strike.

The captain, while still a commander of the GT-3, had been appointed for the management of the Air Unit, which would begin to operate autonomously around the mid of 2010. The command of the GT-3 was assumed by the Deputy Police Chief.

This separation of functions was necessary for the establishment of a specific flight management aimed at the strengthening of the operational safety conditions.

Until receipt of their own helicopter, the Civil Police used to lease helicopters in support of its missions.

The PP-CGO, which arrived in Brazil in December 2010, was not engaged in police missions for a period of about 10 months, due to documentation/insurance regularization issues.

Meanwhile, the aircraft served as an observation deck until it was activated for operational missions in mid-September 2011.

The Air Unit did not have a structured physical location within the Civil Police yet, let alone a hangar for proper aircraft storage.

It made use of a small office room and a small hangar at Santa Genoveva Airport, both of them made available by the INFRAERO. It also made contingent use of another small office located in the Public Security Secretariat for administrative purposes only.

It was a small and structurally lacking air unit, with very limited financial resources regarding the activities of flight, maintenance control, and administrative procedures. Its organizational processes were still being defined.

Because the air activity was highly expensive, the investments in physical infrastructure and personnel were very limited.

According to statements, this factor, in addition to the complexity and specificity of the work associated with aviation, made the internal recruitment of personnel very difficult, since they would, in principle, accumulate their new functions with those they already had in their sector of origin.

The Air Unit did not have its own training program aimed at the education and continued supervision of crews continued, with the purpose of improving and maintaining the proficiency of the activities performed by every individual.

According to reports, this training was under the responsibility of the crew, and each individual was personally committed with maintaining his operational capability in the machine he had to operate.

At the time, all operational and administrative activities of the Air Unit were being performed by eight professionals, among them the captain and the copilot involved in the accident.

As the Air Unit had only a captain and a copilot in its staff, they always composed the crew for all the missions of the Air Unit.

The Deputy Police Chief designated for the command of the GT-3, despite being qualified for the operation of the AW119KII Koala helicopter, was not listed in the flight schedule of the Air Unit.

Among the professionals of the Air Unit, there was one dedicated to the closely monitoring of all the aircraft demands for the pilots. He was a Civil Police registrar and was invited to work in the unit because he was a student of aircraft mechanics, thus having the knowledge required for being the liaison between the Civil Police and the maintenance company.

In addition to his activities as a Registrar, he was in charge of controlling the aircraft refueling and supervising all the services performed in the aircraft. He was also responsible for the execution of all other administrative demands of his sector.

He also reported that he did not participate much in the flights of the Air Unit, for feeling overwhelmed by the administrative job for which he was responsible.

On occasions, the Fênix Manutenção e Recuperação de Aeronaves Ltda. company was informally requested by the Air Unit to provide extra support with the maintenance, still in the period that the company was not officially designated as the workshop in charge of the Goias State Civil Police aircraft maintenance.

According to company reports, such requests were accommodated as a favor for the sake of Flight Safety, and even after having received government approval for the maintenance of the civil police helicopter, the company always showed readiness for providing maintenance service for the Institution.

The Air Unit missions were always planned. According to reports, the demands increased significantly after the air unit received its own helicopter. This fact, together with the need for the implementation of bureaucratic and administrative tasks inherent to the air unit, allegedly generated work overload for some, and, especially, for the civil police registrar in charge of monitoring the maintenance services.

Internally, the captain took responsibility for the administrative activities related to the role of Police Chief of the Air Unit, and assumed the command of all flights made, and monitored the operating conditions of the aircraft - this activity was performed in conjunction with the unit maintenance link.

As for the copilot, he was responsible for the execution and control relative to the Air Unit bidding processes, besides working as a pilot.

For pilots and mechanics in the region, the Koala helicopter, with a small fleet nationwide, was an aircraft whose operating parameters were still considered a novelty, and only recently was it being employed by the Goias State government agencies.

The staff of the Air Unit recognized the increased operational complexity of the aircraft.

The Air Unit maintenance link stated that despite the pilots' constant studies of the helicopter operating characteristics, the lack of continuity in pilot training might produce an insufficient perception of the adverse inflight conditions.

Although the planning and control of maintenance were part of his responsibilities, the air unit maintenance link stressed the difficulty he had in accomplishing the task.

He complained about the understaffing and the shortage of resources, and felt overwhelmed by the activities, mainly the administrative ones.

According to reports, the Air Unit had difficulty conducting an effective control of the aircraft maintenance needs and keeping accurate records of the aircraft problems due to the excessive workload assigned to the maintenance link.

According to information, although the Air Unit recognized the need for an exclusive professional dedicated to the monitoring of control maps, it forwarded the logbooks to the maintenance company, which monitored the necessary inspections and control maps of components.

The Air Unit would not consider the possibility of assigning a dedicated professional to control the airworthiness and maintenance of aircraft, given the insufficient staff assigned to the unit and the difficulty they had in finding volunteers that would like to be transferred to the unit.

1.14 Fire.

A post-impact fire quickly consumed the aircraft cabin, charring the bodies of seven of the eight occupants, and causing the firing of the ammunition that was in possession of the police. It was not possible to determine the point at which the fire started.

According to the AW119 MKII Koala aircraft Operations Manual, besides the JET A1 remaining in the fuel tanks, the aircraft systems were carrying other flammable liquids that may have contributed to the post-impact fire, such as the transmission oil (10.5 liters), engine oil (8.7 liters) and hydraulic fluid (1.6 liters).

1.15 Survival aspects.

In view of the violent impact of the aircraft into the ground, and the fire that began shortly thereafter, there was no possibility of survival of the eight aircraft occupants.

The examination conducted by the Forensic Institute of Goiânia revealed that there was no soot in the trachea of the victims, an indication that death took place due to injuries sustained in the impact..

1.16 Tests and research.

In order to provide greater transparency to the SIPAER investigation, all examinations, tests and subsequent research at the date of the accident were conducted in the presence of representatives of both the Secretariat of Public Security of the State of Goias and Agusta Westland, manufacturer of the aircraft.

After the accident was reported to SERIPA VI, two teams of the office were promptly sent for the preliminary investigation activities: one team went to the *Fazenda Nossa Senhora Aparecida* – the crash site - and the other to Goiania, bound for Santa Genoveva International Airport and for the *Fênix Manutenção e Recuperação de Aeronave Ltda*., aiming to verify the conditions under which the aircraft was refueled, and to perform the initial study of the maintenance records.

<u>Relative to the fuel</u>

On 9 May 2012, in the premises of Air BP Brazil Ltda., interviews were conducted with the Manager, the Supervisor and the professional responsible for the last refueling of the PP-CGO helicopter before the accident. Several documents related to the control of the fuel provision activities by the company were analyzed. On that occasion, the following conditions were found to be most relevant:

- The last refueling of the accident aircraft was done on 7 May 2012 at Santa Genoveva International Airport (SBGO). According to the voucher no. 133630 of Aviation Products Delivery, the refueling was at 18:06 local time, and the aircraft received 166 liters of JET A1. According to the person responsible for the refueling, at the end of that operation, the level of fuel was tangential to the nozzle of the aircraft tanks. The refueling voucher was signed by the aircraft captain;
- The fuel tanker used in the refueling on 7 May 2012 had been replenished with fuel stored in reservoirs (stationary containers) of the Air BP company, which made it unviable to remove samples from the fuel tanker for analysis. However, based on the records of refueling performed by the company, it was found that 11 other aircraft made use of the same fuel tanker on 7 May 2012. The contacts made with the owners and operators of those aircraft revealed that no problems were observed with the JET A1 fuel.
- At the request of the investigation commission, the company procedures from the receipt of the fuel until its delivery to the aircraft were demonstrated, and the SERIPA VI team verified their compliance with the regulations in force;

- On account of the documents submitted by the company, such as refueling control, test certificates issued by laboratories of the Reduc/Ot/Qp - Petrobras laboratories, storage tank control spreadsheets, airport tanks release records, and checklists for JET A1 transport, duly filled out and in accordance with the rules, the team chose not to take samples from the Air BP Brazil stationary fuel containers for further analysis;
- According to the refueling vouchers obtained by the investigation commission, the PP-CGO helicopter was refueled three times in SBGO in the week before the crash:

Date	Local time	Amount of JET-A1 (liters)
2 May 2012	07:20	407
3 May 2012	06:15	425
7 May 2012	18:06	166

Table 4 – Refueling of the PP-CGO in SBGO, in the days prior to the accident. Source: *Air BP Brasil Ltda.*

During the investigation, it was also found that in some operations off the main base, the fuel used for refueling the aircraft was transported by an F-1000 truck in a container with a capacity of 250 gallons of aviation kerosene (Figure 14).

On these occasions, some requirements and procedures for quality control in the storage, transportation and refueling were not conducted in accordance with the rules established in the ABNT NBR 15216 and 13310. According to reports obtained in the investigation, the last time this container had been used was approximately three weeks before the accident.

Figure 14 – Fuel container utilized by the Air Unit in off-base missions.

In the samples taken from this container, tests were performed for the aspect, specific mass, existing washed gum, 2h at 100°C copper corrosiveness, distillation at atmospheric pressure and content of the marker. According to the Test Report no. 39/13 issued by the Brazilian National Agency of Petroleum, Natural Gas and Biofuels (ANP), on account of the physic-chemical parameters achieved, the samples were fully compliant with the current specification for aviation kerosene.

Relative to the GPS equipment

The GPS (model GNS430W), PN 011-01060-00, manufactured by Garmin, and equipping the PP-CGO at the time of the accident (Figures 15 and 16), was analyzed by the Garmin representative in Brazil, GPS Center company, in São Paulo, and by the AERO Avionics company, Sorocaba, SP, specialized in the installation and maintenance of electronic equipment in aircraft. The technical opinions pointed out the impossibility of recovering data from the Non-Volatile Memory (NVM) of the equipment, on account of the damage sustained in the crash.

Figures 15 and 16 – *Garmin* GNS430W GPS equipment retrieved from the PP-CGO wreckage.

Relative to the main and tail rotor blades, as well as main and rear gear boxes

The tests in the main rotor and tail rotor blades, in the main transmission and rear gearbox were performed in the premises of the Department of Science and Airspace Technology (DCTA). The Report no. 23/AMR/2012 of 9 August 2012, signed by engineers of the Institute of Aeronautics and Space (Division of Materials) presented the following relevant results:

The visual tests with respect to the blue marking blade - which detached during the flight - showed that the lugs have suffered overload-related fractures, as can be seen in Figure 17, and, in detail, in Figures 18 and 19.

Figures 17, 18 and 19 – Main Rotor propeller blade (blue). The fractures in A and B are characteristic of overload.

Still with respect to the blue marking blade, it was observed that the inclination of the fracture in the composite material ran from the lower to the upper side, indicating that the propeller blade sustained a vertical movement during the breakage process, as shown by the arrows (Figure 20).

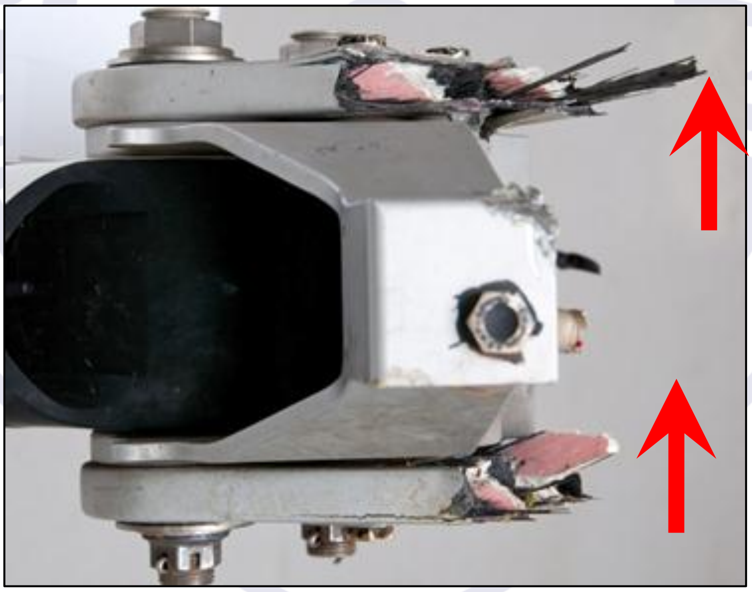


Figure 20 - Lateral view with detail of the fractures. It is possible to see a bottom-up inclination, indicating that the propeller blade moved vertically during the structural disruption process.

Additionally, it was found that the fracture surfaces showed regions characteristic of traction and compression, as can be seen in Figures 21, 22, 23 and 24.

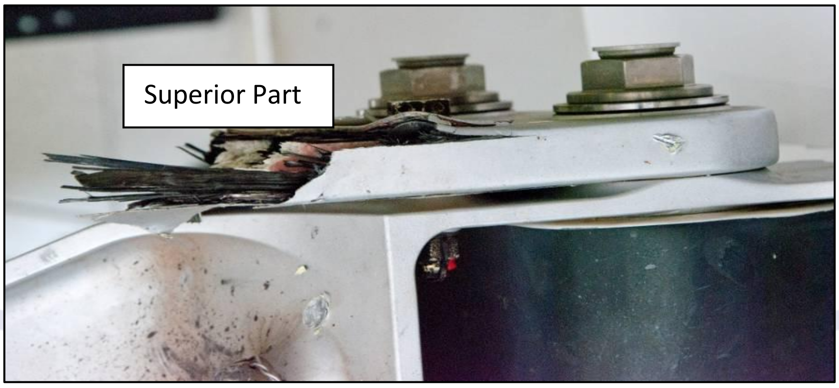


Figure 21 - Detailed view of the fracture from the top.

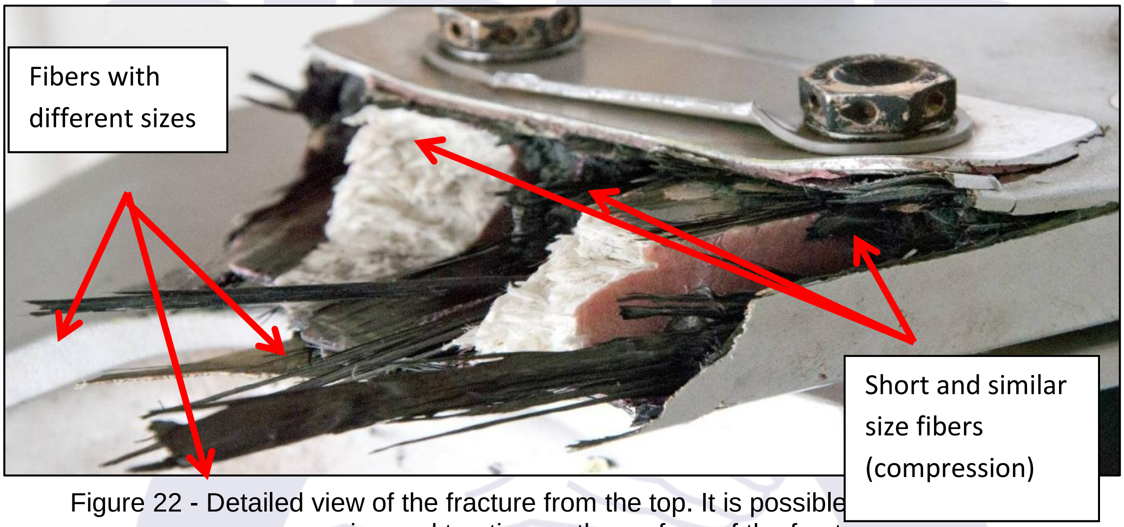
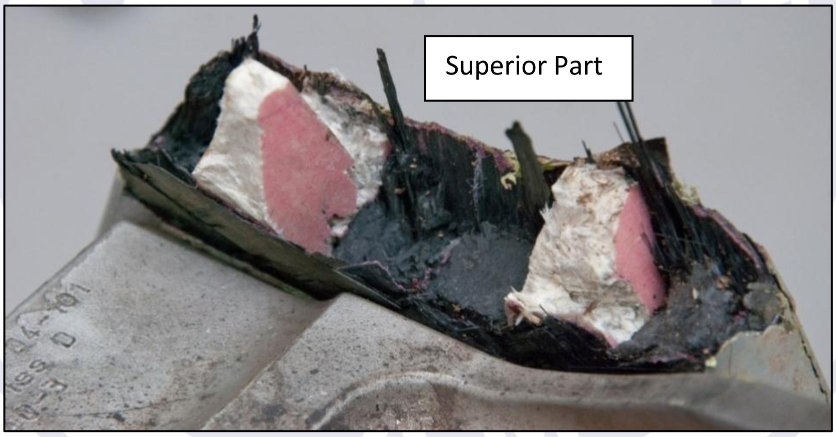
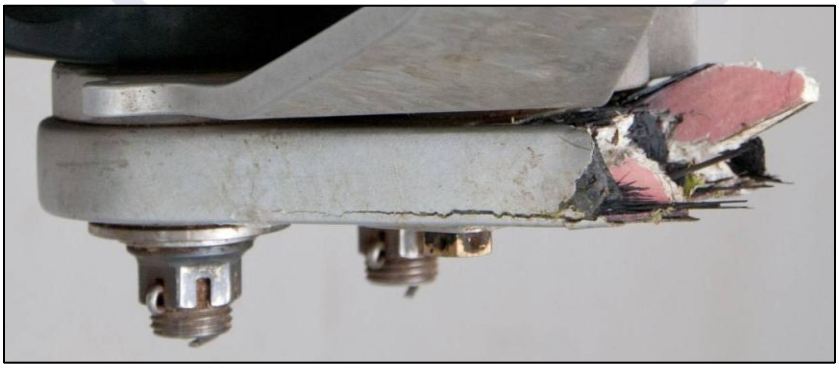


Figure 22 - Detailed view of the fracture from the top. It is possible [to see regions of] compression and traction on the surface of the fracture.



Figures 23 - Detail of the fracture as viewed from the bottom.

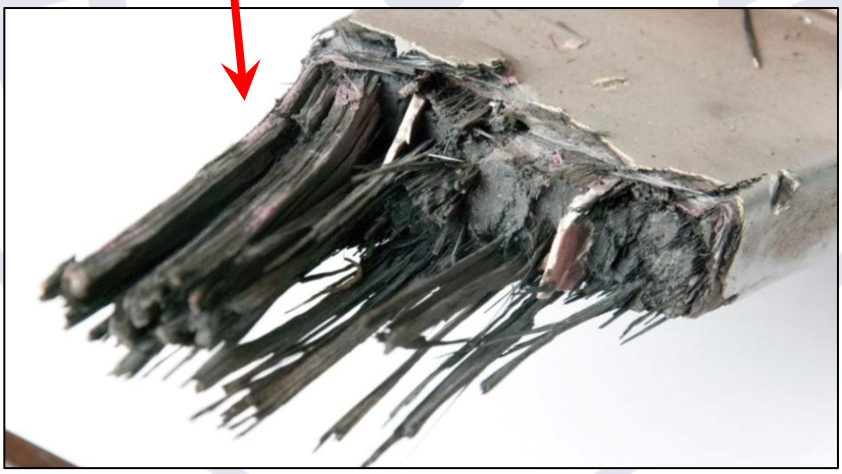


Figures 24 - Detail of the fracture as viewed from the bottom. It is possible to see regions of compression and traction on the surface of the fracture.

As for the red-marking blade, it showed overload-related fracture characteristics on the horizontal axis (Figures 25, 26 and 27).

Figures 25 - Fracture details of the red-marking propeller blade.

Figures 26 - Fracture details.



Figures 27 - Fracture details of the red-marking propeller blade. It is possible to see that the direction of the blade breakage was along the horizontal axis.

One of the main rotor blades suffered a burning process during the event (Figure 28). The other blade, without the fist region, presented an aspect of rupture due to overload (Figure 29).

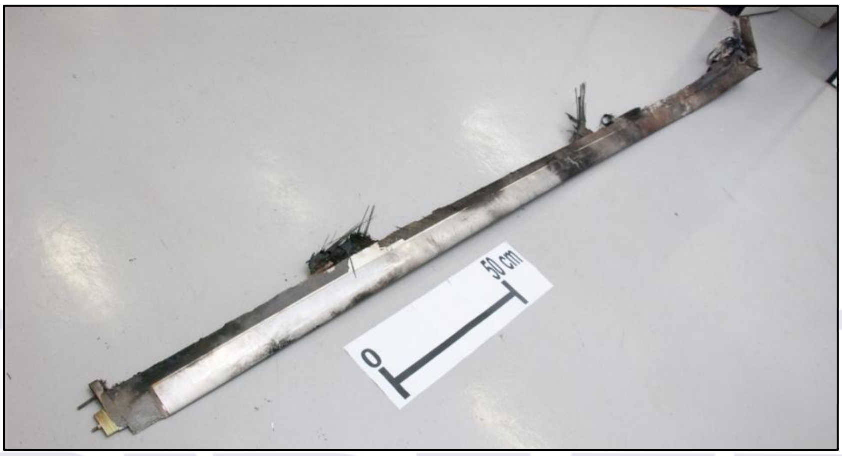


Figure 28 – Main rotor propeller blade.

Figure 29 – Main rotor propeller blade.

The tail rotor blades revealed overload-related fracture characteristics, due to the impact with the ground, with delamination of the composite material, as can be seen in Figures 30, 31 and 32.

Figure 30 – Rear transmission box and tail rotor blades.

Figures 31 and 32 – Details of the tail rotor blade. The fractures and delamination resulted from the impact with the ground.

In the main transmission, the "Chinese Hat" showed a notch probably produced by the vertical movement made by the blue-marking main rotor blade.

Figures 33 and 34 – Main transmission on the left. On the right, detail of the "Chinese Hat", with a notch probably made by the blue-marking blade's upward vertical movement.

After the macroscopic analysis, examinations by means of electron microscopy were performed in the fracture of the blue-marking blade. In Figure 35, the region appears as seen with the naked eye. In Figure 36, it is seen by means of electrophotography.

