COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-078/CENIPA/2021

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-OTF**
MODEL:	**AW 139**
DATE:	**02JUN2021**

NOTICE

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

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

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

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

This Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree nº 21713, dated 27 August 1946.

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

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

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

SYNOPSIS

This is the Final Report of the 2nd June 2021 accident with the AW 139 aircraft, registration marks PR-OTF. The occurrence was typified as “[CTOL] Collision with obstacle during takeoff and landing”.

On a night-time training mission at the 9PBS Maritime Unit (SS-75 *Ocean Courage* Semi-Submersible Rig), as the helicopter was at the final phase of the approach for the first offshore landing, its main rotor collided with structures close to the platform's helideck.

The aircraft suffered substantial widespread damage.

The PIC (Pilot in Command) suffered minor injuries, and the passenger was not injured. The SIC (pilot Second-in-Command) and an occupational-safety technician who was on the helideck suffered serious injuries.

Being Italy the State of design of the aircraft involved, an Accredited Representative of the Italian *Agenzia Nazionale per La Sicurezza del Volo* (ANSV) was designated for participation in the investigation of the accident.

Being Canada the State of manufacture of the aircraft engine involved, an Accredited Representative of the Transportation Safety Board (TSB) was designated for participation in the investigation of the accident.

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

9PBB	Location designator - P-20 Oil Rig - *Macaé*, State of *Rio de Janeiro*.
9PBS	Location designator - *Ocean Courage* (SS-75) Maritime Unit
9PLB	Location designator - P-25 Oil RIg - *Macaé*, State of *Rio de Janeiro*
AAFD	Final Approach and Departure Area
ALT	Altitude/Height
ANAC	Brazil's National Civil Aviation Agency
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CIV	Pilot logbook
CMA	Aeronautical Medical Certificate
COMAER	Brazilian Command of Aeronautics
CVA	Certificate of Airworthiness-Verification
DECEA	Command of Aeronautics' Department of Airspace Control
FAA	USA's Federal Aviation Administration
FSTD	Flight Simulation Training Device
GS	Ground Speed
HDG	Magnetic Heading
HMLT	Multi-Engine Turbine Helicopter Class Rating
HMNC	Single-Engine Conventional Helicopter Class Rating
HMNT	Single-Engine Turbine Helicopter Class Rating
IAS	Indicated Air Speed
ICA	Command of Aeronautics' Instruction
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IFRH	IFR Flight Rating - Helicopter
IMAE	Institute of Aerospace Medicine
IN	Instructor
IOGP	International Association of Oil & Gas Producers
LABDATA	CENIPA's Laboratory for Flight Recorders' Data Readout and Analysis
LDP	Landing Decision Point
METAR	Routine Meteorological Aerodrome Report
MPFR	Multiple Purpose Flight Recorder
NCD	*No Cloud Detected* (automated METAR/SPECI)
NORMAM	Maritime Authority Norms
OHRP	Offshore Helicopter Recommended Practices
PF	Pilot Flying

PIC	Pilot in Command
PLH	Airline Transport Pilot License - Helicopter
PM	Pilot Monitoring
PMD	Maximum Takeoff Weight (abbreviation in Portuguese)
POB	Persons on board
PTO	Operational Training Program
QRH	Quick Reference Handbook
RBAC	Brazilian Civil Aviation Regulation
REDEMET	Command of Aeronautics' Meteorology Network
SBEN	ICAO location designator - PCE-1 Central Fixed Platform of *Enchova* - *Macaé*, State of *Rio de Janeiro*
SBJR	ICAO location designator - *Jacarepaguá* - *Roberto Marinho* – Aerodrome, *Rio de Janeiro*, State of *Rio de Janeiro*
SERIPA III	Third Regional Service for the Investigation and Prevention of Aeronautical Accidents
SIC	Pilot Second in Command
SIPAER	Aeronautical Accidents Investigation and Prevention System
SLO	Obstacle-free Sector
SN	Serial Number
SOAL	Limited-Height Obstacle Sector
SOP	Standard Operating Procedures
SS	Semi-Submersible Rig
UM	Maritime Unit
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VS	Vertical Speed