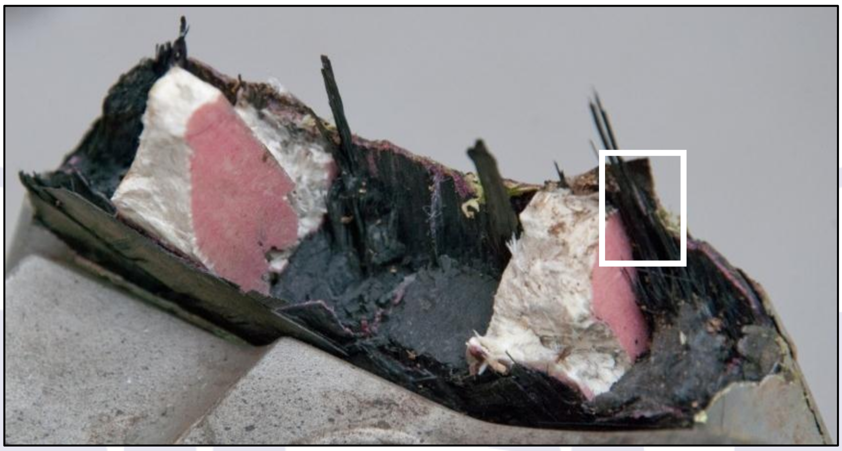


Figure 35 – The area marked with a white rectangle was utilized for Scanning Electron Microscopy.

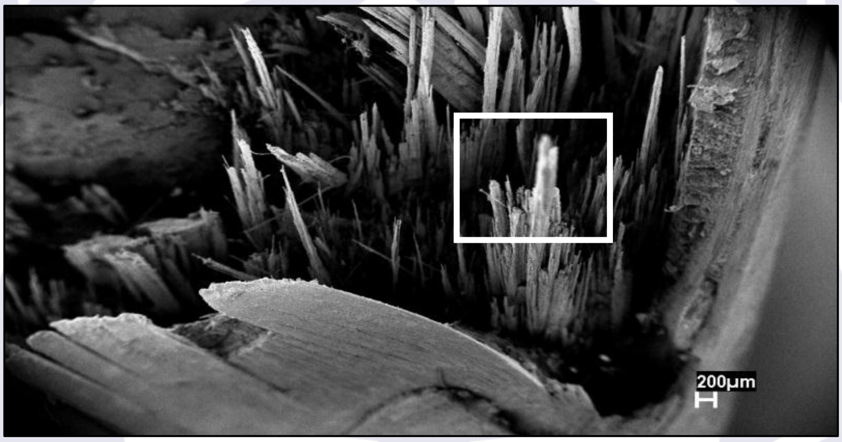
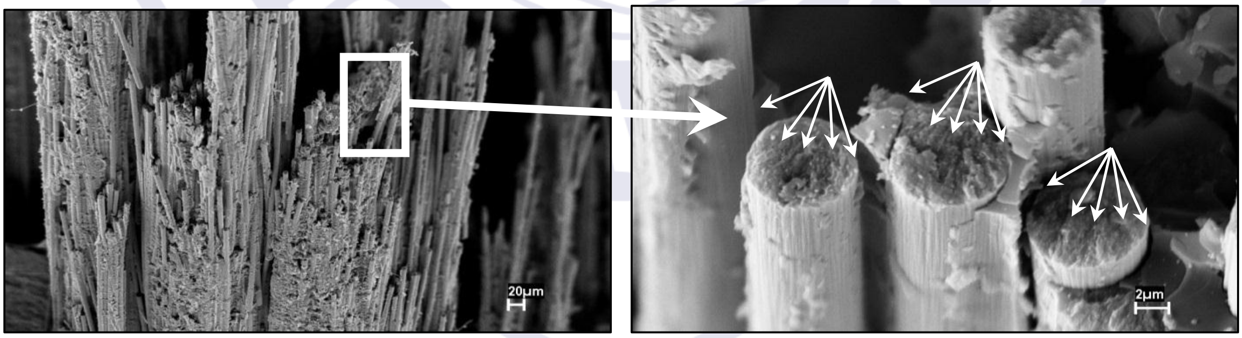


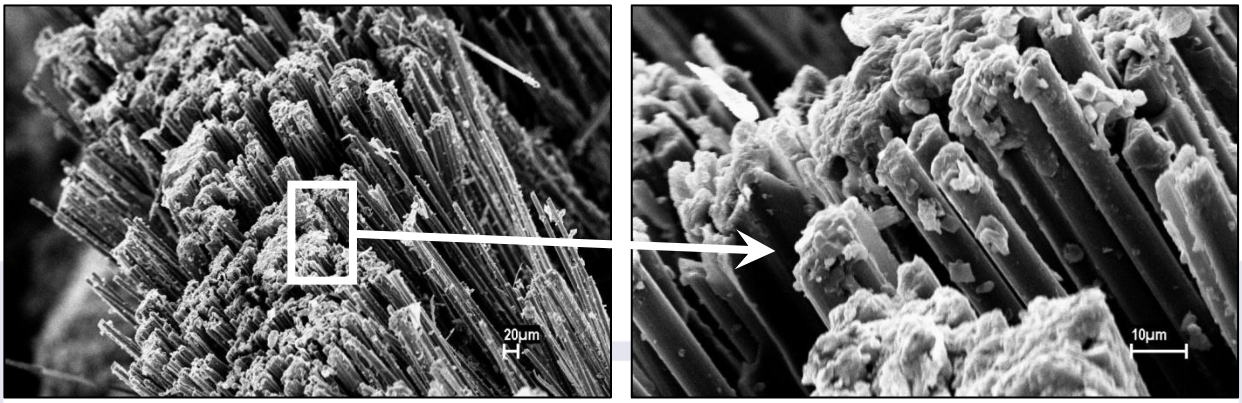
Figure 36 – The area marked with a white square was analyzed with higher magnification from the scanning electron microscopy.

Figure 37 shows fibers with disruption due to traction overload. Figure 38 shows details of the fracture surface of the fibers, with indication of the direction of the rupture.



Figures 37 and 38 – Details of the fractured fibers marked in Figure 36. On the left, it is possible to observe that the fibers had different sizes – characteristic of traction-related fracture. On the right, the arrows indicate the direction of the fracture.

Figure 39 shows fibers with disruption due to compression overload. Figure 40 shows details of the fracture surface.



Figures 39 and 40 – Details of fractured fibers. On the left, one can see that the fibers had similar sizes; they sustained fracture due to compression. On the right, details of compression-related fractured surfaces.

In light of the results obtained, the report 23/AMR/2012 concluded in its item 3 (Discussion of the Results) that:

> the main rotor blue-marking blade sustained rupture of its structure due to overload, with a vertically acting upward force. The red-marking blade sustained rupture caused by overload forces acting in the horizontal direction. A blade, whose marking color was not identified, sustained a burning process after the collision of the aircraft with the ground. The fourth blade of the main rotor showed a high degree of damage that looked like overloaded-related breakage. The tail rotor blades showed typical fractures from impact with the terrain. All observed features of the fractures indicated that the main rotor and tail rotor blades were spinning without power prior to impact against the ground.

Relative to the engine

The aircraft engine was analyzed at the Engines Division of the Institute of Aeronautics and Space (IAE) in São José dos Campos, State of São Paulo. The result of the analysis is in the Investigation Report no. RI APA 03/2013 (1 April 2013), which has the following:

In the beginning of the work, the engine was embroiled in the structure of the nacelle, which exhibited significant damage from impact and severe fire (Figures 41, 42, 43 and 44). The reduction gearbox was fractured at the junction with the power section of the engine (at flange "B") and had no damage caused by heat (Figure 45).

Figures 41, 42, 43 and 44 – Engine of the PP-CGO in the laboratory of the Engine Division of the Aeronautics and Aerospace Institute (IAE). Front, left side, right side and rear views.

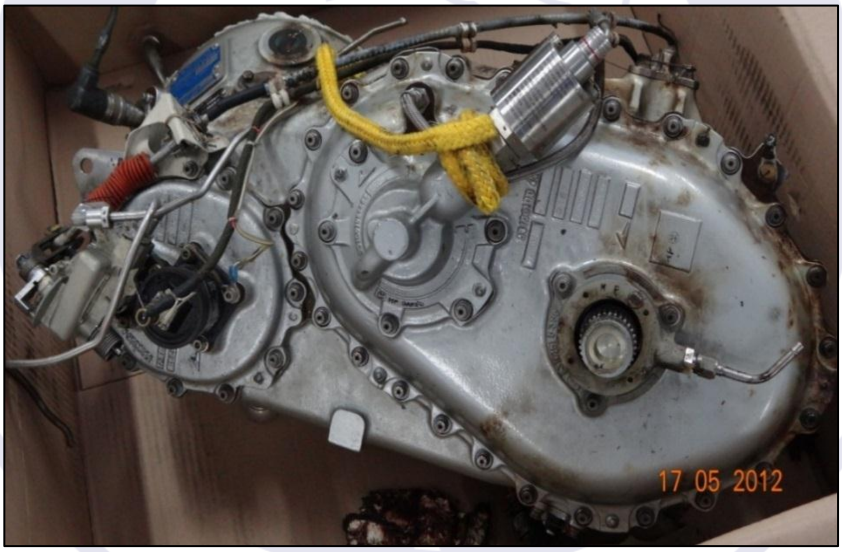


Figure 45 – Engine reduction gear box (RGB).

After removal of the nacelle surrounding the engine, it was found that all external components had been damaged due to impact and fire. The accessories box had been extensively consumed by intense heat, exposing its inner features (Figure 46). The high pressure pump fuel, the fuel control unit (FCU), the fuel heating and the electronic governor were in their correct positions, showing serious damage from fire and impact, which precluded any functional verification (Figure 47).


Figures 46 and 47 – On the left, the engine box of accessories. On the right, the *High Pressure Fuel Pump and the FCU* (*Fuel Control Unit*).

The stator of the compressor turbine (Figure 48) showed no evidence of wear or damage that could impair the operation of the engine.

Figure 48 – Compressor Turbine Stator

The compressor turbine rotor, at its front (Figures 49 and 50), had mild rubbing marks on the root of the blades.

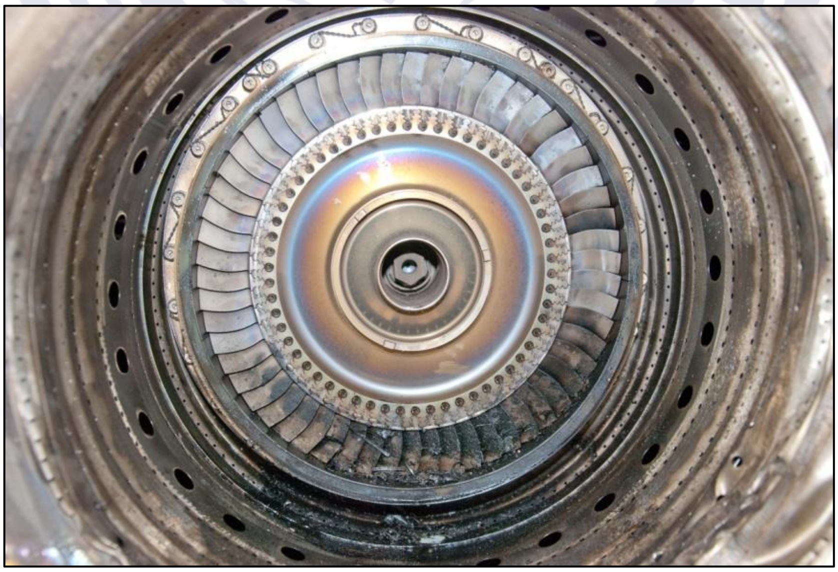


Figure 49 – Compressor Turbine Rotor

Figure 50 – Marks of mild rubbing at the root of the blades.

The compressor turbine segmented ring showed several marks of impact left by the blades of the compressor turbine rotor in the segments, as can be seen in Figures 50, 51 and 52.

Figure 51 – Segmented ring of the compressor turbine.

Figure 51 – Marks of impact left by the compressor turbine rotor blades.

Figure 52 – Marks of impact left by the compressor turbine rotor blades.

The diaphragm showed signs of mild rubbing. The power turbine stator of the engine was in good condition, showing no damage from high rotation or impact. The rear side of the diaphragm (Figures 53 and 54) also had signs of mild rubbing left by the roots of the power turbine rotor blades.

Figure 53 – Diaphragm with marks of light rubbing left by the roots of the compressor turbine rotor blades.

Figure 54 – Back view of the stator of the power turbine with the diaphragm.

The power turbine rotor blades showed no damage or evidence of having suffered sudden stop due to impact (Figure 55).

Figure 55 – Front view of the power turbine rotor.

The small canals of the power turbine rotor sealing ring had no marks or damage resulting from rubbing with the ends of the blades of the power turbine rotor (Figures 56, 57 and 58).

Figure 56 – Overview of the sealing ring of the power turbine rotor.

Figure 57 – Detail of the small canals for ring sealing.

Figure 58 – Detail of the small canals at another point of the sealing ring.

On account of the results obtained, the Report no. RI APA 03/2013 (item 3 - Discussion of the Results), concluded that the impact marks left by the blades of the compressor turbine rotor on the segmented ring were produced when the rotor had already stopped, indicating that, at the time of the collision with the ground, the aircraft engine was inoperative after an inflight flame-out. The report also reads that, during the work of disassembling, no mechanical problems, damage to bearings, lack of lubrication, fractures or other discrepancies capable of causing malfunction or a complete stop of the engine were identified.

Relative to the ASI

The Report no. 20-E/2012 of 12 July 2012, issued by the Division of Certification of the Industrial Foment and Coordination Management Systems (IFI), revealed that, after black light analysis, there was absence of fluorescence spots on the inner surface of the ASI display installed in the aircraft.

In the research that was done, it was possible to observe points with light color, contrasting with the dark background of the instrument, something that, according to the report, could be interpreted as sign of rust or contamination (Figure 59). Moreover, the point found at position "34" (Figure 60), which coincided with the contact region in a frontal impact, presented a light color aspect without the characteristic presence of fluorescence - similar to many other apparent signs - and therefore should not be taken into consideration.

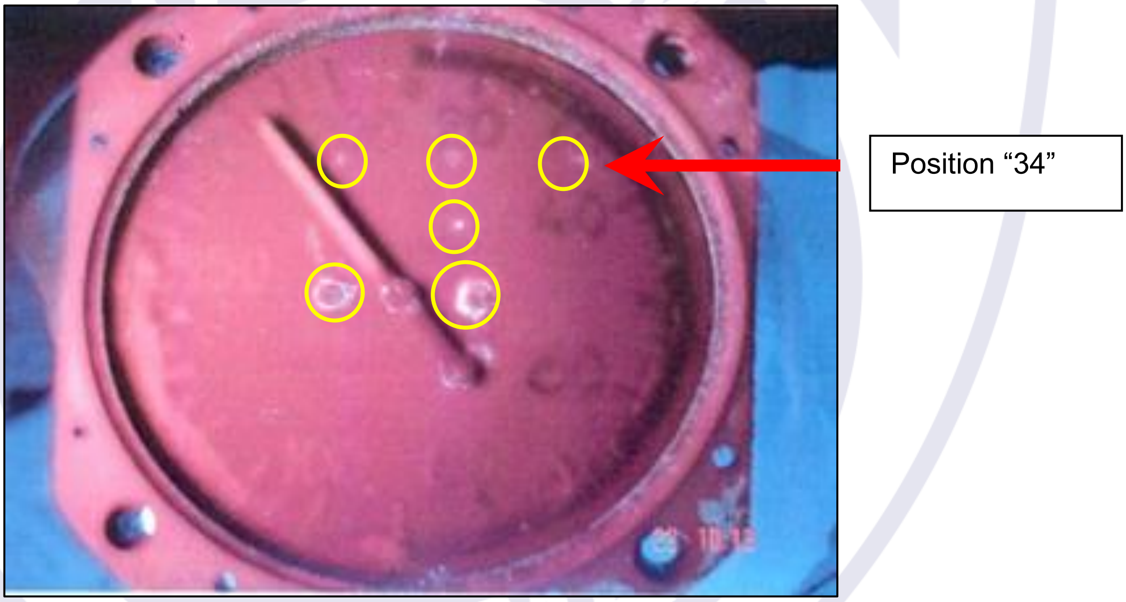


Figure 59 – ASI under the action of black light with intensity of 1,310 $\mu w/cm^2$. The yellow circles indicate the points that were not considered.

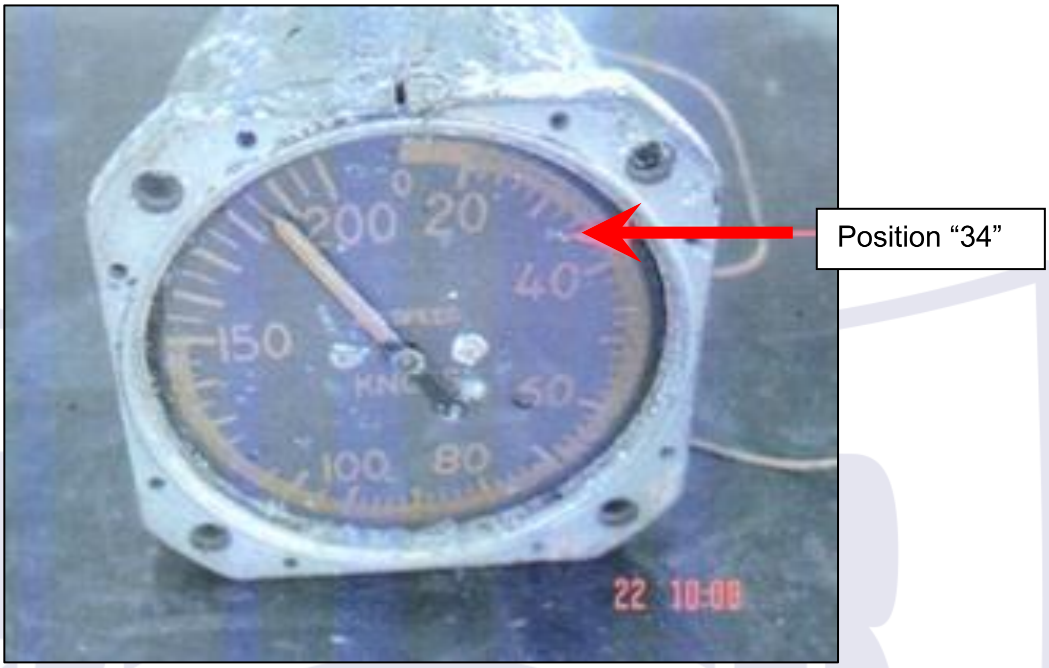


Figure 60 – ASI under the action of white light. In highlight, the only point that could have been caused by the pointer (position "34"), but which was not considered as evidence in the 20-E/2012 Report.

In summary, the Report 20-E/2012 reads (Section 5 – Conclusion) that it was not possible to detect points indicative of the aircraft speed at the time of the collision with the ground. According to the document, the absence of signs or fluorescent evidence may have resulted from impact in an unfavorable direction toward the marking or due to the action of agents that eliminated or masked any possible evidence, such as contamination or oxidation.

Relative to the Electronic Display Units (EDUs)

Despite presenting a high level of destruction and not possessing resistance requirements against impact, temperature and pressure, like the ones of the flight recorders, the two Electronic Display Units (EDUs) installed in the PP-CGO panel were removed from aircraft wreckage (Figure 61, highlighted) and taken for analysis in the laboratories of the Astronautics Corporation - manufacturer of the component - in Milwaukee, USA, in an attempt to recover the data stored in its Non-Volatile Memories (NVM).

Figure 61 – Panel removed from the wreckage of the PP-CGO. In highlight, the two EDUs taken for analysis in the USA.

Characteristics of the EDUs

According to information obtained from the Pilot Guide of the equipment, the EDUs PN 109-0900-66-3A02 installed in the Agusta AW119 MKII aircraft allow the storage of the following flight parameters (when in perfect condition):

Exceedance of the engine and transmission limits (EXCEEDANCE LOG): minimum or maximum values exceeded, description and duration of the event, and time at which it occurred;

"Warning" or "Caution" messages indication (FAULT LOG): description of the message (according to Table) and duration of the event;

Severity	Message	Description
Warning	*XMS OIL HOT*	*Transmission oil temperature above maximum limit (115 °C).*
Warning	*XMS OIL PRESS*	*Transmission oil pressure below minimum limit (30 psi).*
Warning	*BATT HOT*	*Battery temperature exceeding limits.*
Warning	*ENG OUT*	*N1 RPM abnormally low (below 51%). Engine power failure.* ***Note:** With ENG OUT warning message illuminated, a cabin acoustic signal is activated.*
Warning	*ENG FIRE*	*Fire in engine compartment.*
Warning	*ROTOR HIGH*	*Rotor RPM high. Rotor RPM above 108%.*
Warning	*BATT OFF*	*Battery disconnected.*
Warning	*ENG OIL PRESS*	*Engine oil pressure low (< 40 psi).*
Warning	*ENG OIL HOT*	*Engine oil temperature high (>115 °C).*
Caution	*FUEL LOW*	*Fuel quantity is low.* ***Corrective Action**: Verify fuel quantity in tank 1.* *Land as soon as practicable (10 minutes of flight remaining at MCP).* ***Note:** Avoid sideways flight and hovering in crosswind when the indicated fuel quantity is less than 10 kg.*
Caution	*DC GEN*	*Failure of the generator and D.C. bus.*
Caution	*GEN CONTR*	*Generator relay box circuit breaker tripped out.*
Caution	*ENG OIL PRESS*	*Engine oil pressure low (in yellow arc).*
Caution	*FUEL FILTER*	*Engine fuel filter partially clogged.*
Caution	*EEC FAIL*	*Electronic engine control (EEC) failure.*
Caution	*EEC DEGRADED*	*Electronic engine control (EEC) malfunctions.*
Caution	*EDU FAIL-SEC*	*Failure of secondary EDU.*
Caution	*ENG AGB CHIPS*	*Metallic particles in engine accessory gearbox lubricating oil.*
Caution	*ENG RGB CHIPS*	*Metallic particles in engine reduction gearbox lubricating oil.*
Caution	*XMSN OIL CHIPS*	*Metallic particles in the main transmission oil.*
Caution	*T/R BOX CHIPS*	*Metallic particles in the 90 deg tail rotor gearbox lubricating oil.*

Table 5. Indication of "*warning*" and "*caution*" messages (*FAULT LOG*) in the *Electronic Display Units* installed in Agusta A119 aircraft. Source: *Agusta Westland*

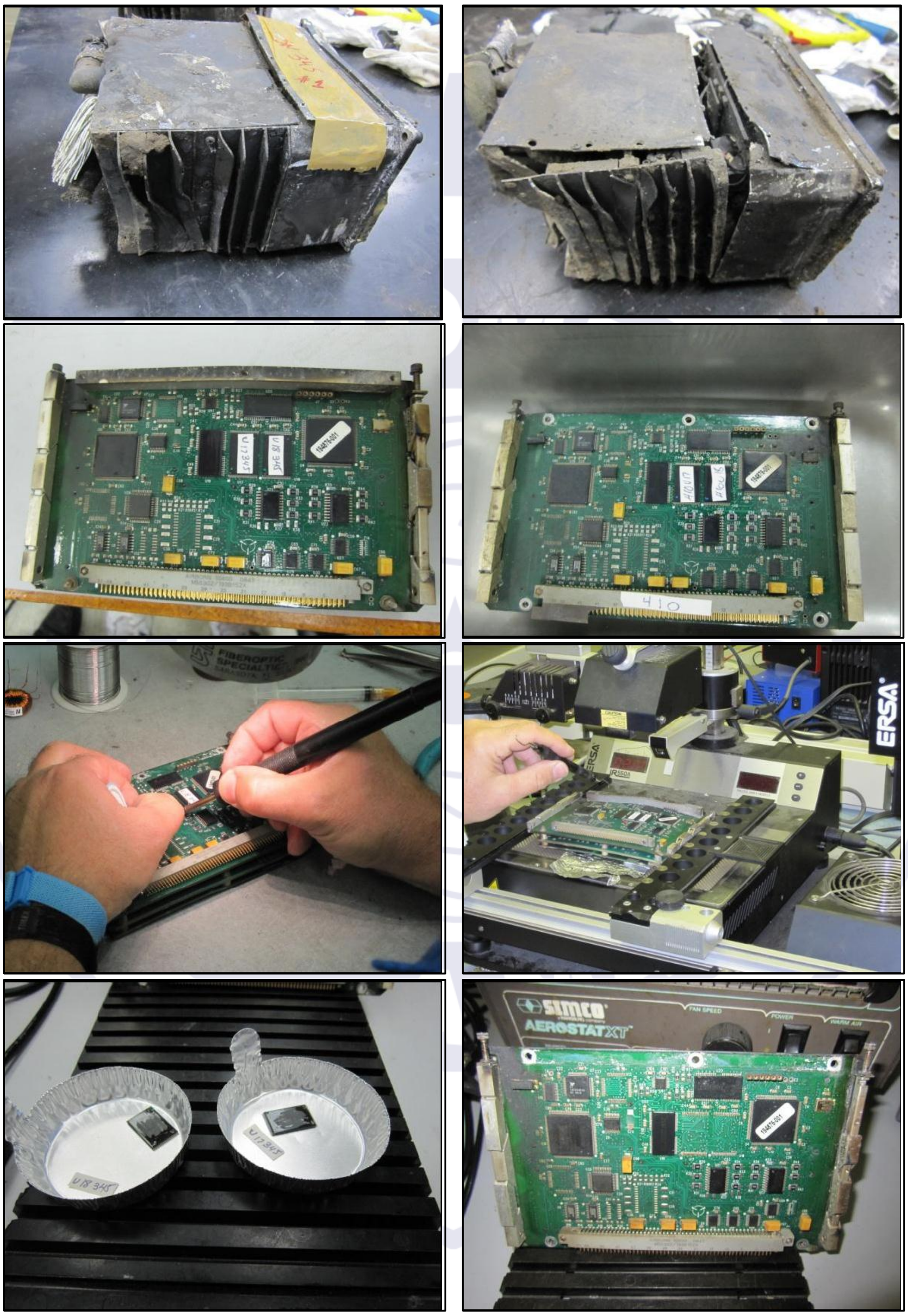
According to the manufacturer, the recording of the parameters described above is initiated and terminated automatically once the main rotor RPM reaches 75%. Each flight is identified as "START OF FLIGHT" and "END OF FLIGHT" along with the time and date it occurred. After the recording is finished, the equipment stores all information in its NVM

(Non-Volatile Memory) chip. If there are no abnormalities during the flight, nothing is recorded.

<u>Readout of data</u>

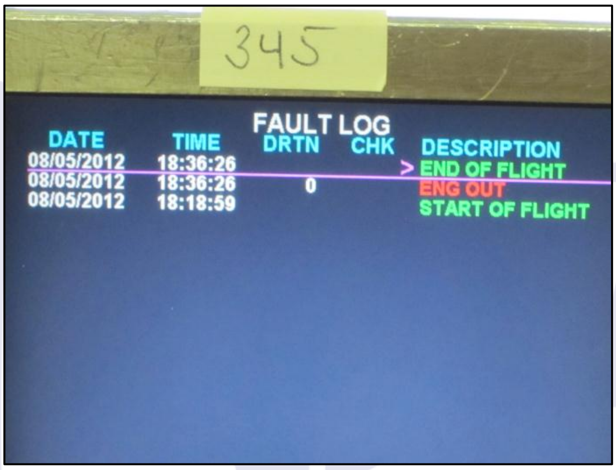
The work of EDU's (Serial Numbers 345 and 410) readout began at the headquarters of the Astronautics Corporation on 27 August 2012.

After an initial analysis, the decision made (on account of the damage sustained by the components) was to remove the non-volatile memory chips of the two electronic units and reinstall them on the test bench of the company (Figures 62, 63, 64, 65, 66 and 67).



Figures 62, 63, 64, 65, 66 and 67 – Sequence of pictures showing the removal of the non-volatile memory from the EDU's installed in the PP-CGO, and its later installation in the protoboard of the *Astronautics Corporation.*

Despite presenting a difference of 87 seconds in the TIME (hour) field – something which probably occurred due to different settings entered by the crew - it was found that both EDUs recorded the "ENG OUT" warning approximately 0.1 seconds before the end of flight (Figures 68, 69, and Table 6).

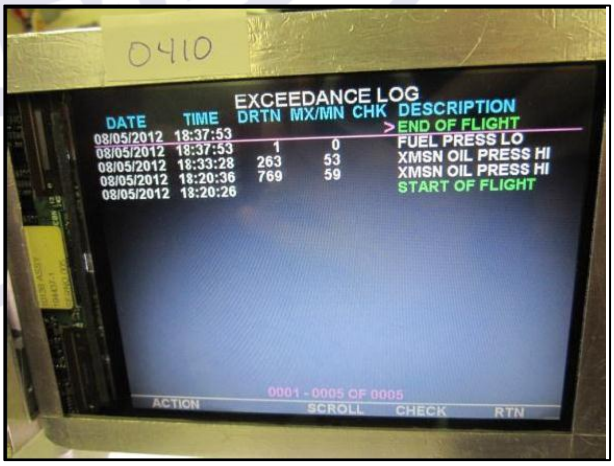


Figures 68 and 69 –*Fault Log* messages relative to the accident flight stored in the PP-CGO EDUs.

EDU SN 345				EDU SN 410			
Date	Time	Duration (ms)*	Description	Date	Time	Duration (ms)*	Description
08/May/2012	18:19:59.03	0	START OF FLIGHT	08/May/2012	18:20:26.03	0	START OF FLIGHT
08/May/2012	18:26:26.06	200	ENG OUT	08/May/2012	18:37:53.08	100	ENG OUT
08/May/2012	18:36:26.08	0	END OF FLIGHT	08/May/2012	18:37:53.09	0	END OF FLIGHT

Table 6. *Fault Log* in the PP-CGO EDUs. Source: RELTEC /SERIPA VI/2012. * Event duration in milliseconds (the duration is related to all the exceedance period and not to the max or min value reported).

In relation to the Exceedance Logs, the results were different. As can be seen in Figures 70, 71, and in Table 7, the EDU SN 345 did not record any information; however, the EDU SN 410 presented the extrapolation of the maximum oil pressure limit (XMSN OIL PRESS HI) for 769 seconds (at 18:20:36), and for 263 seconds (at 18:33:28), and of the minimum fuel pressure limit (FUEL PRESS LOW) approximately 0.8 seconds before the termination of the flight (END OF FLIGHT).



Figures 70 and 71 – *Exceedance Log* Messages of the accident flight stored in the EDUs of the PP-CGO.

EDU SN 345					EDU SN 410				
Date	Time	Duration (ms)*	Desc.	Max/Min	Date	Time	Duration (ms)*	Desc.	Max/Min
DATA NOT STORED					08/05/2012	18:20:26.03	0	START OF FLIGHT	
					08/05/2012	18:20:36.01	769000	XMSN OIL PRESS HI	58.674
					08/05/2012	18:33:28.06	262866	XMSN OIL PRESS HI	52.898
					08/05/2012	18:37:53.01	732	FUEL PRESS LO	0.073
					08/05/2012	18:37:53.09	0	END OF FLIGHT	

Table 7. *Exceedance Log* stored in the EDUs of the PP-CGO Source: RELTEC /SERIPA VI/2012. * Event duration in milliseconds (the duration is related to all the exceedance period and not to the max or min value reported).

Since the fuel pressure indication is taken from the airframe supply to the engine, it could not be ruled out that the fuel flow to the engine was compromised prior to the event.

In order to evaluate the functionality of the chip removed from the EDU SN 345, Fault and Exceedance Log messages were inserted in this component, from the bench on which the data readout was performed. The check indicated that the chip in question was storing only Fault Log messages. Thus, only the Exceedance Log data stored on the chip removed from the EDU SN 410 was considered in the investigation (Table 7, on the right).

Through a study of the data relative to the days preceding the accident, it was observed that the "LOW FUEL" light illuminated on 2 and 3 May 2012, indicating a proper record of that message in the Units of Data Visualization (EDU's) installed in PP-CGO.

The indications of other messages recorded on the day of the accident, as well as in the seven previous days are discussed in more detail in item "1.18 - Operational Information."

<u>Relative to the engine reduction box</u>

Since there is no availability of appropriate tools in Brazil, the reduction gearbox of the engine (Reduction Gearbox - RGB), 3310000.19 PN, SN RGB-PU0172, was sent for analysis at the Pratt & Whitney company (manufacturer of the engine) in Montreal , Canada, where it was disassembled in the presence of a DCTA engineer and investigators from the SERIPA, Agusta Westland and Pratt & Whitney.

The figures below illustrate this stage of the investigation and show the general condition of internal RGB components installed on the aircraft.

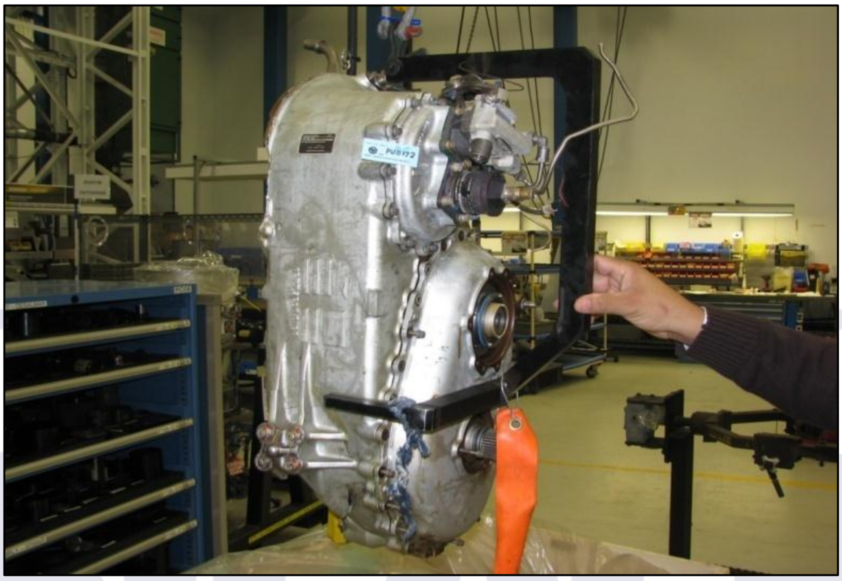


Figure 72 – View of the reduction gear box in the laboratory of analysis of PW Canada.

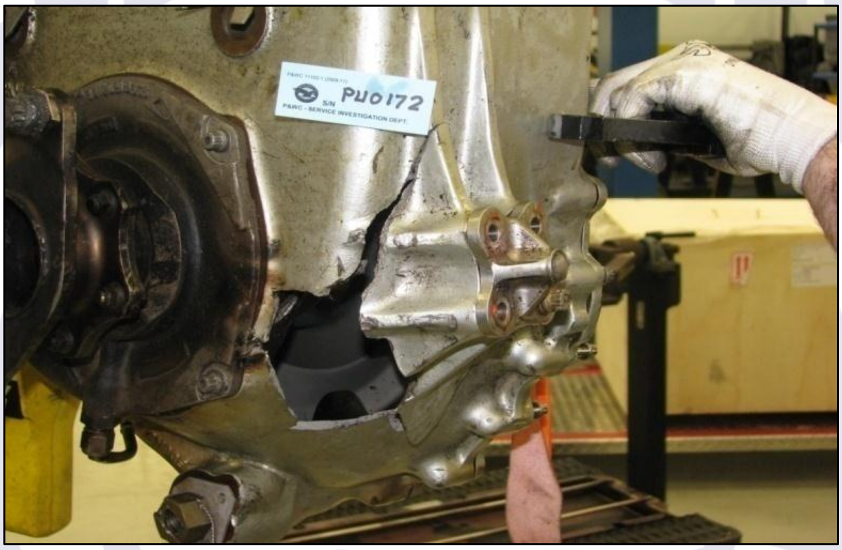


Figure 73 - Fracture resulting from the impact sustained by the RGB in the accident.

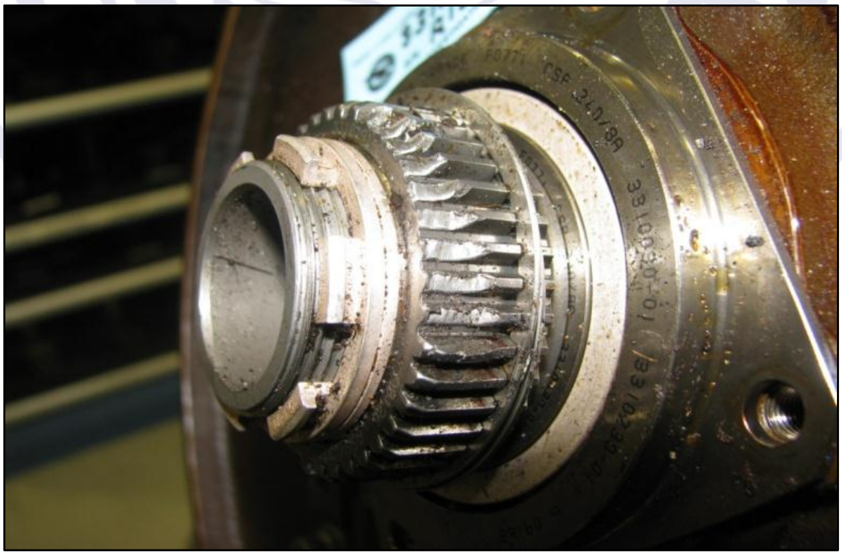


Figure 74 – Coupling gear of the RGB.

Figure 75 – Rollers of the bearing no. 10

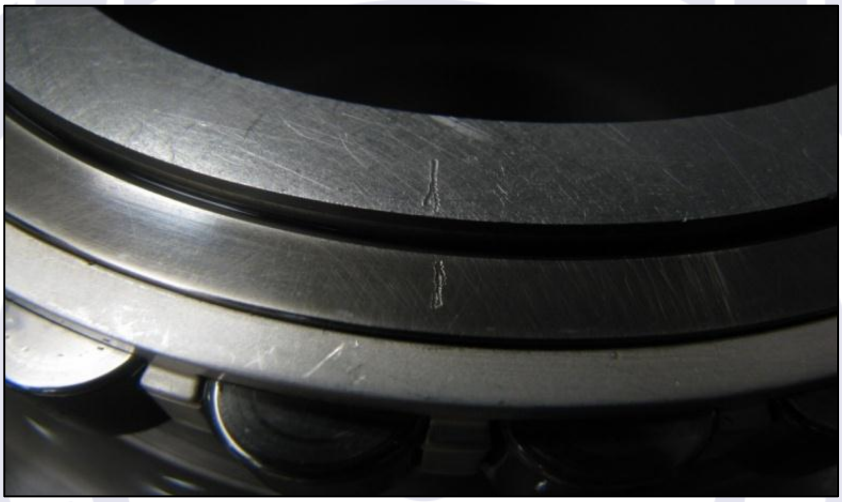


Figure76 – Marks of alignment made after the application of torque in the nut.

Figure 77 – View of the bearing of the free wheel.

The RI APA Report 03/2013, signed by engineers of the Aeronautical Propulsion Division of the Aeronautics and Space Institute (IAE), concluded that no evidence of malfunction or abnormalities was found in the reduction gearbox box that could have compromised the operability of the engine.

1.17 Organizational and management information.

According to comments contained in item "1.13.3 Psychological aspects ".

1.18 Operational information.

On 8 May 2012, the PP-CGO aircraft took off from SBGO at 06:47 local time, destined for *Fazenda Nossa Senhora Aparecida*, in the municipality of *Doverlândia*, State of Goias, with six passengers and two pilots on board.

The objective of the flight was to transport three police chiefs, two forensic experts of the Goias State Civil Police and a justice prisoner for the second reconstitution of the scene of a crime of great national repercussion committed on 28 April 2012.

After completion of the activities, while returning to Goiania, the aircraft crashed near the town of Piranhas, State of Goias, where a refueling point had been established.

On account of the scope of the information obtained by the investigators in the course of the investigation, this part of the report seeks to describe chronologically all the factors involved in the operation of the AW119 Mk II helicopter by the Civil Police of the State of Goias, from pilot training to the technical details of the accident flight, covering, among other aspects, the planning of the mission.

Crew training

The “Item 91.959 - Qualification, Training and Proficiency” of the Brazilian Aeronautical Certification Regulations (RBHA) 91, in force at the time of the accident, and applicable to the type of operation of the equipment, contains the following instructions:

> 91.959 QUALIFICATION, TRAINING AND PROFICIENCY
>
> (b) The Organizations are allowed to train their own crews, provided that they have courses approved by the DAC. They are also allowed to train crews of other organizations by means of certified courses, but they cannot teach courses directly to the public, competing with flying schools owned by the private sector or to organizations of the indirect public administration.
>
> (d) It is the responsibility of the Organization to establish minimum training standards for of crews with regard to air operations of public security and/or civil defense, specified in the paragraph 91.953 (b) of this Regulation.
>
> (e) With regard to the verification of crew proficiency:
>
> (1) The exams relative to the proficiency standards established by the RBHA 61 are a competence of the DAC;
>
> (2) The exams related to the verification of the efficiency standards established in accordance with the paragraph (d) of this section are a competence of the organization.
>
> *(Port. 139/DGAC, 29/01/03; DOU 29, 10/02/03) (Port. 899/DGAC, 01/09/05; DOU 172, 06/09/05)*

Specifically, in relation to the training of pilots and mechanics, the announcement relative to the process of acquisition of aircraft established the following most relevant requirements:

> 15.1.1.2.5. OF THE TRAINING
>
> 15.1.1.2.5.1. The contractor shall provide training of practical flight-adaptation and emergency-adaptation of at least five (5) hours per pilot to a minimum of four (4) pilots per aircraft, as well as airframe and engine courses to at least two (2) mechanics per aircraft.

15.1.1.2.5.2. The training shall have the duration set by the manufacturer's program, provided it includes at least the "Ground School" of the model offered and five (5) hours of flight.

15.1.1.2.5.3. The training of the mechanics will be in accordance with the manufacturer's standard for the aircraft airframe and engine.

Eleven pilots, being three of them from the civil police, were selected by Public Security Secretariat of the State of Goias (SSP/GO) to do the AW119 MKII Koala training, which was divided into two phases:

- The Pilot Transition Ground Course, with a training load of 60 hours, was held at the premises of the Agusta Aerospace Corporation, Philadelphia, USA, between 17 and 28 January 2011. In this phase, the pilots received theoretical instruction on the general features and systems of the AW119 MKII, in addition to normal and emergency procedures, limits, and performance graphs.
- The Pilot's Transition Flight Maneuver Evaluation, with average duration of 12 hours, was held in Brazil, in the city of Goiânia (capital city of the State of Goias), in the months of June and July 2011, with instructors from the Agusta Aerospace Corporation. At this training phase, the students reviewed the aircraft manuals and systems, emergency procedures, performance charts, pre-flight inspection, and were familiarized with the cockpit. They made five flights, in which the following procedures, exercises and maneuvers were performed:

PRE-FLIGHT

- *Flight Manual Review*
- *Pre-Flight Inspection*
- *Cockpit Familiarization / Start Procedures*
- *Power Assurance / Systems Check*

TAKEOFFS

- *Normal*
- *Maximum Performance*

IN FLIGHT

- *Steep Turns*
- *#1 Hyd Fail @ 90kt / Cruise speed*/40kt*
- *Both SAS Fail@ 90kt / Cruise speed*/40kt*
- *Un-commanded SAS inputs / API indic.*
- *Rapid Decelerations*
- *Auto entry / Rotor mgmt / 111 & 80kias*

APPROACHES/LANDINGS

- *Normal*
- *Steep*
- *Running*

MALFUNCTIONS/EMERGENCIES

- *Approach/Landing - # Hyd. Failure*
- *Appr/Land-Sim EEC Fail/MEC opns*

- *Approach/Landing-Manual Cont. of Eng*
- *Autorotations*
- *Hover*
- *Hovering Forward*
- *Straight In*
- 90°/180 °
- HOGE (Outside HV)
- *Appr/Landing-Tail Rotor Suck Right*
- *Appr/Landing-Dual SAS Failure*
- *Slope Landings*
- *Night Familiarization*

A summary of the activities performed in this training phase by the two pilots involved in the occurrence can be seen in the following table:

Captain		Copilot	
Date	Activity	Date	Activity
6/Jun	Review Flight Manual, Aircraft Systems and Emergency Procedures. Perform Pre-Flight Inspection, and Cockpit Familiarization – 4.0 hours	6/Jun	Review Flight Manual, Aircraft Systems and Emergency Procedures. Perform Pre-Flight Inspection, and Cockpit Familiarization – 4.0 hours
6/Jun	Flight Transition – 1.1 hours	11/Jun	Flight Transition – 1.0 hours
7/Jun	Flight Transition – 1.4 hours	13/Jun	Flight Transition – 1.8 hours
8/Jun	Flight Transition – 1.5 hours	14/Jun	Flight Transition – 1.8 hours
9/Jun	Flight Transition – 1.9 hours	16/Jun	Flight Transition – 2.6 hours
10/Jun	Flight Transition – 1.4 hours	18/Jun	Flight Transition – 1.0 hours
	TOTAL TRAINING BLOCK TIME – 11.3 HOURS		TOTAL TRAINING BLOCK TIME – 12.2 HOURS

Table 8. Summary of activities performed in the Pilot's Transition Flight Maneuver Evaluation by the pilots involved in the accident. Source: Agusta Westland

In this second phase of the training, 11.3 hours were flown by the captain, and 12.2 hours by the copilot, who had at the time respectively 550 and 170 total hours in rotary wings, according to their flight records. All flights took place in June 2011, between 6 and 18 June 2011, with takeoffs and landings in SWNV. In the pilots' evaluation forms, it was found that the possible grades were "S" (Satisfactory) and "U" (Unsatisfactory), with the pilots having achieved "S" levels in all 24 items.