1. FACTUAL INFORMATION.

Aircraft	**Model:** AW 139 **Registration:** PR-OTF **Manufacturer:** *Leonardo S.P.A.*	**Operator:** *Omni Táxi Aéreo S/A.*
Occurrence	**Date/time**: 02JUN2021 - 22:35 (UTC) **Location:** SS-75 (9PBS) **Lat.** 27°17'54"S **Long.** 043°06'37"W **Municipality – State:** *Santos* Basin	**Type(s):** [CTOL] Collision with obstacle(s) during take-off and landing

1.1. History of the flight.

At 21:53 UTC, the aircraft took off from SBJR (*Jacarepaguá - Roberto Marinho* - Aerodrome, *Rio de Janeiro*, State of *Rio de Janeiro*), bound for the SS-75 *Ocean Courage Maritime Unit*, located in the *Santos* Basin, in order to perform a night-time training flight including *offshore* takeoffs and landings, with 03 POB (2 pilots and 1 passenger).

During the approach for the first landing, the aircraft's main rotor collided with structures near the platform's helideck.

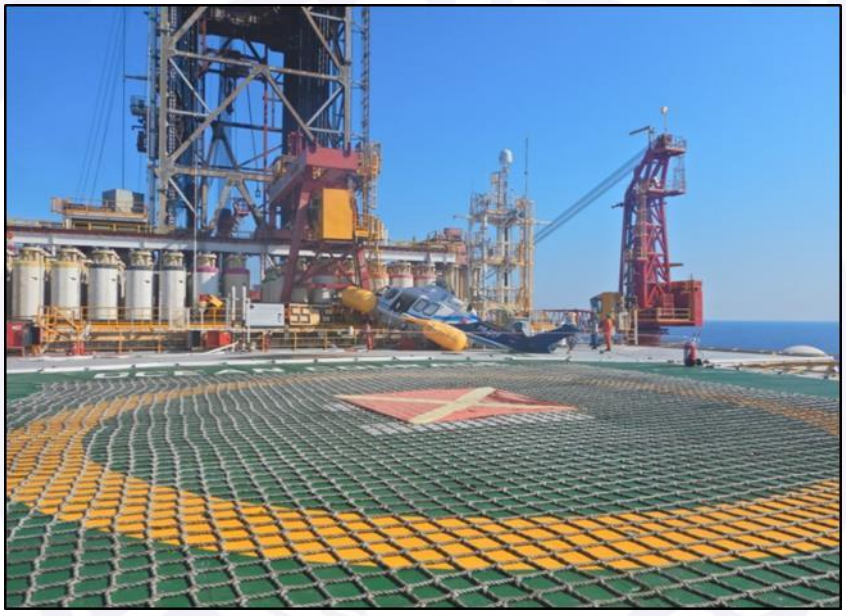


Figure 1 - View of the PR-OTF aircraft at the accident site.

The aircraft sustained substantial widespread damage.

The PIC suffered minor injuries, and the passenger was not injured. The SIC and an occupational-safety technician, who was on the helideck, suffered serious injuries.

1.2. Injuries to persons.

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

1.3. Damage to the aircraft.

The aircraft sustained substantial damage to its entire structure. In addition, the engine was internally fragmented, with fragments being expelled onto the surface of the platform. The main rotor blades were destroyed after impact with the structure of the maritime unit (Figure 2).

Figure 2 - View of the main rotor head without the blades.

1.4. Other damage.

There was damage to the fire station, to the handrail, to the vertical ladder, and to the cabin of the riser crane operator, to the antennas, to the wind sensor, and to the surveillance cameras.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Flight Experience		
	PIC	SIC
Total	9.321:28	4.863:15
Total in the last 30 days	63:23	22:15
Total in the last 24 hours	01:00	01:10
In this type of aircraft	4.072:59	3.395:21
In this type in the last 30 days	63:23	22:15
In this type in the last 24 hours	01:00	01:10

RMK: data provided by the operator of the aircraft.

1.5.2. Personnel training.

The PIC did the PPH course (Private Pilot – Helicopter) in 1999, at the *Skylab Escola de Aviação*, *Rio de Janeiro*.

The SIC did his Helicopter Pilot course in 2006 in the Brazilian Navy, *Rio de Janeiro*.

1.5.3. Category of licenses and validity of certificates.

The PIC and SIC held PLH Licenses (Airline Pilot - Helicopter) and had valid ratings for A139 aircraft type (which included the AW 139 model) and IFRH (Instrument Flight – Helicopter).

1.5.4. Qualification and flight experience.

Both pilots were experienced in offshore operations and were hired to perform the role of aircraft commanders.