Five days after the completion of training in 23 June 2011, the captain and the copilot were checked by the ANAC in the aircraft model, as determined by the Brazilian aeronautical legislation. The pilots were considered technically apt and were granted the respective type qualification certificate.

The Operation of the AW119 MKII Koala helicopter in the Air Unit

The operation of the PP-CGO in the Civil Police Air Unit lasted approximately 17 months, with a total 309 hours and 40 minutes flight time. Although there was no effective control, the hours flown during this period can be grouped into four mission types:

Type of mission	Hours flown
Public Security (Operational)	171:00
Training	32:40
Passenger Transportation	66:00
Observation Platform (period 18 DEC 2010 – 29 SEPT 2011)	40:00
TOTAL	309:40

Table 9. Summary table of the flights performed by the PP-CGO. Source: State of Goias Civil Police Aviation Unit.

According to interviews given to the investigators, the air unit had only eight crewmembers and only two of them were pilots. Thus, only the captain and the copilot involved in the accident flew the accident aircraft since its delivery to the Civil Police.

As described in "1.16 Tests and research", during the readout of the EDUs' data, information recorded as early as 2 November 2010 was recovered.

By means of the analysis of the Fault and Exceedance Log of the seven days prior to the accident, it is possible to verify that the aircraft made five flights on 1 May 2012, with messages of FUEL PRESS LO, XMSN PRESS OIL HI, XMSN OIL PRESS LO, EDU FAIL-PRI and XMSN OIL PRESS (Tables 10 and 11).

Because of the publication "Pilots Guide to write in PLG08909 Change" issued by Astronautics in 03AGO2009, instructed operators to consider - for the purpose of logging XMSN OIL PRESS HI messages - only the main rotor pressures above 55.5 PSI, the messages below this value were omitted (see more details in item "1.19 Additional Information").

Date	Time	Duration	Name	Value
1-May-2012	09:35:36.06	0	START OF FLIGHT	0
1-May-2012	09:38:23.05	1567	FUEL PRESS LO	0,111
1-May-2012	09:35:43.03	632335	XMSN OIL PRESS HI	66,138
1-May-2012	10:34:14.08	1800	XMSN OIL PRESS LO	26,417
1-May-2012	10:34:16.06	0	END OF FLIGHT	0
1-May-2012	13:17:43.05	0	START OF FLIGHT	0
1-May-2012	13:17:51.04	501465	XMSN OIL PRESS HI	60,368
1-May-2012	14:07:41.05	2435	XMSN OIL PRESS LO	25,887
1-May-2012	14:07:44.00	0	END OF FLIGHT	0
1-May-2012	14:31:05.01	0	START OF FLIGHT	0
1-May-2012	14:31:24.10	186865	XMSN OIL PRESS HI	55,623
1-May-2012	14:39:33.04	0	END OF FLIGHT	0
1-May-2012	15:30:21.03	0	START OF FLIGHT	0
1-May-2012	15:30:34.07	294367	XMSN OIL PRESS HI	57,198
1-May-2012	16:23:11.02	0	END OF FLIGHT	0
1-May-2012	16:49:33.02	0	START OF FLIGHT	0
1-May-2012	16:49:44.05	234632	XMSN OIL PRESS HI	55,839
1-May-2012	17:40:00.03	1833	XMSN OIL PRESS LO	27,944
1-May-2012	17:40:02.01	0	END OF FLIGHT	0

Table 10. Exceedance Log messages recorded in the EDU SN 410 on 1 May 2012 Source: RELTEC /SERIPA VI/2012 (the duration is related to all the exceedance period and not to the max or min value reported).

Date	Time	Duration	Name	Category
1-May-2012	09:35:36.06	0	START OF FLIGHT	Undefined
1-May-2012	09:46:17.04	2135	EDU FAIL-PRI	Caution
1-May-2012	10:34:16.06	0	END OF FLIGHT	Undefined
1-May-2012	14:31:05.01	0	START OF FLIGHT	Undefined
1-May-2012	14:31:05.01	600	XMS OIL PRESS	Warning
1-May-2012	14:39:33.04	0	END OF FLIGHT	Undefined
1-May-2012	16:49:33.02	0	START OF FLIGHT	Undefined
1-May-2012	16:49:33.02	333	XMS OIL PRESS	Warning
1-May-2012	17:40:02.01	0	END OF FLIGHT	Undefined
1-May-2012	17:43:21.08	0	START OF FLIGHT	Undefined
1-May-2012	17:43:22.09	900	XMS OIL PRESS	Warning
1-May-2012	17:52:15.10	0	END OF FLIGHT	Undefined

Table 11. Fault Log messages recorded in the EDU SN 410 on 1 May 2012. Source: RELTEC /SERIPA VI/2012 (the duration is related to all the exceedance period and not to the max or min value reported).

On 2 May 2012, in addition to the messages recorded on 1 May 2012, there were indications of ENG OIL PRESS LO, DC GEN and FUEL LOW (Tables 12 and 13).

Date	Time	Duration	Name	Value
2-May-2012	10:18:34.01	0	START OF FLIGHT	0
2-May-2012	10:18:34.01	200	ENG OIL PRESS LO	60,273
2-May-2012	10:18:34.01	200	XMSN OIL PRESS LO	0,612
2-May-2012	10:18:34.04	0	END OF FLIGHT	0
2-May-2012	10:19:04.07	0	START OF FLIGHT	0
2-May-2012	10:21:32.04	2965	FUEL PRESS LO	0
2-May-2012	10:19:09.10	709700	XMSN OIL PRESS HI	66,503
2-May-2012	11:41:21.01	1832	XMSN OIL PRESS LO	26,129
2-May-2012	11:41:22.10	0	END OF FLIGHT	0
2-May-2012	16:29:17.08	0	START OF FLIGHT	0
2-May-2012	16:29:26.03	619265	XMSN OIL PRESS HI	60,573
2-May-2012	16:45:20.03	0	END OF FLIGHT	0
2-May-2012	19:21:28.04	0	START OF FLIGHT	0
2-May-2012	19:21:39.03	354735	XMSN OIL PRESS HI	57,077
2-May-2012	19:58:29.01	2232	XMSN OIL PRESS LO	26,084
2-May-2012	19:58:31.03	0	END OF FLIGHT	0
2-May-2012	20:29:47.03	0	START OF FLIGHT	0
2-May-2012	20:29:57.04	184265	XMSN OIL PRESS HI	55,986
2-May-2012	21:23:15.04	1700	XMSN OIL PRESS LO	25,722
2-May-2012	21:23:17.01	0	END OF FLIGHT	0
2-May-2012	21:26:45.08	0	START OF FLIGHT	0
2-May-2012	21:34:29.03	2532	XMSN OIL PRESS LO	28,138
2-May-2012	21:34:31.09	0	END OF FLIGHT	0

Table 12. Exceedance Log messages recorded in EDU SN 410 on 2 May 2012 Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Date	Time	Duration	Name	Category
2-May-2012	10:18:34.01	0	START OF FLIGHT	Undefined
2-May-2012	10:18:34.01	235	DC GEN	Caution
2-May-2012	10:18:34.04	0	END OF FLIGHT	Undefined
2-May-2012	19:21:28.04	0	START OF FLIGHT	Undefined
2-May-2012	19:57:39.05	300	FUEL LOW	Caution
2-May-2012	19:57:40.05	365	FUEL LOW	Caution
2-May-2012	19:57:41.04	565	FUEL LOW	Caution
2-May-2012	19:57:42.04	565	FUEL LOW	Caution
2-May-2012	19:57:43.03	700	FUEL LOW	Caution
2-May-2012	19:57:44.03	35500	FUEL LOW	Caution
2-May-2012	19:58:31.03	0	END OF FLIGHT	Undefined
2-May-2012	20:29:47.03	0	START OF FLIGHT	Undefined
2-May-2012	20:29:47.03	467	XMS OIL PRESS	Warning
2-May-2012	21:23:17.01	0	END OF FLIGHT	Undefined
2-May-2012	21:26:45.08	0	START OF FLIGHT	Undefined
2-May-2012	21:26:48.04	2100	XMS OIL PRESS	Warning
2-May-2012	21:34:31.09	0	END OF FLIGHT	Undefined

Table 13. Fault Log messages recorded in the EDU SN 410 on 2 May 2012. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

On 3 May 2012, in addition to the messages recorded on 1 May 2012 and 2 May 2012, indications of NR TRANSIENT, EEC-CAUTION DSC, ROTOR HIGH and EEC DEGRADED were identified (Tables 14 and 15).

Regarding the " FUEL LOW" indication on the days 2 and 3 May 2012, the Unit crewmembers confirmed in interviews to the investigators that on these occasions the aircraft had landed with a small amount of fuel, i.e., with less than 45kg (see item 1.19 FUEL LOW light illumination").

As can be seen in Tables 14 and 15, on 2 May 2012, the "END OF FLIGHT" indication occurred 50 seconds after the indication of “FUEL LOW ". On 3 May 2012, the time difference was 10 minutes and 50 seconds.

The rotorcraft flight manual includes the following corrective action to the FUEL LOW caution activation: “Verify fuel quantity in tank 1. Land as soon as practicable (10 minutes of flight remaining at MCP).” Although this information is somehow reported (table 5, in the column “description” of the EDU FAULT LOG).

Date	Time	Duration	Name	Value
3-May-2012	10:40:19.08	0	START OF FLIGHT	0
3-May-2012	10:43:12.01	1865	FUEL PRESS LO	0,111
3-May-2012	10:40:28.05	755735	XMSN OIL PRESS HI	63,323
3-May-2012	10:53:18.02	0	END OF FLIGHT	0
3-May-2012	12:58:55.10	0	START OF FLIGHT	0
3-May-2012	12:59:06.02	379400	XMSN OIL PRESS HI	59,116
3-May-2012	13:05:29.01	665	XMSN OIL PRESS HI	52,351
3-May-2012	13:05:40.04	0	END OF FLIGHT	0
3-May-2012	13:08:16.04	0	START OF FLIGHT	0
3-May-2012	14:34:18.08	0	END OF FLIGHT	0
3-May-2012	14:35:59.07	0	START OF FLIGHT	0
3-May-2012	14:35:59.07	200	ENG OIL PRESS LO	0,178
3-May-2012	14:35:59.07	200	XMSN OIL PRESS LO	1,079
3-May-2012	14:35:59.07	200	FUEL PRESS LO	0,22
3-May-2012	14:35:59.07	200	NR TRANSIENT	125,898
3-May-2012	14:35:59.09	0	END OF FLIGHT	0
3-May-2012	16:21:52.05	0	START OF FLIGHT	0
3-May-2012	16:22:06.09	284600	XMSN OIL PRESS HI	56,884
3-May-2012	16:33:33.08	0	END OF FLIGHT	0
3-May-2012	17:34:50.09	0	START OF FLIGHT	0
3-May-2012	17:34:50.09	200	ENG OIL PRESS LO	42,888
3-May-2012	17:34:50.09	200	XMSN OIL PRESS LO	0,116
3-May-2012	17:34:51.01	0	END OF FLIGHT	0
3-May-2012	17:35:18.02	0	START OF FLIGHT	0
3-May-2012	17:35:27.00	178733	XMSN OIL PRESS HI	56,859
3-May-2012	17:46:17.02	0	END OF FLIGHT	0
3-May-2012	19:23:11.05	0	START OF FLIGHT	0
3-May-2012	19:23:20.08	233933	XMSN OIL PRESS HI	56,617
3-May-2012	20:03:50.05	2635	XMSN OIL PRESS LO	25,722
3-May-2012	20:03:53.02	0	END OF FLIGHT	0
3-May-2012	20:21:03.09	0	START OF FLIGHT	0
3-May-2012	20:21:15.04	70633	XMSN OIL PRESS HI	54,682
3-May-2012	21:17:58.09	0	END OF FLIGHT	0

Table 14. Exceedance Log messages recorded in the EDU SN 410 on 3 May 2012
Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Date	Time	Duration	Name	Category
3-May-2012	12:58:55.10	0	START OF FLIGHT	Undefined
3-May-2012	12:58:55.10	403733	EEC-CAUTION DSC	Caution
3-May-2012	13:05:40.04	0	END OF FLIGHT	Undefined
3-May-2012	13:08:16.04	0	START OF FLIGHT	Undefined
3-May-2012	13:08:16.04	600	XMS OIL PRESS	Warning
3-May-2012	13:08:16.04	5154165	EEC-CAUTION DSC	Caution
3-May-2012	14:34:18.08	0	END OF FLIGHT	Undefined
3-May-2012	14:35:59.07	0	START OF FLIGHT	Undefined
3-May-2012	14:35:59.07	232	ROTOR HIGH	Warning
3-May-2012	14:35:59.07	232	ENG OIL PRESS	Warning
3-May-2012	14:35:59.07	232	DC GEN	Caution
3-May-2012	14:35:59.07	232	EEC DEGRADED	Caution
3-May-2012	14:35:59.07	232	EEC-CAUTION DSC	Caution
3-May-2012	14:35:59.09	0	END OF FLIGHT	Undefined
3-May-2012	16:21:52.05	0	START OF FLIGHT	Undefined
3-May-2012	16:21:52.05	700235	EEC-CAUTION DSC	Caution
3-May-2012	16:33:33.08	0	END OF FLIGHT	Undefined
3-May-2012	17:34:50.09	0	START OF FLIGHT	Undefined
3-May-2012	17:34:50.09	233	DC GEN	Caution
3-May-2012	17:34:51.01	0	END OF FLIGHT	Undefined
3-May-2012	17:35:18.02	0	START OF FLIGHT	Undefined
3-May-2012	17:35:18.02	165	XMS OIL PRESS	Warning
3-May-2012	17:46:17.02	0	END OF FLIGHT	Undefined
3-May-2012	19:23:11.05	0	START OF FLIGHT	Undefined
3-May-2012	19:53:02.09	649233	FUEL LOW	Caution
3-May-2012	20:03:53.02	0	END OF FLIGHT	Undefined
3-May-2012	20:21:03.09	0	START OF FLIGHT	Undefined
3-May-2012	20:21:03.09	767	XMS OIL PRESS	Warning
3-May-2012	21:17:58.09	0	END OF FLIGHT	Undefined

Table 15. *Fault Log* Messages recorded in the EDU SN 410 on 3 May 2012. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

On 4 May 2012, only a 15-minute flight was made and in which there were no different indications of those described previously, as can be seen in Tables 16 and 17.

Date	Time	Duration	Name	Value
4-May-2012	13:14:34.05	0	START OF FLIGHT	0
4-May-2012	13:17:13.03	1035	FUEL PRESS LO	0
4-May-2012	13:14:42.04	642800	XMSN OIL PRESS HI	63,594
4-May-2012	13:27:48.08	2365	NR TRANSIENT	111,084
4-May-2012	13:26:56.10	60265	XMSN OIL PRESS HI	57,052
4-May-2012	13:29:02.06	0	END OF FLIGHT	0

Table 16. Exceedance Log messages recorded in the EDU SN 410 on 4 May 2012. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Date	Time	Duration	Name	Category
4-May-2012	13:14:34.05	0	START OF FLIGHT	Undefined
4-May-2012	13:27:47.08	4500	ROTOR HIGH	Warning
4-May-2012	13:29:02.06	0	END OF FLIGHT	Undefined

Table 17. Fault Log messages registered in the EDU SN 410 on 4 May 2012. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

On 5 and 6 May 2012, nothing was recorded in the EDUs. From interviews during the investigation, it was confirmed that no flights were made on those days.

On 7 May 2012, as described in "1.6 Aircraft Information," the PP-CGO aircraft underwent maintenance services in the premises of the Fênix Manutenção e Recuperação de Aeronaves Ltda. company. Exceedance and Fault Log data recorded that day (Tables 18 and 19) corroborated the reports of mechanics of the maintenance company of the interventions performed on the aircraft:

- The records entered between 13:38 and 13:41, 13:41 and 13:44, and 20:40 and 20:44 showed complete starts;
- The messages recorded between 14:29 and 14:46 occurred during the test flight, which lasted approximately 17 minutes;
- Messages beginning at 19:50, 19:58 and 20:29 - which had duration shorter than a minute - represented four starts without ignition made during the provision of oil to the main rotor transmission system.

Additionally, it was noted that the ferry flight from SWNV to SBGO was made between 20:46 and 20:57.

Date	Time	Duration	Name	Value
7-May-2012	13:38:31.01	0	START OF FLIGHT	0
7-May-2012	13:38:39.10	140735	XMSN OIL PRESS HI	63,472
7-May-2012	13:41:10.03	0	END OF FLIGHT	0
7-May-2012	13:41:57.04	0	START OF FLIGHT	0
7-May-2012	13:42:03.08	126900	XMSN OIL PRESS HI	60,694
7-May-2012	13:44:21.03	0	END OF FLIGHT	0
7-May-2012	14:29:51.00	0	START OF FLIGHT	0
7-May-2012	14:32:55.05	800	FUEL PRESS LO	0
7-May-2012	14:30:01.05	185767	XMSN OIL PRESS HI	61,076
7-May-2012	14:33:10.05	522100	XMSN OIL PRESS HI	57,174
7-May-2012	14:46:53.05	0	END OF FLIGHT	0
7-May-2012	19:50:44.00	0	START OF FLIGHT	0
7-May-2012	19:50:44.00	200	ENG OIL PRESS LO	39,728
7-May-2012	19:50:44.00	200	XMSN OIL PRESS LO	0,726
7-May-2012	19:50:44.00	200	FUEL PRESS LO	0
7-May-2012	19:50:44.03	0	END OF FLIGHT	0
7-May-2012	19:50:45.08	0	START OF FLIGHT	0
7-May-2012	19:50:45.08	200	ENG OIL PRESS LO	30,531
7-May-2012	19:50:45.08	200	XMSN OIL PRESS LO	0,726
7-May-2012	19:50:45.08	200	FUEL PRESS LO	0,258
7-May-2012	19:50:46.00	0	END OF FLIGHT	0
7-May-2012	19:58:10.05	0	START OF FLIGHT	0
7-May-2012	19:58:10.05	200	ENG OIL PRESS LO	39,245
7-May-2012	19:58:10.05	200	XMSN OIL PRESS LO	0,604
7-May-2012	19:58:10.05	200	FUEL PRESS LO	0
7-May-2012	19:58:10.07	0	END OF FLIGHT	0
7-May-2012	20:29:22.03	0	START OF FLIGHT	0
7-May-2012	20:29:22.03	200	ENG OIL PRESS LO	0,184
7-May-2012	20:29:22.03	200	XMSN OIL PRESS LO	0,968
7-May-2012	20:29:22.03	200	FUEL PRESS LO	0
7-May-2012	20:29:22.03	200	NR TRANSIENT	188,419
7-May-2012	20:29:22.05	0	END OF FLIGHT	0
7-May-2012	20:40:50.01	0	START OF FLIGHT	0
7-May-2012	20:40:59.03	203133	XMSN OIL PRESS HI	60,834
7-May-2012	20:44:33.01	0	END OF FLIGHT	0
7-May-2012	20:46:43.08	0	START OF FLIGHT	0
7-May-2012	20:46:51.08	548565	XMSN OIL PRESS HI	58,895
7-May-2012	20:57:10.02	0	END OF FLIGHT	0

Table 18. Exceedance Log messages recorded in the EDU SN 410 on 7 May 2012. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Date	Time	Duration	Name	Category
7-May-2012	19:50:44.00	0	START OF FLIGHT	Undefined
7-May-2012	19:50:44.00	232	ENG OIL PRESS	Warning
7-May-2012	19:50:44.00	232	DC GEN	Caution
7-May-2012	19:50:44.03	0	END OF FLIGHT	Undefined
7-May-2012	19:50:45.08	0	START OF FLIGHT	Undefined
7-May-2012	19:50:45.08	233	ENG OUT	Warning
7-May-2012	19:50:45.08	233	ENG OIL PRESS	Warning
7-May-2012	19:50:45.08	233	DC GEN	Caution
7-May-2012	19:50:46.00	0	END OF FLIGHT	Undefined
7-May-2012	19:58:10.05	0	START OF FLIGHT	Undefined
7-May-2012	19:58:10.05	232	ENG OIL PRESS	Warning
7-May-2012	19:58:10.05	232	DC GEN	Caution
7-May-2012	19:58:10.07	0	END OF FLIGHT	Undefined
7-May-2012	20:29:22.03	0	START OF FLIGHT	Undefined
7-May-2012	20:29:22.03	232	ROTOR HIGH	Warning
7-May-2012	20:29:22.03	232	ENG OIL PRESS	Warning
7-May-2012	20:29:22.03	232	DC GEN	Caution
7-May-2012	20:29:22.05	0	END OF FLIGHT	Undefined

Table 19. *Fault Log* Messages recorded in the EDU S/N 410, on 07 MAY 2012. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

The accident flight

In the flight plan filed by the copilot at the AIS room of Santa Genoveva International Airport at 06:01 local time on 8 May 2012, the following more relevant information was listed:

- Aerodrome of departure: SBGO
- Time: 09:45 UTC
- Route: N0120 VFR DCT
- Altitude: 500ft AGL
- Destination: ZZZZ (Doverlândia, GO)
- Flight time: 01:30h
- Endurance: 03:00h
- POB: 08 (2 pilots + 6 passengers)

Despite the fact that it was an established procedure in the Air Unit, in the accident flight, there was no operational crewmember in the back of the aircraft. According to information provided by members of the unit, this fact resulted from the need to transport six passengers for the reconstitution of the crime scene at *Fazenda Nossa Senhora Aparecida* (five police officers and a prisoner of justice).

The investigators did not find the "CHART E" (see item 1.19 "Additional Information) or any other specific form that could demonstrate the weight and balance calculations for the takeoff from SBGO on the day of the accident.

According to information provided by the Unit's operational crewmembers, the "CHART E" was not used on all flights, and the weight and balance calculations was almost always made by means of the notes on sheets of paper that were attached to a clipboard in the cockpit.

Considering the weight of the empty helicopter as 1,810kg, and the weight of each occupant of the aircraft as 80kg, the weight of the baggage as 10kg, and the weight of fuel onboard as 476kg (maximum refueling capacity, as described in "1.16 Relative to the fuel"), it results that PP-CGO took off with approximately 2,946.2kg, i.e., 96.2 kg more than the maximum takeoff weight (MTOW) prescribed by the manufacturer (Table 20).

Item	Weight (kg)
Weight (empty)	1,810
Pilots (2)	160
Engine oil	10,2
Passengers in the front (3)	240
Passengers in the back (3)	240
Baggage	10
Fuel (JET A-1)	476
TOTAL	2,946,2
Maximum Take-Off Weight (PMD)	(-) 2,850
Excess	**96.2**

Table 20. Weight of the PP-CGO at the first takeoff on the day of the accident.

According to accounts obtained from the interviews conducted by the investigators, and based on data red out from the EDUs (Table 21 and 22), the PP-CGO flew four legs on the day of the accident (Table 21):

Date	Time (UTC)	Start/End of Flight	Flight Legs
8-May-2012	09:37:30.01	START OF FLIGHT	1st LEG
8-May-2012	11:03:59.08	END OF FLIGHT	
8-May-2012	14:27:25.04	START OF FLIGHT	2nd LEG
8-May-2012	14:40:40.06	END OF FLIGHT	
8-May-2012	15:36:37.07	START OF FLIGHT	3rd LEG
8-May-2012	15:48:07.02	END OF FLIGHT	
8-May-2012	18:20:26.03	START OF FLIGHT	4th LEG
8-May-2012	18:37:53.09	END OF FLIGHT	

Table 21. Data obtained from the EDU S/N 410. Source: RELTEC /SERIPA VI/2012.

LEG	From	To	Distance (km)	Duration of flight
1st	SBGO	*Fazenda Nossa Senhora Aparecida*	359	01:26:29
2nd	*Fazenda Nossa Senhora Aparecida*	*Doverlândia*	35	00:13:15
3rd	*Doverlândia*	*Fazenda Nossa Senhora Aparecida*	35	00:11:30
4th	*Fazenda Nossa Senhora Aparecida*	Accident site	63.9	00:17:27
TOTAL			**492.9**	**02:08**

Table 22. Legs flown on the days of the accident

The first and fourth legs had the objective of transporting the ones involved in the reconstitution, from Goiânia to *Fazenda Nossa Senhora Aparecida* and back to Goiania. The second and third legs were short trips of approximately 35km between *Fazenda Nossa Senhora Aparecida* and the city of Doverlândia in the State of Goias in order to fetch lunch for the teams that were working on the farm.

Tables 23, 24, 25 and 26 show the Exceedance Log messages recorded in the four legs of the flight described above. In these tables, no information of XMSN OIL PRESS HI below 55.5 PSI was taken into account because of the considerations described earlier (more details in item "1.19 Additional Information").

Date	Time	Duration (ms)	Name	Value	Category
8-May-2012	09:37:30.01	0	START OF FLIGHT	0	Undefined
8-May-2012	09:37:36.04	917132	XMSN OIL PRESS HI	67,721	Max
8-May-2012	09:40:29.01	1567	FUEL PRESS LO	0,111	Min
8-May-2012	11:03:58.04	1366	XMSN OIL PRESS LO	26,781	Min
8-May-2012	11:03:59.08	0	END OF FLIGHT	0	Undefined

Table 23. General data of the first phase of flight. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Date	Time	Duration (ms)	Name	Value	Category
8-May-2012	14:27:25.04	0	START OF FLIGHT	0	Undefined
8-May-2012	14:27:45.04	670200	XMSN OIL PRESS HI	61,18	Max
8-May-2012	14:40:40.06	0	END OF FLIGHT	0	Undefined

Table 24. General data of the second phase of flight. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Date	Time	Duration (ms)	Name	Value	Category
8-May-2012	15:36:37.07	0	START OF FLIGHT	0	Undefined
8-May-2012	15:36:49.01	580200	XMSN OIL PRESS HI	58,531	Max
8-May-2012	15:48:07.02	0	END OF FLIGHT	0	Undefined

Table 25. General data of the third phase of flight. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Date	Time	Duration (ms)	Name	Value	Category
8-May-2012	18:20:26.03	0	START OF FLIGHT	0	Undefined
8-May-2012	18:20:36.01	769000	XMSN OIL PRESS HI	58,674	Max
8-May-2012	18:37:53.01	732	FUEL PRESS LO	0,073	Min
8-May-2012	18:37:53.09	0	END OF FLIGHT	0	Undefined

Table 26. General data of the fourth phase of flight. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

Based on the data above, it was found that the aircraft recorded XMSN OIL PRESS HI messages for all flights performed on the day of the accident. In each message the following values were shown:

	Leg 1	Leg 2	Leg 3	Leg 4
Oil pressure	67,721	61,18	58,531	58,674
Duration of leg	01:26	00:13	00:12	00:17
Duration of message (min)	00:15	00:11	00:10	00:13

Table 27. Maximum values of the transmission oil pressure during the phases of flight on the day of the accident. Source: RELTEC /SERIPA VI/2012.

Still based on information provided by the Tables 23, 24, 25 and 26, it was found that the XMSN OIL PRESS HI messages of each of the four legs were recorded a few seconds after the "START FLIGHT" and lasted longer than 10 minutes, according to Table 28:

Record	Time difference between the beginning of the flight and the XMSN OIL PRESS HI indication	Approximate duration of each flight leg	Approximate duration of the event
START OF FLIGHT	00:00:06	01:26:00	--
XMSN OIL PRESS HI			00:15:00
START OF FLIGHT	00:00:20	00:13:00	--
XMSN OIL PRESS HI			00:11:00
START OF FLIGHT	00:00:12	00:12:00	--
XMSN OIL PRESS HI			00:10:00
START OF FLIGHT	00:00:10	00:17:00	--
XMSN OIL PRESS HI			00:13:00

Table 28. Time difference between the beginning of the flight and the XMSN OIL PRESS HI indication, and approximate duration of the event. Source: RELTEC /SERIPA VI/2012.

In the Table 26 (General information on the fourth stage of the flight), it is possible to identify that, moments before the end of the recording (END OF FLIGHT), there was indication of low fuel pressure (FUEL PRESS LO).

In addition to the information described above, in the EDU SN 410 (Fault Log messages), the following data were recorded in the last stage of the flight:

Date	Time	Duration	Name	Category
8-May-2012	18:20:26.03	0	START OF FLIGHT	Undefined
8-May-2012	18:37:53.08	100	ENG OUT	Warning
8-May-2012	18:37:53.09	0	END OF FLIGHT	Undefined

Table 29. Fault Log data of the EDU SN 410, relative to the fourth stage of flight. Source: RELTEC /SERIPA VI/2012. (the duration is related to all the exceedance period and not to the max or min value reported)

From this table, it is possible to verify the exact time when the motor stopped working (0.01 second before the termination of the flight - "END OF FLIGHT"), when there was an "ENG OUT" indication (18:37:53.08).

Considering that the aircraft took off from SBGO fully loaded with fuel, as described in "1.16 Relative to the Fuel", and that it flew at a speed of 120kt, maintaining a height of 500 feet AGL over a terrain whose mean elevation was 1,500ft, it is possible to affirm that there were still approximately 102kg of Jet A-1 in the tanks at the time of the accident (see Figure 78 and Table 30).

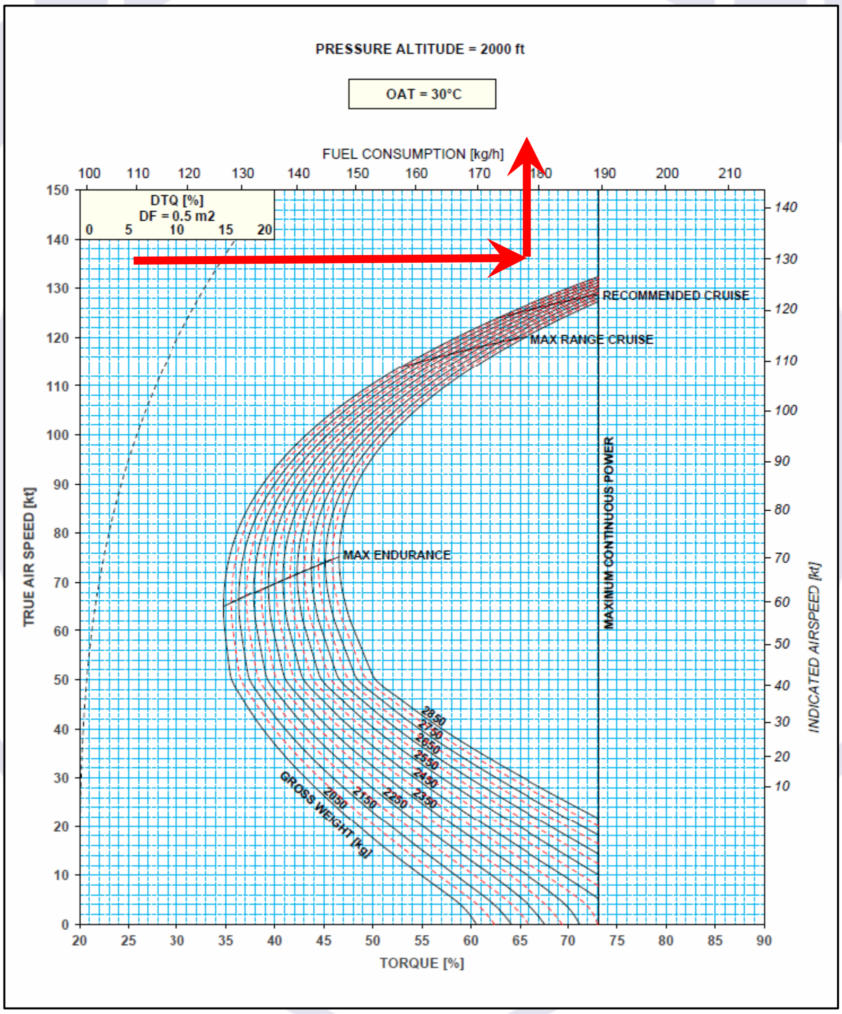


Figure 78 – Graph of the AW119 MKII fuel consumption. The arrows indicate the consumption of 178 kg/h for a speed of 120kt, air temperature 30ºC at an altitude of 2,000ft.

Amount of fuel in SBGO	476kg
Fuel spent in the four stages of the flight (2 hours and 8 minutes) considering an average consumption of 178 kg/h (see Figure)	374kg
Remaining fuel	102kg

Table 30. Remaining fuel after the four legs of the flight performed on the day of the accident.

At the moment of the engine failure, discounting the 374kg relative to the average consumption during the 2 hours and 8 minutes of flight, it is estimated that the weight of the aircraft was around 2,842kg, therefore, within the limits established by the manufacturer (Figure 79). The balance of the aircraft, taking into account to the distribution of its occupants, was also within the operational limits.

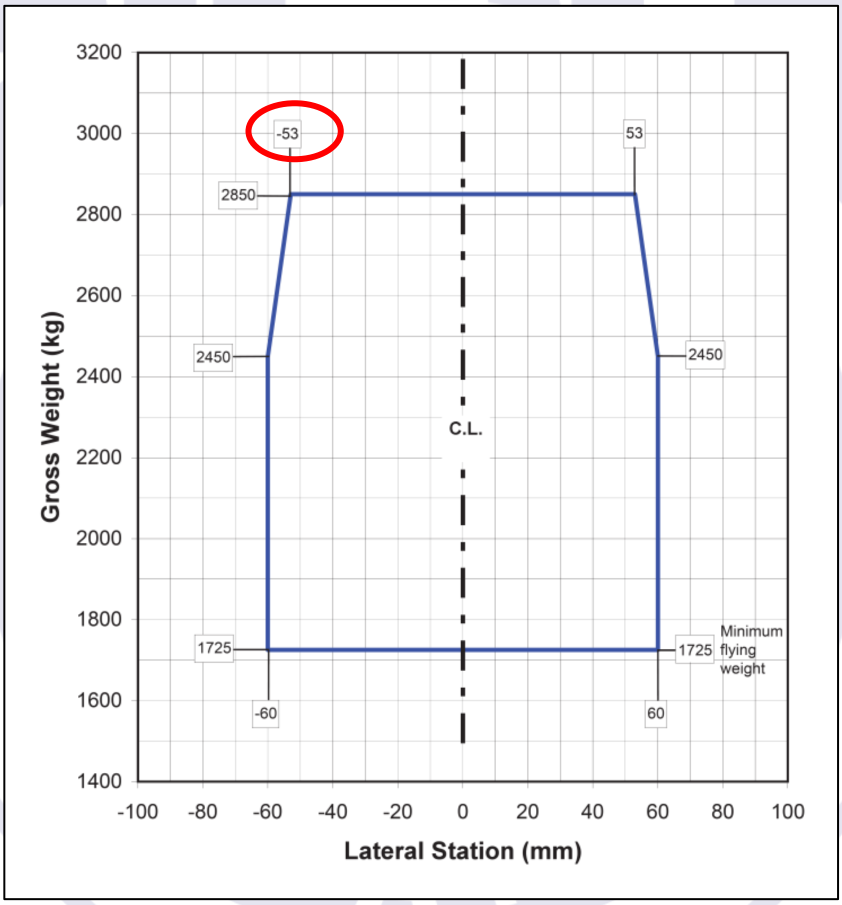


Figure 79 – Graph of the AW119 MKII weight. In highlight, the maximum takeoff weight established by the aircraft manufacturer.

The Civil Police Air Unit had established a point of refueling in the municipality of Piranhas, State of Goias, at a distance of about three minutes from the site where the helicopter crashed. The fuel to be used had been stored in a container of 250 gallons that had been received fuel from a fuel truck of the Military Police.

According to reports obtained in the course of the investigation, there was no fixed position inside the aircraft for transporting the justice prisoner. In the photos taken during the first reconstitution, it is possible to observe that he was being transported in position 3 – his back to the pilots' cabin (Figures 80 and 81).

Figures 80 and 81 – Position at which the justice prisoner was transported in the first reconstitution.

According to the reports of police officers who participated in the second reconstitution, the possible position of the occupants of the aircraft at the time of the accident can be seen below:

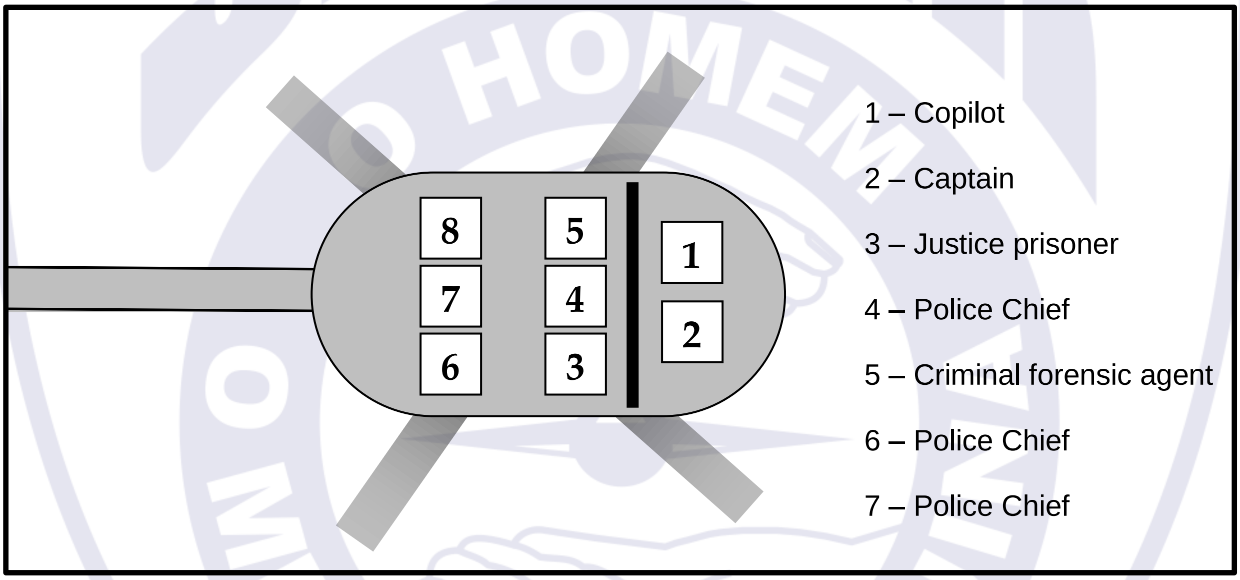


Figure 82 – Possible position of the PP-CGO occupants at the moment of the accident.

During the Initial Action by the go-team, it was found that one of the bodies removed from the wreckage was with both hands cuffed. In addition, as pointed out by the autopsy reports prepared by the forensic medicine unit (IML) of Goiania, GO, on the occasion of the autopsy, the wrists of the justice prisoner presented marks compatible in length and width with those produced by handcuffs.

The aircraft logbook, which could provide more accurate information on the hours flown by the helicopter in its 17 months of operation in the Civil Police, was not located. It is possible that this document was burned in the midst of the aircraft wreckage. Some documents found in the crash site were identified as part of the police investigation in progress (Figures 83 and 84).


Figures 83 and 84 – Documents found amidst the wreckage of the PP-CGO.

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1.19 Additional information.

Relative to the maintenance company

The *Fênix Manutenção e Recuperação de Aeronaves Ltda.* company worked in accordance with the Certificate of Approval (CHE) no. 0902-61 issued by the National Civil Aviation Agency (ANAC) on 12 August 2010. On the occasion of the of the accident, there were in its Addendum, among other aircraft, the A119 Koala and AW119 MKII helicopters manufactured by Agusta Westland.

On 8 MAR2012, the company participated in a bidding process promoted by the Government of the State of Goias in a trading session mode known as "*Public Bid*" of the Lower Price type, aiming at the hiring of a company to supply parts/components and conduct periodic and calendar inspections, in accordance with the maintenance program established by the manufacturer of AW119 MKII Koala helicopter recently acquired by the Department of Public Security, having been declared the winner at the end of the event.

In an abridged manner, according to the prescriptions of Annex II to the bidding announcement 115/2011, the winning company had to comply with the following requirements (among others):

> Possess a workshop homologated by the National Civil Aviation Agency (ANAC) [...];
>
> Possess, as part of the permanent personnel effective, technically qualified persons, in accordance with the ANAC regulations [...].

On the days 2, 3 and 4 April 2012, in an Annual Technical Audit performed in the company, the Regulatory Agency found the following most relevant nonconformities, which resulted in the suspension of the company activities from 2 May 2012:

RBHA 145.23 (a)	The implementation of the Corrective Action Plan was not effective because of the following non-compliance: "The tools that require calibration are past due, according to the Calibration Control Map presented." Four tools were past due according to the Calibration Control Map. Of these, one was found installed in the PT-HZA (dynamic balancing tool MICRO VIB 1300 2009, with past due calibration since 13/October/2011).
RBHA 145.35 (d) IAC 145-1001 Item 4.2.7.2 (u)	There was no effective control of stock, in contradiction of the item 6.1 of the MPI. Parts in good condition were stored in the same location of used parts and past due materials. Some of the parts did not have a certificate of compliance, hindering traceability.
RBHA 145.11 (a-9) IAC 145-1001 Item 4.2.7.4	No evidence was found of compliance with the requirements of the RBAC, IAC and the very MPI (Section 12.1.1) relative to initial and recurrent training.
RBHA 145.46 (c)	According to item 8.5.3 of the MPI, weekly consultation had to be made of all the directives (both Brazilian and foreign) concerning the products listed in the company's addendum. As shown in the form "Control of Consultations for the Updating of Publications", the last consultation was made in February, contrary to the prescriptions of the MPI.
RBHA 145.57 (a)	According to the item 8.5.2 of the MPI, a conference aimed at the updating of technical publications should be held in the first week of every month. As shown in the form "Control of Consultations for the Updating of Publications", the last consultation was held in February, contrary to the prescriptions of MPI.
RBHA 145.35 (d)	It was observed that the company had a variety of controlled products (screws, washers, etc.) without a document of traceability, batch control, and with batch discontinuity.
RBHA 145.35 (d)	In the company supply section, the audit observed the storage of flammable products (molykote, oils and epoxy), and items without traceability (screws, washers, clamps and connectors). The company had no control over the entry and exit of materials from the supply section.
RBHA 145.35 (e)	An Esquilo aircraft transmission was found in the Tooling Section, and a main rotor damping set was in Deposit without identification and lying on top of tires. In the Weld Section, there was a main rotor mast with the top casing of the transmission box of Robinson aircraft, placed on top of a tire. In the Metal Sheet Sector, an upper casing of an Esquilo aircraft transmission box was found on the floor without identification.
RBHA 145.37 (c)	In Assembly / Disassembly Section, an engine was found without the required protection.
RBHA 145.47 (a)	The following special tools of the Bell manufacturer were not presented: Model 412 (PN BH120-1032-M2, LM8202-747-401-1, SWE13875-70, T101429, T101656-145, T102118-101, T103263-101, 204-040-001-17PAT-5S, 412-240-028-101) The "Extractor Case Shaft" tool of the Eurocopter France manufacturer, model EC130B4 (P/N 350A93-3700-01) was presented.

RBHA 145.47 (b) (3)	According to the Precision Tools Calibration Control Data Sheet, four tools had past due calibration. The MICRO VIB 1300 2009 tool, with calibration past due on 13/October/2011 was found installed near the tail rotor of the PT- HZA aircraft, and being used for dynamic balancing. The K-D TOOLS 2953 torquemeter was found in the Tooling Section, with its calibration past due since 02/March/2010, according to the sticker pasted on the tool. This tool was not included in the Precision Tools Calibration Control Data Sheet. Four pachymeters and two micrometers were found in the lathe section. None of these items was listed in the Precision Tools Calibration Control Data Sheet. Only one pachymeter (Tag : PAQ - 001) had a calibration sticker (calibration past due on 08/October/2011). The mechanic who worked in the lathe said that he used these tools whenever a maintenance task required dimensional verification.
RBHA 145.47	The company chose to manufacture various special tools, however, it did not present a Report of Equivalence with Manufacturer by the Responsible Technician; it did not show how the tools were made (technical drawings and materials used); and it did not present documents proving ownership of all special tools.
RBHA 145.45 (c) 1 (i) (ii)	Materials for aeronautical use were found in the Stock without a certificate of conformity, and various aircraft parts had no identification cards.
RBHA 43.9 e 43.11 IAC 3149 Item 3.5	There were Inspection Sheets without identification of the mechanic who provided the maintenance service (ANAC code, license number, and name).
RBHA 145.65 (b)	The company did not present the trimestrial reports relative to the months of July/August/September and October/November/December 2011.
RBHA 145.65 (a)	The company did not present the workshop activity reports of December 2011 and February 2012. The last monthly report was November 2011.
RBHA 145.47 (b)	The special tools contained in tooling section were not identified with the manufacturer PN. The company had no control of the entry and exit of tools.
RBHA 145.11 (a) 5	The company did not provide a signed list of the tools, equipment, tests, benches and approved technical documents necessary for the safe performance of its activities.
RBHA 145.39 (e)	The mechanic with familiarization in the BO 105 model of the Eurocopter Germany manufacturer had a Technical Qualification Certificate allowing only GMP.
RBHA 43.9 (a)	No record of inspection was presented relative to the Service Order OS 158/2011 (PT-HZA aircraft) – AMI, 300 hours, CTP CTT replacement, replacement of engines 1 and 2, checking of altimeter and transponder (Mode C).

Table 31. Excerpt of the nonconformities identified by the ANAC in the *Fênix Manutenção e Recuperação de Aeronaves* Ltda. company. Source: National Civil Aviation Agency (ANAC).

On 22 July 2012, after 80 days without performing maintenance activities, the Fênix Manutenção e Recuperação de Aeronaves Ltda. company had its suspension withdrawn by the National Civil Aviation Agency (ANAC), after a special audit of the workshop, which was in conformity to all the legislation requirements.

Relative to the Electronic Display Units (EDUs)

The Astronautics Corporation issued the following Service Information Letter concerning the EDU P/N 109-0900-66 on 20 August 2010.

> The Green Arc exceedance threshold for XMSN OIL PRESS (leading to XMSN OIL PRESS HI message) is not correct. The right threshold is 55.5 PSI but exceedance events are logged when XMSN OIL PRESS rises above 50.5 PSI. However the XMSN OIL PRESS data is correctly presented to the pilot.

According to the above text, the indications of extrapolation of transmission oil pressure that reached values between 50.5 and 55.5 PSI were being improperly stored in the EDUs. However, such data were presented to the crew in a correct manner.

Relative to the regulation

The items 145.11 (Request and Issuance of Certificate), 145.23 (Inspections), and 145.39 (Personnel Requirements - General) of the Brazilian Aeronautical Certification Regulation (RBHA) 145, in force at the time of the accident and applicable to the type of operation of the equipment, had the following observations:

> 145.11 – REQUEST AND ISSUANCE OF CERTIFICATE
>
> (4) Name list of qualified technical personnel, including number of license or of the cadastration in the Civil Aviation Department (DAC), and copy of their licenses and technical qualification certificates.
>
> (5) Signed list, containing the tools, equipment, tests, benches, and approved technical documents necessary for the safe performance of their duties and responsibilities, belonging to its fixed assets;
>
> 145.39 – PERSONNEL REQUIREMENTS. GENERAL
>
> The RBHA 145.39 defines the qualification and the technical body numbers to perform, supervise, and inspect the work for which the workshop intends to be certified.

The items 91.403 (General) and 91.409 (Inspections) of the Brazilian Aeronautical Certification Regulation (FAR) 91, in force at the time of the accident, and applicable to the type of operation of the equipment, had the following observations:

> 91.403 GENERAL
>
> (c) No person may operate an aircraft that has a manufacturer's maintenance manual or Instructions for Continued Airworthiness having an Airworthiness Limitations section, unless the time for replacement of component, inspection intervals, and the specific procedures contained in that section are met. Alternatively, it is possible to use the inspection intervals and procedures established in the operations specifications issued under the RBHAs 121 and 135, or established in a program of inspections, approved in accordance with paragraph 91.409 (e) of this Regulation.
>
> 91.409 INSPECTIONS
>
> (e) No person may operate a large airplane, a multi-engine airplane with turbine engines, or a helicopter with turbine engines, unless the aircraft (including airframe, engines, propellers, pieces of equipment, survival and emergency equipment) has been inspected in accordance with an inspection program selected under paragraph (f) of this section, and also provided that the time for the replacement of all the parts with limited lifetime as detailed in the aircraft specifications, in the technical specification of the type homologation certificate and in other approved documents has been fulfilled. However, the owner or operator of a turbine engine helicopter may choose to use the inspection provisions of 91.409 (a), (b), (c) or (d) in lieu of the inspection option contained in 91.409 (f).
>
> (f) Selection of programs in accordance with the paragraph (e) of this section. The owner or operator of each aircraft described in paragraph (e) of this section must

select, identify in the aircraft maintenance records, and use one of the following programs for the inspection of the aircraft:

(3) An updated inspection program recommended by the manufacturer.

The item 43.15 (Additional Rules for the conduction of Inspections) of the Brazilian Aeronautical Certification Regulations (RBHA) 43, in force at the time of the accident and applicable to the type of operation of the equipment, had the following observations:

INSPECTION

43.15 Additional rules for the conduction of inspections

(a) General. Every person making an inspection required by the RBHA 91, or by the RBAC that replaces it, or by the RBAC 135, must:

(1) Make the inspection in order to determine whether the item under inspection meets all applicable airworthiness requirements, and

(2) If the inspection is required by the RBAC 135 or by paragraph 91.409 (e) of the RBHA 91, or the corresponding provision of the RBAC that may replace it, it must be made in accordance with the instructions and procedures related to the inspection program of the aircraft involved.

(b) Rotary-wing aircraft. Any person conducting an inspection of a rotary wing aircraft required by RBHA 91, or RBAC that supersedes it, must inspect the following systems in accordance with the maintenance manual, or continued airworthiness instructions issued by the aircraft manufacturer :

(1) Transmission shafts or similar system;

(2) Transmission box of the main in relation to evident defects;

(3) Main rotor and central section (or equivalent area); and

(4) Auxiliary rotor of helicopters.

Known precedents

As for the precedents of aeronautical events involving A119 and AW119 MKII Koala aircraft, data were obtained from the Aviation Safety Network Database of the Flight Safety Foundation (FSF), from the Aircraft Accident and Incident Database of the National Transportation Safety Board (NTSB), from the Italian *Agenzia Nazionale per la Sicurezza del Volo* (ANSV), and from the Aeronautical Accident Investigation and Prevention Center (CENIPA), with data extracts being presented in the Tables 32 and 33.

Date, country, and Acft registration	Summary of the Occurrence
09/Nov. /2001 USA (N119RX)	The aircraft was on the approach for landing on the Mackay-Dee Hospital helipad. Upon lowering of the collective, the RPM dropped to 96%, and the "LOW ROTOR WARNING" alert was activated. Since the helicopter was not at an altitude AGL sufficient for an autorotation, the pilot immediately lowered the collective and assumed a pitch-down attitude. The RPM dropped to 90%, and stabilized. At an altitude of approximately 20 feet AGL, the pilot pulled the collective to perform the "flare". At this time, the RPM dropped sharply and the helicopter collided with the ground with a low tail. The pilot and another occupant suffered minor injuries. The aircraft, which had only 40 hours of flight, suffered substantial damage. Problems in Rotary Variable Differential Transformer (RVDT) - which resulted in erroneous information to the Fuel Control Unit (FCU) - was identified as one of the contributing factors for the loss of power.
14/Oct. /2002 Austria (OE-XSB)	The helicopter was on rescue training with a SAR specialist attached to an external cable, when the RPM dropped to 70% - 80% for about 20 seconds. Then there was an uncontrollable increase in the rotation. The pilot released the crew specialist attached to the cable over a lake from a height of 15 feet, at a speed between 70 and 80 kt. Then, he shut down the engine and landed in autorotation. The aircraft was not damaged, but the SAR specialist perished in the fall.
30/Aug. /2004 Brazil (PR-HVR)	The helicopter took off from Malaga Helipad in Osasco, State of São Paulo, with the pilot and five passengers on board for a flight demonstration of the equipment for members of the State of Bahia Government. After takeoff, the aircraft suffered loss of rotation, and the pilot decided to make a forced landing in the courtyard of a factory located approximately 300 meters from the place of departure. After touching the ground, due to the slope of the terrain, the aircraft began a lateral movement of 15 meters, colliding with a grid. The helicopter suffered substantial damage. The pilot suffered minor injuries, while the other occupants were not injured.
30/June/2005 USA (N403CF)	The helicopter - operated by Tri-State Care Flight - was on the approach for landing on a helipad located at 8NM from Mancos, Colorado, and at altitude of approximately 220 feet, an engine failure occurred. Due to a violent impact with the ground, the helicopter was destroyed. The pilot, a paramedic and a nurse perished in the crash. The National Transportation Safety Board (NTSB) - the government agency responsible for investigating aircraft accidents in U.S. territory - determined that the probable cause of this accident was a loss of engine power whose factors could not be established, associated with the inability of the pilots to start an appropriate autorotation regime before the impact with the ground.
11/June/2007 USA (C-GNSR)	The aircraft was proceeding for a landing on top of Ptarmigan Mountain, Colorado, at an altitude of 11,900ft, when suddenly a "LOW ROTOR RPM" alert sounded in the cockpit. The pilot immediately lowered the collective and, after a drop of about 50 feet, started the "flare" to cushion the landing. The A119 touched the ground in an abrupt manner causing the aircraft skis to break. One passenger suffered fracture of the lumbar spine due to compression. The aircraft engine was tested at the headquarters of Pratt & Whitney by the Transportation Safety Board (TSB), on request of the American NTSB. The tests revealed minor variations of NF (power turbine speed) and NG (compressor turbine or gas generator speed) in the modes MEC (mechanical mode) and EEC (electronic engine control). Despite these discrepancies, the engine behavior and its power of response remained within acceptable limits during rotation on the test bench. Later, in Montreal, the Fuel Control Unit (FCU) was tested in the premises of the manufacturer (Honeywell) by the Transportation Safety Board on behalf of the NTSB. The tests showed wear of the pressure regulators, which, in turn, led to NC and NG instability. According to Honeywell, this abnormality would not be able to prevent the engine from reaching full power.

Table 32. Reports of occurrences involving A119 and AW119 MKII aircraft related to engine-failure problems Sources: *Agenzia Nazionale per la Sicurezza del Volo (Italy)*, Aeronautical Accident Investigation and Prevention Center (Brazil), *Flight Safety Foundation,* and National *Transportation Safety Board (USA).*

Specifically with regard to the accident with the PR-HVR aircraft on 30 August 2004, the Aeronautical Accident Investigation and Prevention Center (CENIPA) issued on 5 May 2006, the Final Report 018/CENIPA/2006, which containes the results obtained by the SIPAER in relation to the circumstances that contributed to that occurrence.

According to the report, between 26 and 29 October 2004, the engine underwent inspection at the premises of Pratt & Whitney - Canada, and in the preliminary and visual examinations no signs of breakage or fracture were seen, except for some irregular bolt wires which, despite being in contradiction to what is prescribed in the maintenance manuals, did not contribute to the accident.

As for the research conducted by the manufacturer on the test bench, the engine fully reproduced the deficiency reported by the pilot during the flight that resulted in the accident.

Subsequent tests revealed malfunctioning of Electronic Governor Unit and the Fuel Control Unit. Pratt &Whitney Canada issue the Report 04-096 R1 dated 29 March 2005 stating “the instability observed in the test-cell, was probably the result of a combination of a high gain EGU, hysteresis in the Ng (compressor rotor speed) governor and Pr air pressure regulator mechanism wear in the fuel control unit (FCU)”

According to a research conducted by the investigators of the accident, 11 (eleven) service bulletins related to the fuel control system, prior to the accident, were issued by Pratt & Whitney.

After the accident with the PR-HRV aircraft, the engine manufacturer issued three (03) more Service Bulletins, the first of which - directly connected to the accident - was revised twice.

The Final Report 018/CENIPA/2006 (item "2 ANALYSIS") said that failures of the engine control system were already known to the manufacturer for some time. According to the document, the accident helicopter had already shown symptoms of malfunction in this system, as well as another helicopter of the same model operating in Brazil (PP-MSF).

Of the 31 (thirty one) Service Bulletins issued by Pratt & Whitney regarding this engine, fourteen (14) were issued to correct the functioning of the control system, with eleven (11) of them being issued before the accident. These bulletins even included full replacement of major system components.

The accident helicopter, submitted to the manufacturer maintenance in Brazil, complied with all the Service Bulletins issued on the subject. Even the EGU (P/N 3049709, S/N 044) originally installed, was replaced with another (P/N 3049709, S/N 032) on 16 July 2003.

Thus, the final report 018/CENIPA/2006 concluded that the engine malfunction was not a result of improper maintenance procedures or operation of the aircraft, but of a chronic problem of the engine manufacturing, which Pratt & Whitney Canada was trying to solve since before the accident, when one considers the many numerous service bulletins issued.

At the end, the report issued a Safety Recommendation to the National Civil Aviation Agency (ANAC) to reassess the certification for operation in Brazil of Pratt & Whitney Canada PT-6B-37A engine, as well as of the Agusta A119 aircraft equipped with it.

The Official Document no. 918/2006/GGCP, issued by the National Civil Aviation Agency (ANAC) on 27 December 2006, forwarded to the CENIPA the document "Report on the certification actions taken as a result of the recommendations contained in the Final Report 018/CENIPA/2006", in which the measures taken by the Agency in the area of aeronautical products certification were presented, namely:

OBJECTIVE

Taking into account the final report issued by CENIPA concerning the accident with the PR-HVR on 30 August 2004, requesting (page 16) the CTA/IFI (ANAC) to review the certification (in Brazil) of AGUSTA A119 aircraft equipped with Pratt & Whitney PT-6B-37A engines, we have held discussions and forwarded a request for clarification to the Agusta SpA aircraft manufacturer, whose headquarters is located in Cascina Costa, Italy. The requests were made under knowledge of the local authority, the Ente Nazionale per l'Aviazione Civile (ENAC), and were accommodated as described in item 3. ENGINEERING ANALYSIS.

SUMMARY

In a brief manner, in this report, we have listed the improvements implemented by the manufacturers. These changes were introduced to prevent the occurrence of aircraft incidents and accidents due to partial loss of power caused by malfunction of the electronic control of the fuel in the engines installed in the A119 Koala aircraft.

The latest improvements consist of modifications made available by the last three service bulletins issued by the engine manufacturer and by a mandatory technical bulletin issued by the aircraft manufacturer.

ENGINEERING ANALYSIS

The four bulletins mentioned in the previous paragraph established the following improvements:

SB39036: introduces new software and a new EEC (Electronic Engine Control) to improve the stability of the rotor governor;

SB39038: Prevents contamination caused by migration of the Accessory Gearbox oil and oil vapor from the FCU to the EGU;

SB39039: Improves the seals of the fuel pump pneumatic ducts, which could also contaminate the FCU with oil vapor;

Agusta Service Bulletin 119-10: Modifies the installation of drains reduction gearbox drains by means of application of a P/N 109-0823-78-101 kit, together with replacement of the engine pump (PW SB 39039).

ADDITIONAL INFORMATION

According to the manufacturers mentioned herein, greater care was introduced in the production line of the engines (we cannot quantify this aspect).

As shown in the Attachment, all operators of this aircraft and engine operating in Brazil have already implemented the changes listed here.

After implementation of the changes mentioned in the EN-6B-37A engines, the number of flight hours without incidents or accidents up to 4 October 2006 was:

Cumulative total of 25,458 hours, with the aircraft which flew the most having accumulated 996 hours. This situation shows that, in 2006, there were no occurrences associated with failures pertinent to the object of this report.

There was no issuance of Airworthiness Directives either by the European EASA authority or the Canadian TCCA. Regarding the implementation of changes, there was monitoring by the authorities responsible for the implementation and a joint effort by both manufacturers.

CONCLUSION

Considering the measures taken by the manufacturers aiming to ensure the continued airworthiness and the evidence of the non-recurrence of new events similar to the one that was reported, we conclude that the AGUSTA A119 aircraft airworthiness is reestablished. Thus, we will continue to monitor its life in service through the reports from operators and manufacturers. If necessary, we will intervene with appropriate actions within the scope of accreditation.

Basic mechanism of the autorotation regime

One of the most significant advantages of helicopters compared to other types of aircraft resides in its ability to make safe landings even after a complete loss of power. The operating regime allowing such ability is known as autorotation.

An important constraint to be observed in the autorotation regime is called Height x Speed Diagram - also known as Dead Man's Curve - which must be included in any helicopter operations manual, and aims to show the pilot regions with restrictions to flight, both in terms of height and speed forward, limiting the operational envelope of the equipment.

Once the power loss occurs within the restrictive limits of this diagram, a situation exists in which the autorotation regime becomes unviable - due to the reduced time for the aircraft to respond to the command of pilot, before its arrival on the ground. A typical model of the Height x Speed Diagram is shown in Figure 85.

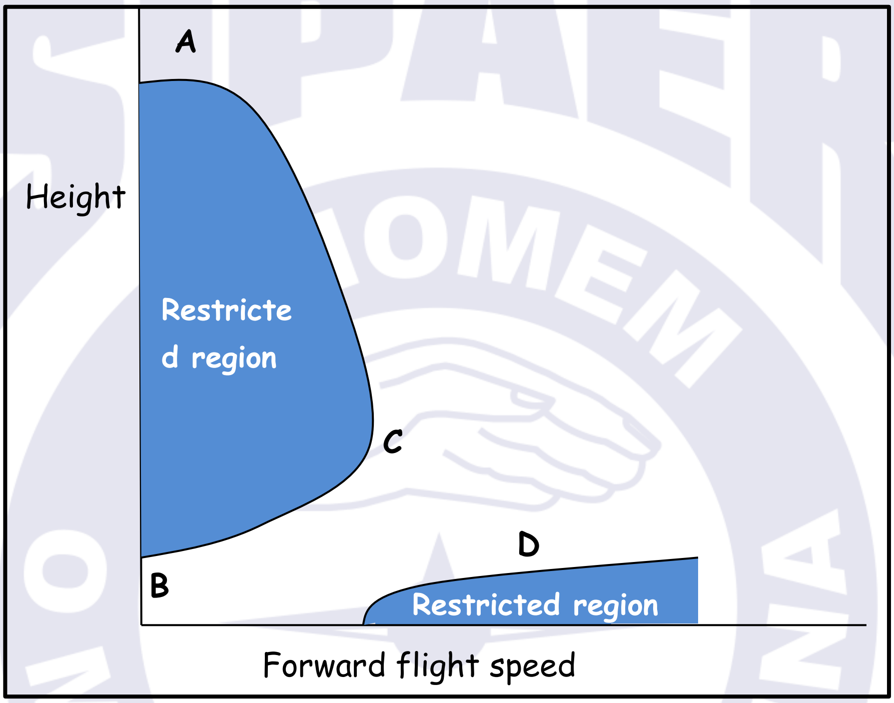

Figure 85 - Height x Speed Diagram. Source: SAUNDERS, 1975.

The Height x Speed diagram, shown in Figure 85, is characterized by four key points:

Point A represents the minimum height AGL at which the pilot has enough time to command an autorotation regime and perform a safe landing, if loss of power occurs during the hovering flight.

As for the point B, it represents the maximum height above the ground, in which, if there is loss of power during hovering flight, the pilot can use the residual lift provided by the main rotor in order to cushion the impact of the aircraft with the ground, minimizing damage to the crew and the aircraft. It is noteworthy that, in this case, the landing gear/ski is strong enough to absorb the impact energy of the fall without causing further damage to the crew and the aircraft.

The point C means the combination between minimum forward flight speed and height, which allows the pilot to make a safe landing in autorotation regime, in case there is loss of power.

The region bounded by D provides an area of restricted operation that combines high speeds and very low heights above the ground – something that makes autorotation not feasible - since the time is too short for any corrective action; thus the aircraft, as it crashes into the ground, transforms its high kinetic energy into impact energy, with the resulting injury or damage.

According to the Rotorcraft Flight Manual (RFM) (Section 4 - Performance, pages 4-21), the AW 119 MKII aircraft had the following Height x Speed diagram:

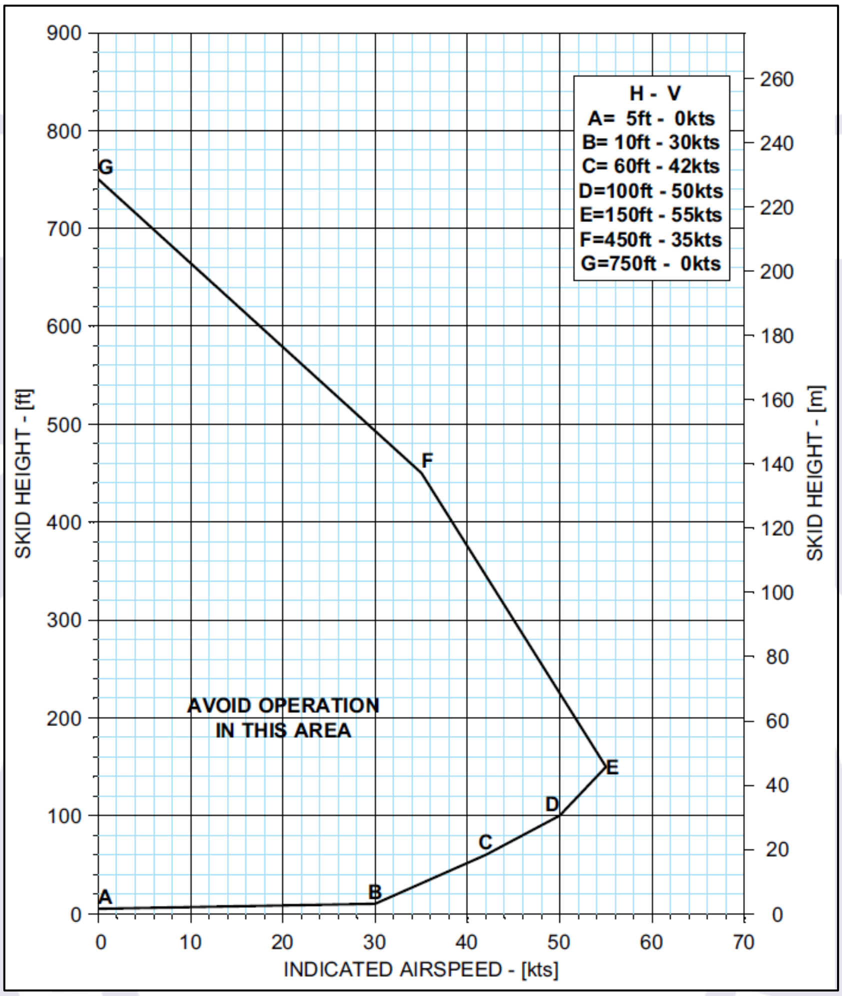

Figure 86 - AW119 MKII Height x Speed Diagram.

According to Prouty, in cases of loss of engine power, the drop rate of a rotational system is directly proportional to the applied torque and inversely proportional to the moment of inertia.

The fast response of the pilot in the controls is, therefore, a critical component for a successful autorotation (see Figure 87). That is why every helicopter features sound and light alerts regarding stop of the engine, and every pilot is trained to lower the collective immediately after hearing these alerts.

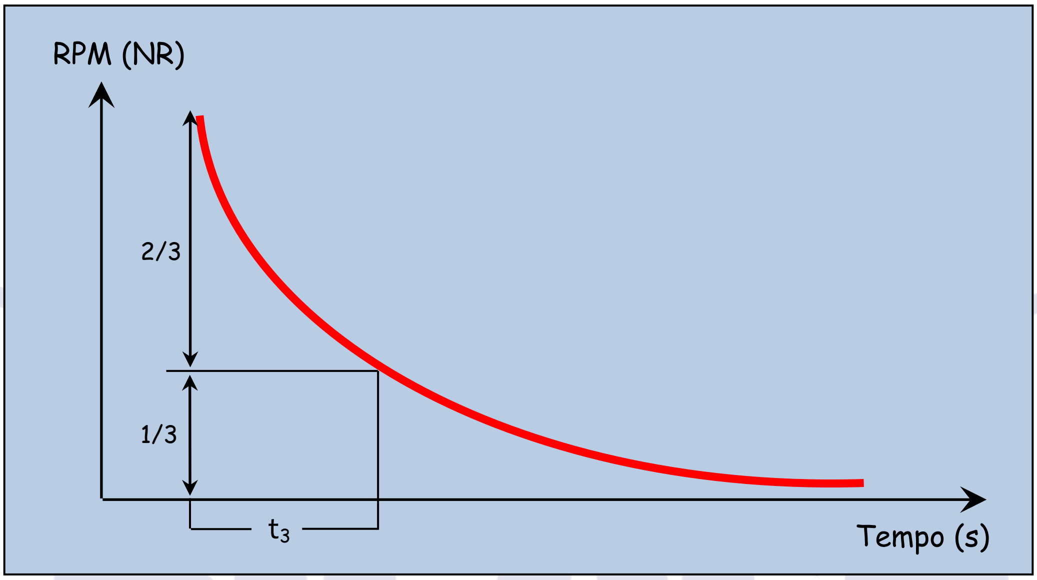

Figure 87 –Drop of RPM as a function of the pilot's response time. Source: IPEV (2010).

In the event of loss of rotation, in addition to losing directional control to correct the tendency of fuselage roll, one also loses the centrifugal force that keeps the rotor blades forming a disk. The result is what is called a "Cone Effect", in which the blades fold up and, in situations that are more critical, they may end up breaking at the point of attachment.

Figure 88 – Cone effect. Source: NIKOLSKY and SECKEL (1949).

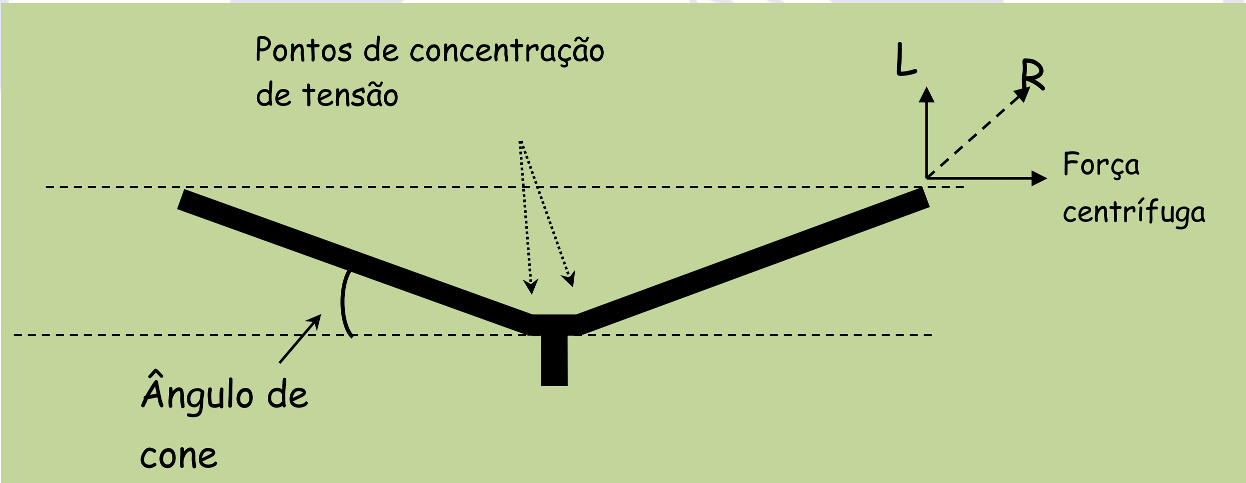

Figure 88 - The "Cone Effect" has the following characteristics:

a) Tends to be bigger in pitch-down attitudes and heavy weight/G load conditions;

b) tends to decrease with increasing speed of blade rotation speed and with the consequent increase of the centrifugal force;

c) tends to increase when the helicopter is operated at rotations below the minimum specified by the manufacturer;

d) Results in overload to the blades, decreased amplitude (area) of the rotor disc, and loss of lift.

A previous accident involving the Robinson R22 aircraft, registration EN-YZZ, on 25 September 2009, which landed in autorotation in the parking lot of a supermarket in São Paulo, State of São Paulo, is a good illustration of this situation.

On a training flight, upon returning to SBMT, the aircraft sustained an engine flameout. The instructor, who was inserting the Tower Control frequency at the moment, was alerted by the illumination of the Low RPM light, and took over the aircraft controls. However, without engine traction and with the angle of the blades outside the minimum, the aircraft quickly lost rotation. The combined action of the loss of centrifuge lift force and of the helicopter weight on the main rotor disk resulted in an excessive upward bending of the blades.

Although there was no rupture, the two main rotor blades had suffered deformation and wrinkling compatible with the "Cone Effect", as can be seen in the figures below.

Figures 89, 90 and 91 – Situation of the PT-YZZ main rotor blades after the accident. In highlight, details of the upward bending of the blades. Source: SERIPA IV

The AW119 MKII Koala Rotorcraft Flight Manual (RFM), in its Section 3 - Emergency and Malfunction Procedures, page 3-12, recommended the following procedures for engine failure during cruise flight:

ENGINE FAILURES	
FAILURE OF ENGINE	
INDICATIONS	
Helicopter	*Left yaw.*
Audio signal:	*Present*
EDU 1	*ROTOR LOW warning message displayed and "ROTOR LOW" aural warning activated.* *ENG OUT warning message displayed and "ENGINE OUT" aural warning activated when N1 below 51% and decreasing*
Gas generator (N1)	*Rapidly decreasing.*
NR	*Rapidly decreasing*
ITT	*Rapidly decreasing*
Torque	*Rapidly decreasing*
PROCEDURE - CRUISE	
Pedals	*Control yaw rate.*
Collective	*Lower immediately to stop the NR decay. Then maintain the NR between 90 and 110%.*
Cyclic	*Adjust to obtain desired autorotative airspeed*
Note *Airspeed for minimum rate of descent is 80 KIAS.* *Airspeed for maximum glide distance is 110 KIAS.*	
Engine throttle	*OFF*
*If altitude permits, attempt to restart the engine (see "**Engine restart in flight**" procedure).*	
CAUTION *When the cause of engine failure is suspected to be of a mechanical nature, do not attempt a restart.*	
If the engine cannot be restarted:	
FUEL VALVE switch	*CLOSED*
FUEL PUMP 1 and 2 switches	*OFF*
Xfer PUMP switch	*OFF*
GEN switch	*OFF*
Perform an autorotative landing (refer to "Autorotative landing" procedure).	
AUTOROTATIVE LANDING	
Cyclic	*At approximately 150 ft AGL, initiate a flare and hold the flare to reduce the forward speed.*
Collective	*Apply at the end of the flare, before touchdown, to reduce the rate of descent.*
Cyclic	*Forward to obtain a level attitude (landing skid parallel to the ground).*
Collective	*Continue application to cushion the touchdown.*
Pedals	*Maintain direction.*
Note *In case of ground contact on the aft portion of the landing skid, avoid counteracting the pitch down with cyclic.*	

Items to be considered in the AW119 MKII aircraft's inspection of 50 hours

The AW119 Koala MKII Maintenance Planning Manual (MPM) includes 77 items to be executed in the 50 hours Inspection. According to interviews given to the investigators, only the services described in the Table 3 of the item "1.6 Aircraft Information" were executed. However, there was no record of these interventions.

Storage and provision of fuel in accordance with NBRs 15216 and 13310

The NBR 15216, containing provisions relative to "Storage of Flammable Liquids and Fuels - Quality Control in Storage, Transportation and Supply of Aviation Fuels", established the following procedures:

> "Transport equipment requisites
>
> In the manufacturing of tanks, pipes or any other component getting in direct contact with aviation fuels, the following must not be utilized: plastic material, galvanized steel, copper, zinc, cadmium, or their alloys. Zinc silicate-based paint must not be used in internal coating. Pipes that cannot be coated internally on account of their diameter must be made of stainless steel or aluminum.
>
> For Transport
>
> Fuel-Tanker Truck (CTA)
>
> The cargo tank must be made of stainless steel, aluminum or carbon-steel coated internally with epoxy. It must have a device allowing the making of inspections and feature a low point with drain. It must have dedicated use, that is, it must be used for transporting a single product, with the exemption contained in the items 6.5 and 6.5.1.
>
> Road transportation of aviation fuel must meet the requirements of the Hazard Material Transportation Regulation and the prescriptions established in RTQ-7i, with inspection certificate for the transport of hazard materials granted by the INMETRO (CIPP) for the groups (2D) QAV and (2E) GAV-100 LL, in accordance with the Group List of Hazard Material Groups of the INMETRO.
>
> During transport between facilities, the tanks must be sealed with a special colored seal and be numbered with at least three digits.
>
> Metal barrels
>
> The barrels used for storing aviation fuels must be made of stainless steel or carbon steel coated internally with epoxy, featuring a BG 18 gauge, with the following features:
>
> Capacity of 200 liters;
>
> Preferably new or fully reconditioned, exempt from any defects on the external surface and in the internal coating;
>
> Two openings for receiving the product, providing full stanchness when closed (free from dents, paint and damaged screw threads);
>
> Clean stoppers with usable threads and with a sealing surface free from paint and abrasions;
>
> New stopper gaskets, without deformation, in the right size for each type of stopper, in Buna N;
>
> Identified in accordance with the last version of the API/IP STD 1542, for each type of packed aviation product;
>
> Homologated for the transport mode in accordance with the Aviation regulation of INMETRO conformity.
>
> When refurbished, the barrels must undergo a washing process without utilization of caustic or acid cleaning products.
>
> Container
>
> The container must be made of aluminum, stainless steel or carbon steel, internally coated with epoxy, with selective connections. It must be constructed in a way

> allowing an effective drainage of water accumulated in the fuel. Its use must be dedicated, that is, it must be used to carry a single product. Utilization of a plastic container is forbidden".

Figure 92 – Stainless steel and carbon steel barrels in accordance with the NBR 15216.

The NBR 13310, with provisions relative to the “Aviation Fuel-Tanker Truck (CTA)”, had the following prescriptions:

> “6 Quality control procedures
>
> In the systems of distribution and storage of aviation fuels, it is necessary to collect samples, perform tests for verification of the conformity of the product with the respective specifications and, by means of a consistency analysis, detect possible contaminations or degradation of the aviation fuel during transportation.
>
> In all phases of the quality control procedures prescribing a test of the appearance, one must observe the aspect, color, and presence of water in the fuel. The fuel must be clear, transparent and visually free of undissolved water and solid material. The assessment must be made in a 1-liter sample, in a transparent glass container, without any imperfections and with a lid, so as to allow agitation through whirling of the sample. "

“*FUEL LOW*” Message in the EDUs

According to the AW119 MKII Rotorcraft Flight Manual (RFM), Section 4 - Performance Data, page 4-5, the "FUEL LOW" message appears when the amount of fuel drops below 45kg. In the event of failure of the sensor responsible for the indication, an "F LOW FAIL" message will appear in EDU # 1.

CHART E

According to the Rotorcraft Flight Manual (RFM), Section 6 - Weight and Balance, pages 6-17, filling out the CHART E (Figure 93) was required before any flight.

CHART E - WEIGHT & BALANCE COMPUTATION FORM						
MODEL	S/N	REGISTRATION MARKS		DATE	PLACE	COMPUTED BY
Ref.	ITEM	WEIGHT (Kg)	STA (mm)	LONG.MOMENT (Kg mm)	BL (mm)	LAT.MOMENT (Kg mm)
1	HELICOPTER BASIC (Ref. To Chart C)					
2	PILOT					
3	COPILOT					
4	PASSENGER					
5	PASSENGER					
6	PASSENGER					
7	PASSENGER					
8	PASSENGER					
9	PASSENGER					
10	LOOSE EQUIPMENT LOAD					
11	CABIN LOAD					
12	BAGGAGE COMPARTMENT LOAD					
13						
14						
15						
16						
17						
18						
19						
20						
21	**DRY WEIGHT**					
22	FUEL (at Take-off)					
23	**GROSS WEIGHT (at Take-off)**					
24	FUEL (at Landing)					
25	**GROSS WEIGHT (at Landing)**					
26	**BALLAST (if required)**					
LIMITATIONS Refer to Section 1		REMARKS				

Figure 93 – *CHART E.* Source: RFM AW119 MKII.

Limits of the transmission oil pressure

The AW119 MKII *Rotorcraft Flight Manual* (RFM), Section 1 - *Limits*, pages 1-17, presents the following limits for the main rotor oil pressure:

MAIN TRANSMISSION LUBRICATION SYSTEM LIMITS

OIL PRESSURE

Minimum ....30 psi

Continuous operation.. 30 to 55 psi

Cautionary...55 to 70 psi

Maximum ....70 psi

AW119 MKII Koala Maintenance Program

The AW119 MKII Koala Maintenance Planning Manual (MPM) established the following tolerance criteria for the aircraft maintenance program:

05-03-3. PERMISSIBLE INSPECTION INTERVAL TOLERANCES

In order to facilitate the inspection planning in accordance with the helicopter inspection schedule, the following tolerances are permissible.

SCHEDULED MAINTENANCE CHECKS

NOTE: Tolerances are not cumulative and they do not change the date at which the next inspection was scheduled.

In case of inspection anticipation it is possible to recover the gap using the tolerances of subsequent inspections.

i.e., 50 hours scheduled inspection

1. The 50 hours inspection must be performed mandatorily within 60 hours (50 hours + 10 hours tolerance).

2. It is mandatory to perform at least scheduled inspections (50 hours) in 210 hours (200 hours + 10 hours tolerance)

If the first scheduled inspection (50 hours) is performed at 30 hours (i.e. following corrective actions), the next three scheduled inspections (50 hours) must be performed as follows:

1º	-	30 hours (first inspection) +
2º	within	60 hours (50 hours + 10 hours tolerance) +
3º	within	60 hours (50 hours + 10 hours tolerance) +
4º	within	60 hours (50 hours + 10 hours tolerance) +
TOTAL		210 hours (200 hours + 10 hours tolerance)

The same criteria is applied to inspections 200, 400 and 800 hours, where there will be 4 times the 200 hours inspections in 830 flight hours (800 flight hours + 30 flight hours tolerance), 4 times the 400 hours inspections in 1630 flight hours (1600 flight hours special inspection + 30 flight hours of tolerance) and 4 times to 800 hours inspections in 3260 hours (3200 flight hours + 60 flight hours of tolerance).

Extended inspection program (Sect. 05-20)

INSPECTION

05-20-1 — Basic 50 Flight hours/60 days	: + 10 Flight hours/10 days.
05-20-2 — 200 Flight hours	: + 10 Flight hours
05-20-3 — 400 Flight hours	: + 30 Flight hours
05-20-4 — 800 Flight hours	: + 30 Flight hours
05-20-5 — 3200 Flight hours	: +/- 60 Flight hours (see note 1)
05-20-6 — 12 months	: +/- 2 months (see note 1)

Background of engine problems of AW119 MKII aircraft operating in Brazil

Research in the aircraft and engine logbooks of the PR-CBG and PR-PMG helicopters, operated respectively by the Military Fire Brigade and Military Police of the State of Goias, indicated that corrective maintenance was not necessary in their Pratt & Whitney PT-6B -37A engines.

In relation to the PR-PMM helicopter, operated by the Military Police of the State of Santa Catarina, it was found that, on 14 October 2012, during a ferry flight in the State of Bahia, the aircraft had an intermittent failure of the FCU, which forced the pilots to make a precautionary landing in SBSV. Later, following an instruction given by Pratt & Whitney - Canada, the FCU P/N 3122758-13, S/N C6822 was replaced with the FCU P/N 3122758-13 S/N C68014.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

The analysis of the factors intervening in the accident is divided into two parts. The first ("Dynamics of the Accident") aims at reconstructing the final moments of the flight which resulted in the helicopter crash. Despite the lack of flight recorders and survivors, the investigation commission tried to establish, on the basis of the research conducted, the most plausible hypothesis to describe the dynamics of the accident and the aerodynamic forces involved in the event.

The second part ("Considerations on the Results Obtained") analyzes in detail the various aspects related to human, operational and material factors that contributed to the accident, based on the tests and research performed by the investigators. It also brings an examination of the systemic weaknesses identified during the investigation and their possible contributions to the occurrence.

Dynamics of the Accident

In Figures 94 and 95, Phases 1-5, the most plausible hypothesis to explain the dynamics of the accident is presented. The proposed sequence of events was based on interviews conducted by the investigators, on the results obtained from the examinations conducted by the investigation commission and on research of the literature related to rotary wing aerodynamics.

Figure 94 – Dynamics of the accident (Phases 1, 2, and 3).

Cruise flight: The aircraft took off from *Fazenda Nossa Senhora Aparecida* at 18:20 UTC, with eight persons on board, destined for a refueling point established in the municipality of Piranhas, State of Goias. 17 minutes into the flight, after flying over an elevation of 2,150 feet located in the southern sector of *Fazenda Rancho Alegre*, the aircraft engine flamed out. According to information obtained through the testimony of witnesses, the helicopter was at an altitude of approximately 1,000 feet above the ground.

Cone Effect: the engine loss of traction associated with the high torque applied, with the aircraft weight near the maximum for operation, and with the low momentum of inertia provided by the composite material blades of the AW119 MKII Koala aircraft caused a quick drop of the main rotor RPM. As a result, the combined action generated by the loss of lift centrifugal force and by the weight of the helicopter on the main rotor disc caused the blades to bend up (Cone Effect)

Breakage of the blade: at a third moment, the bending up of the blades continuously intensified up to the occurrence of a static failure of the main rotor blade marked in blue color.

Figure 95 – Accident dynamics (Phases 4 and 5).

Roll around the longitudinal axis: the tendency of the fuselage to roll after the quick drop of rotation (RPM), associated with the momentum provided by the loss of one of the main rotor blades caused the aircraft to initiate a roll around the longitudinal axis in a counterclockwise direction.

Collision with the ground: it was not possible to determine how many rolls were performed by the aircraft around its longitudinal axis; however, on account of the conditions found by the investigators at the Initial Action, it is likely that the PP-CGO collided with the ground in a nearly upside down position.

Although it was not possible to identify the angle and speed at which the helicopter hit the ground (see section "1.16 Relative to the ASI"), the conditions found at the crash site indicated that the collision occurred at a high angle of attack and great speed.

Considerations on the results obtained

The investigation of this aeronautical accident identified that the weather conditions were favorable for VFR flights on the day of occurrence. There were no clouds or high winds capable of hindering judgment on the part of the pilots or depriving them from keeping control of the aircraft during flight.

After analysis of the last three reports issued by the Air Force Hospital of Brasilia relative to the pilots' Health-Checkup (JES), no evidence of alterations in their health condition were found that could be relevant in relation to the accident. According to interviews, the crew had an adequate rest period in a favorable environment before the accident flight. Their working day on the day of the accident was within the limits prescribed by the aeronautical regulations.

At the time of the engine failure, after one discounts the 374kg of average fuel consumption for 2 hours and 8 minutes of flight, it is estimated that the aircraft weight was around 2,842kg, therefore, within the limits recommended by the manufacturer. The balance of the aircraft, considering the distribution of its occupants, was also within operational limits.

According to witnesses' accounts, the aircraft was flying forward at an altitude of more than 300 meters AGL (about 1,000 feet). Thus, based on the AW119 MKII Height x Speed Diagram (see item "1.19 Basic Autorotation Regime Mechanism") it is possible to be inferred that we can infer that the PP-CGO was out of the "Dead Man Curve" at the time of engine failure.

Considering that the aircraft took off from SBGO fully loaded with fuel, and that it flew at a speed of 120kt, at an altitude of 500ft AGL over a terrain whose mean elevation was 1,500 feet, it is possible to affirm that there were approximately 102kg of JET A-1 in the aircraft tanks at the time of the accident. Moreover, in the flight phase in which the accident occurred, the EDU did not record a " FUEL LOW " message, and seven of the eight bodies were found with a high degree of charring. Such evidence confirmed that the engine flameout in flight was not due to lack of fuel in the aircraft tanks.

According to the Test Report No. 39 /13 issued by the National Agency for Petroleum, Natural Gas and Biofuels (ANP), samples taken from the container utilized by the Civil Police in operations off headquarters showed full compliance with the specifications for jet fuel. Additionally, the investigation found out that in the three weeks preceding the accident, the Air Unit did not use the container, and the last three refuelings of the accident aircraft took place at the *Air BP Brazil Ltda.* located in SBGO, as described in item "1.16 Relative to the fuel".

On account of the procedures and documents handed in by Air BP Brazil Ltda. Company to the SIPAER investigators one day after the accident, the company had fully complied with the norms and regulations established by the Regulatory Authority . Additionally, the investigators contacted the owners and operators of other aircraft that used the same CTA that provided fuel to the civil police helicopter on 7 May 2012, and found out that there had been no problems with the JET A-1 used. Thus, one can say that the fuel used on the day of the occurrence did not contribute to the engine flameout.

In the tests of the blades of the main and tail rotors, no evidence of fatigue-related structural failure was identified.

As for the breakage of the blue marking blade (as explained in the item "1.19 Basic Autorotation Mechanism"), it is plausible to suppose that , after the loss of power, the pilots' response time was not timely enough to avoid an excessive main rotor RPM drop, which made the blades bend up on account of the "Cone Effect " – with the blue marking blade reaching its structural limit, breaking in flight and falling on the ground at a distance of 150 meters from the point where the aircraft crashed.

Furthermore, at the time of inflight engine failure, the aircraft was operating close to the maximum structural weight (approximately 8kg less), a condition that intensified the "Cone Effect ".

It was found that the Air Unit had not formally established a program for the training and operational maintenance of its crewmembers, as required by the RBHA 91, Requisite 91.959 - Qualification, Training and Proficiency. The investigators did no find the flight evaluation records of the flights made after the Pilot's Transition Flight Maneuver Evaluation, which took place in June and July 2011 (see "1.18 Operational information").

The lack of records made it impossible to analyze the suitability and effectiveness of the training done by pilots, especially with regard to the autorotation procedures. Thus, it was not possible to assess whether the amount of repetitions of this exercise was sufficient to ensure proper crew when facing a real emergency.

The availability of initial and continuous training programs allows the pilots to maintain the knowledge, abilities and attitudes required for effective performance in flight, as well as improvement of their judgment, decision-making, and emotional stability, which are fundamental in reacting quickly and appropriately when an adverse condition exists.

During a real emergency, the lack of regular training may expose the crew to presenting insufficient levels of performance, mainly due to a high level of stress and anxiety – feelings that may be strong enough to produce a defective evocation of the pilot's memory, a delay in his cognitive and motor responses, or even a human error.

In the PP-CGO accident, the scope of the autorotation training, in addition to the operation of the AW119 MKII Koala aircraft (close to its maximum structural weight – an unusual flight condition for the pilots - may have influenced the pilots' decision-making process, leading them to emission of cognitive and motor responses that were inadequate to the initiation of an autorotation procedure.

During the process of collection of data, discrepancies were found concerning the maintenance of the aircraft, specifically with regard to the implementation of the maintenance program after the deadline established by the manufacturer.

As described in "1.19 - Additional Information ", sub item "AW119 MKII Koala Maintenance Program", the AW119 MKII Maintenance Manual read that "50 hours Inspection" could be postponed for up to 10 hours. The last inspection, type IAM (Annual Maintenance Inspection), was made on 15 March 2012, and the aircraft flew 70 hours and 40 minutes until the accident. It exceeded 10h40min the limit established in the manufacturer's maintenance program.

Although the aircraft had entered the *Fênix Manutenção e Recuperação de Aeronaves Ltda*. company for the "50 hours Inspection" on 4 May 2012, the investigation found out that this scheduled maintenance was not performed.

Based on accounts, it is understood that there was a precocious removal of the aircraft from the maintenance company, as a result likely of a high motivational load on the part of the 1P and of the police officers involved in the crime scene reconstruction. They were wanted that phase of the criminal investigation to be completed before the Civil Police workers' strike began.

It is, therefore, inferred that such a context contributed to an inadequate judgment on the part of the pilots in relation to the helicopter airworthiness, causing them to take the risk of operating the machine without execution of the prescribed maintenance.

Thus, before taking off from SBGO, the aircraft had already exceeded in 10 hours and 40 minutes the maximum postponement of the "50 hours Inspection " established by the manufacturer (see section "1.6 – Aircraft Information"). Consequently, according to the prescriptions of the RBHA 91, Requisites 91.405 and 91.409 (e) (f) (3), the aircraft was not airworthy on the day of the accident, i.e., it could not be flying.

The fact that the aircraft exceeded the extension limit established by the manufacturer does not ensure that the engine failure origin had causal connection with the inobservance of the maintenance program. On the other hand, it is not possible to utterly rule out such correlation, given that the tests and research were inconclusive as to the origin of the failure.

These events, therefore, highlighted a sequence of unsafe decisions and acts, critical from a safety standpoint, on the part of the pilots (and reinforced by the Organization, which intended to accomplish a mission within an inflexible deadline). Such events confirmed the existence of a fragile professional and organizational culture, prone to permitting the predominance of a mission over the safety conditions under which it had to be accomplished.

The maintenance services supposedly performed on 5 and 7 May 2012 were of low complexity and had already been performed on other occasions by mechanics of the *Fênix Manutenção e Recuperação de Aeronaves Ltda.* Company. However, as established by the by the RBHA 145 (items 145.11 and 145.23), they could not have been performed due to the suspension imposed to the company.

During the bidding process for the execution of maintenance services in helicopters of the Department of Public Security of the State of Goias, the *Fênix Manutenção e Recuperação de Aeronaves Ltda*. had in its addendum the A119 and AW119 MKII aircraft manufactured by Agusta Westland and met all the Regulatory Authority (ANAC) requirements.

In an audit made by the National Civil Aviation Agency (ANAC) from 02 to 04 April 2012, non-conformities were found that resulted in the suspension of the maintenance company. Despite such discrepancies were relevant in terms of Flight Safety, it was not possible to determine their contribution to the accident.

The information collected by the investigators confirmed that the justice prisoner was wearing handcuffs at the time of the accident. Despite his position in the helicopter, it was not possible for him to interfere with the aircraft flight controls, due to the physical separation between the passengers' and pilots' cabins, as described in the item 1.6 "Aircraft Information".

The investigation of the fuel system and its main components (high-pressure pump, FCU and electronic governor) was harmed due to substantial damage caused by the collision of the aircraft with the ground and by the raging post-impact fire. Consequently, it was possible to analyze in greater depth only the reduction gear box and the hot section of aircraft engine.

During the disassembly work relative to these components, performed at the Pratt & Whitney – Canada headquarters, and at the Department of Science and Aeronautical Technology (DCTA) in São José dos Campos, SP, no mechanical problems, bearing damage, lack of lubrication, fractures or other discrepancies were identified that could cause malfunction or total engine stop.

In relation to precedents of aeronautical occurrences with A119 and AW119 MKII Koala aircraft, 11 accidents were identified around the world involving aircraft of the same model, five of them related to engine failure.

Specifically with regard to the accident with the N403CF, the National Transportation Safety Board of the USA, responsible for the investigation, concluded that the aircraft crashed due to engine failure, the causes of which were not identified, and due to the inability of the pilots to properly maintain an autorotation regime.

In the accident with the PR-HVR on 30 August 2004, the CENIPA concluded that the aircraft engine failure was due to malfunction of the Governor - NF Speed, Electronic (EGU) component, responsible for transmitting fuel flow information in the FCU (Fuel Control Unit).

As described earlier, it was not possible in this study to analyze such components of the fuel control system due to its high level of destruction, as described in "1.16 Tests and research", "Relative to the engine" (Figures 46 and 47).

The history of corrective maintenance services performed on the AW119 MKII aircraft, registration PR-CBG, PR- PMG and PR-PMM, which started being operated in Brazil on 18 December 2010 and 7 February 2011, indicated no recurrence of problems in Pratt & Whitney PT-6B -37A engines.

The history of the messages obtained from the readout of the Electronic Display Units (EDUs), and the detail exam of the documents relative to the maintenance services provided did not indicate recurrence of aircraft problems during the 17 months of operation by the Goias State Civil Police. By the same token, the information provided by the EDUs on the day of the accident and previous seven days did not provide any clues as to the factors that contributed to the inflight engine flame-out (see item " 1.18 Operational Information") .

At an organizational level, the Air Unit lacked basic structures, composing a frame of serious latent conditions associated with the performance of the air activity and maintenance of Flight Safety processes.

The lack of a hangar and an office room of their own, physically and strategically located in the premises of the Civil Police, did not favor a unified work in administrative and operational terms. This made it difficult to structure more defined organizational processes, for a better control over the activities associated with the operation of the helicopter and the performance of their staff.

This fact became even more delicate when the shortage of human resources was considered. The difficulty that the Civil Police Air Unit had for recruiting professionals capable of fully devoting themselves to the tasks of this sector generated a work overload for its personnel, mainly for the maintenance link of the Unit.

This work overload indicated inadequate structuring of human resources, which was contributing to the existence of latent and continued flawed controls of the Air Unit on important information about the aircraft (maintenance controls, records of failures, and control maps) that were so important for the maintenance of a safety culture in the Air Unit.

Work overload was also evident in the pilots' work shift, since there were only two pilots to support all missions of the Air Unit. This fact configured a risk factor for Flight Safety in the Organization, since the responsibilities inherent to administrative functions, which the pilots accumulated with their flight duties, represented potential elements of fatigue that could impair their cognitive and psychomotor performance in flight.

Therefore, the pilots' routine hindered a more careful monitoring of the workload and work conditions of the personnel, the administrative processes, as well as the aircraft maintenance and airworthiness controls. Such facts exposed the Organization to a poor structural condition, which favored an organizational culture quite vulnerable in terms of Flight Safety.

Thus, it was observed that, in the Air Unit, there were latent conditions, which, associated with difficulties related to structural and human resources, undermined the maintenance of an adequate operational safety culture.

The lack of a safety culture was observed in unsafe acts during the work routine, and in the actions of pilots, whose decisions exposed the aircraft to unsafe conditions.

In this context, one may highlight, for example, the disorganized control process of the aircraft maintenance; the delay in delivery of the aircraft to the maintenance company for the "50 hours Inspection"; the inadequate judgment and decision by the 1P to withdraw the aircraft from maintenance, when it still was not airworthy, and practice of transporting fuel for refueling off base using plastic containers that compromised the requirements and procedures defined in the ABNTs NBR 15216 and 13310 .

Moreover, one should also cite the complacent attitude of the pilot towards the landing the aircraft already indicating " LOW FUEL " 2 times, a few days before the accident; the aircraft takeoff with excessive weight on the day of the accident; the informal use of a piece of paper to calculate the aircraft weight and balance, when these should be formally recorded by means of the "CHART E"; and even the complacency of the crew to perform a flight without the presence of operational crewmember on board, since his presence would configure an established safety rule in the Air Unit .

Although these conditions have no direct correlation to the engine failure, they reflect the informality of the organizational culture of the Air Unit, representing latent factors that minimized the safety margins of the operation.

3. CONCLUSIONS.

3.1 Facts.

a) the pilots' aeronautical medical certificates and technical qualification certificates were valid;

b) the pilots were qualified and had enough experience for the flight;

c) the prevailing weather conditions were VMC;

d) at the moment of the accident, the aircraft was not airworthy, since it had surpassed the maintenance program limit established by the manufacturer in ten hours and forty minutes.

e) the aircraft departed from SBGO with a full load of fuel, that is, 476Kg of JET A1;

f) the aircraft departed from SBGO with approximately 96.2Kg above the Maximum Take-Off Weight established by the manufacturer;

g) in the research sessions that were conducted, no evidence was found related to problems with the fuel utilized by the aircraft;

h) at the moment of the accident, the aircraft had approximately 102Kg of fuel;

i) at the moment of the engine failure, the EDUs did not show the "FUEL LOW" message;

j) at the moment of the engine failure, the aircraft weight and Center of Gravity were within the limits established by the manufacturer;

k) all Service Bulletins and Airworthiness Directives applicable to the AW119 MKII design were complied with in the aircraft;

l) the Report RI APA 03/2013 concluded that, at the moment of collision with the ground, the aircraft engine was inoperative due to an inflight engine flameout;

m) the Report 23/AMR/2012 concluded that the main rotor blade with a blue marking presented structural breakage due to overload with a vertical force acting in an upward direction;

n) the aircraft occupants suffered fatal injuries;

o) the aircraft was completely destroyed.

3.2 Contributing factors.

- **Application of controls – undetermined**

From the tests performed in the main rotor blades, a possibility was raised that the pilots did not act with an adequate response time to prevent an excessive drop of the main rotor RPM just after the engine failure, something that caused the blades to bend upward, and one of them - with the blue marking - reached its structural limit.

- **Attitude – undetermined**

The complacent attitude of the pilots in consenting to the removal of the aircraft in an unairworthy status may have favored its exposition to an unsafe flight condition.

- **Organizational culture – undetermined**

The hasty withdrawal of the aircraft from the maintenance company, added to the other organizational variables mentioned in this report, confirmed the existence of a fragile flight safety culture in the Air Unit, which, in this case, may have subjected the aircraft to an adverse inflight condition, since it was not airworthy on the day of the accident.

- **Manufacturing or Design - undetermined**

Because of the results obtained in the tests and research conducted by the investigators, it was found that an engine failure occurred. However, due to the severe damage sustained by some components of the power plant, it was not possible to determine if there was any component failure.

- **Training – undetermined**

The lack of a minimum training program and operational maintenance in the Air Unit, specifying the time load for the autorotation exercise, may have contributed to the issuance of inadequate cognitive and motor responses by the pilots.

- **Pilotage judgment – undetermined**

It was not possible to discard the hypothesis that the decision to operate the aircraft without complying with the planned maintenance program may have contributed to the engine failure.

- **Aircraft maintenance – undetermined**

The aircraft was in operation even after exceeding the maintenance deadline established by the manufacturer in 10 hours and 40 minutes. Moreover, since the services provided by *Fênix Manutenção e Recuperação de Aeronaves Ltda.* were not recorded, and the research conducted in the powerplant was not conclusive as to the origin of the failure, one cannot rule out that inadequate maintenance contributed to the engine failure.

- **Motivation – undetermined**

The hasty removal of the aircraft from the maintenance company, in anticipation of the Civil Police strike, demonstrated a possible load of motivation of this institution for the flight with the purpose of concluding the criminal investigation.

- **Work organization – undetermined**

The accumulation of administrative and operational functions by the pilots and the maintenance link, the inflexibility of the flight schedule due to staff shortage and lack of structure may have hampered a more detailed control on the part of the Air Unit over important pieces of information that could have signaled some kind of risk to the operation of the aircraft.

- **Decision-Making Process – undetermined**

The lack of a regular training program in the Air Unit may have favored a delay in the judgment and response on the part of the pilot in face of the emergency, leading him to take longer than would be required to initiate the rotation procedure.

Moreover, the removal of the aircraft from the maintenance company, without completion of the prescribed inspection, indicated an inadequate judgment on the part of the pilot, and reinforced by the Corporation, when he deemed possible to accomplish an air support mission with the helicopter in an unairworthy condition.

4. SAFETY RECOMMENDATION.

A measure of preventative/corrective nature issued by a SIPAER Investigation Authority or by a SIPAER-Link within respective area of jurisdiction, aimed at eliminating or mitigating the risk brought about by either a latent condition or an active failure. It results from the investigation of an aeronautical occurrence or from a preventative action, and shall never be used for purposes of blame presumption or apportion of civil, criminal, or administrative liability.

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

To the State of Goias Public Security Secretariat:

A – 061/CENIPA/2013 - 01 **Issued on 04/03/2016**

Provide human, financial and material resources exclusively dedicated to structuring an Air Unit within the organizational system of the Civil Police, composing it minimally with sections of Maintenance, Ground Support, Operations, Training and Flight Safety.

A – 061/CENIPA/2013 - 02 **Issued on 04/03/2016**

Implement a training program in public security air units, considering both initial and continued training in order to maintain the proficiency of the crews.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

Flight Safety Audits were made in the Military Police Group of Airborne Radiopatrol and in the Air Operations and Airport Security Company by the SERIPA VI in February 2013. The Civil Police Air Unit (GT-3) was not included since it still did not have its own air assets.

A Cockpit Resource Management (CRM) course was given to the Air Units of the Goias State Civil Police in April 2013.

A recurrent pilot trainings ground and flight, including full autorotation maneuvers, were offered without charge by AW to the Brazilian state AW119MKII operators. Three pilots, one from each organization, Military Police, Civil Police and Fire Department Police attended the course.

On March 4th, 2016.

APPENDIX A – Comments by the ANSV not included in the Final Report

Below, there is a list of all the comments made by Agusta Westland and forwarded by the *Agenzia Nazionale per la Sicurezza del Volo* (ANSV) which were not included in the text of this Final Report.

a) COMMENT 1

In relation to the following portion of the item "1.19 – Known precedents":

"The Final Report 018/CENIPA/2006 states (item "2 Analysis") that failures of the engine control system were already known to the manufacturer for some time. According to the document, the helicopter involved in the accident in question had already presented events of malfunctioning in this system, as well as the other helicopter of the same model operating in Brazil (i.e., PP-MSF).

Agusta Westland's argumentation

The statement wording is considered captious and should be withdrawn or reworded considering the following:

Although it is recognized that previous malfunctions affecting engine fuel control system were reported (i.e N119RX and OE-XSB accident), the specific causes identified were different and prompt corrective actions have been taken as soon as a specific malfunction was recognized and this happen (sic), as also noted, for the specific accident (PR-HVR).

In accordance with the above consideration the recommendation issued by CENIPA and addressed to ANAC (Report 018/CENIPA/2006) received the following conclusive reply also reported in the paragraph:

"Considering the measure taken by the manufacturers aiming to ensure the continued airworthiness and the evidence of non-recurrence of new events similar to the one that was reported, we conclude that AGUSTA A119 aircraft worthiness is re-established. Thus, we will continue to monitor its life in service through the reports from operators and manufacturers."

CENIPA's comment:

The argumentation was not accepted, since the text portion in question is an integral part of the report issued in 2005 by this Center, and represents the conclusions obtained by the investigators of the accident at the time, which were reported in a clear manner in the body of the document.

Among other pieces of information, the Report 018/CENIPA/2006 verified that 31 (thirty-one) Service Bulletins (SB) were issued by Pratt & Whitney in relation to the engine PT-6B-37A, being 14 (fourteen) aimed at correcting the functioning of the fuel control system. Although P&W issued 11 of the referred Service Bulletins before the accident with the PR-HVR, such corrective measures were not sufficient for preventing the occurrence in question.

COMMENT 2

In relation to the following portion of the item "2 Analysis" (Dynamics of the accident):

"2) Cone Effect: the engine loss of traction associated with the high torque applied, with the aircraft weight near the maximum for operation, and with the low momentum of inertia provided by the composite material blades of the AW119 MKII Koala aircraft caused a quick drop of the main rotor RPM. As a result, the combined action generated by the loss of lift centrifugal force and by the weight of the helicopter on the main rotor disc caused the blades to bend up (Cone Effect)

Agusta Westland's argumentation

The consideration provided about the momentum of inertia seems indicate (sic) a negative behavior of AW119MkII meanwhile is a typical characteristic of modern and performing helicopter design. The phrase could be reworded as follow (sic): "……… and with the low momentum of inertia, typical of modern and performing helicopter design, caused a quick drop of the main rotor RPM."

CENIPA's comment

The argumentation was not accepted, taking into account that the item "2 Analysis - Dynamics of the accident" has the objective of reconstructing the final moments of the flight which resulted in the crash of the PP-CGO helicopter, and it is necessary to refer specifically to the characteristics of the *Koala*'s composite blades. In any way, the CENIPA recognizes and agrees with the Agusta Westland's statement that such characteristic is not exclusive of the AW119MkII, being present in several models of modern helicopters.

COMMENT 3

In relation to the item "3 Facts".

Agusta Westland's argumentation

In accordance with the consideration included in par. 1.19 and the information about the flight altitude reported in par. 2, an additional point should be included in the list of fact after the point "m)", dealing with the pilot inability to perform an emergency autorotation landing.

CENIPA'S comment

The argumentation was not accepted because such inference is only associated with an hypothesis raised in the item "2 Analysis - Dynamics of the accident", and, therefore, is not considered a fact.