The PIC, who was the Instructor (IN) of the flight and, according to information provided by the operator, had performed simulator training on 05 May 2021, in which he simulated a night-time landing at an aerodrome.

For pilots to meet the requirement for recent night-time flight experience, the letter (a), Section 135.247 of the Brazilian Civil Aviation Regulation nº 135 (RBAC-135) refers to the Section 61.21 of the RBAC-61:

> 135.247 Recent experience: pilot in command
>
> (a) Except as provided in paragraph (b) of this section, the certificate holder is only allowed to employ a person and such person is only allowed to work as pilot in command of an aircraft if s/he meets the recent experience requirements of section 61.21 of the RBAC-61.

In turn, the Section 61.21 of the RBAC-61 established the following requirement for night-time flight operations:

> 61.21 Recent experience
>
> (a) Except for the deadlines established in the section 61.19 of this Regulation, a pilot is only allowed to act as pilot in command of an aircraft if within the preceding 90 (ninety) days he has performed:
>
> [...]
>
> (2) for night-time flight operations: at least 3 (three) takeoffs and 3 (three) landings at night, during which the pilot has effectively operated the controls of aircraft of the same category and class/type; and

Since the company's Operational Training Program (PTO) established night-time flight training in accordance with the frequency established in Section 135.247 of the RBAC-135, and the RBAC-61 did not clarify the possibility of use of the simulator to meet the recent experience requirement, a formal consultation was made with the Regulatory Agency on that matter.

In response, the ANAC sector responsible for the RBAC-61 reported that:

> the fulfilment of a simulator session, outside of training for granting or revalidating a class or type rating, with the sole purpose of recovering recent experience, is not a method provided for in the regulation.

However, emphasis was placed in the fact that the response had to be complemented by other sectors of the ANAC.

Therefore, the sector responsible for the RBAC-135, after being consulted, answered that:

> one understands to be possible that, in compliance with the RBAC-135, pilots utilize the FSTD from level B onwards to recover recent experience, provided that the applicable requirements for approval of the FSTD and the training program are met.

However, night-time landing and takeoff training on a maritime platform carried out in a simulator would not provide one with the ability to replicate, with the desired verisimilitude, the same conditions of night-time flights in real situations.

Therefore, since the established requirement was not clear, questions remained as to whether the PIC was qualified for the flight, according to the concept established in the RBAC:

> 135.321 Applicability and terms used
>
> [...]
>
> (b) For the purposes of this Subpart and Subpart G, the following terms and definitions apply:
>
> [...]
>
> (10) *qualified*. It means that the pilot must have valid appropriate ratings for category and class, type, and operation, besides having successfully completed the approved training program for the operations approved for the certificate holder, as well as having met the recent experience requirements (emphasis added), in a specific aircraft and onboard function.

In relation to night-time operations on platforms, one observed that there were no records in the company that the PIC had performed previous night-time takeoff and landing training on a helideck located in a maritime unit. Likewise, the PIC reported that he did not remember having done this type of training in another company.

In turn, the SIC, on 05 January 2021, performed real night-time takeoff and landing training at SBJR. On 01 February 2021, he underwent training in a flight simulator to maintain his recent experience in flights that he could perform as Pilot in Command, given that there were no recent experience requirements for Second Pilot in Command established in the RBAC-135.

There were reports that he had performed real training at night in 2018, with 3 landings on a platform. No evidence, however, was found to confirm this previous experience.

No records were presented demonstrating night-time operation on offshore platforms, and there was no provision for this type of training to be carried out at the company's PTO.

It is worth noting that at the time of the occurrence, the ANAC did not determine a specific requirement for night-time operation in helicopters, whether in private, commercial, or offshore operations, at an airfield or on an offshore platform, since the regulation in question referred only to airplanes.

However, there was an understanding within the company that carrying out a night-time landing in the simulator would be sufficient to provide the pilot with the necessary qualification to conduct the real operation.

1.5.5. Validity of medical certificate.

The crew held valid CMAs (Aeronautical Medical Certificates).

1.6. Aircraft information.

The SN 41573 aircraft was a product manufactured by *Leonardo S.P.A.* in 2021, and registered in the Non-Scheduled Public Air Transport Registration Category (TPX).

The aircraft's had a valid CVA (Certificate of Airworthiness Verification).

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

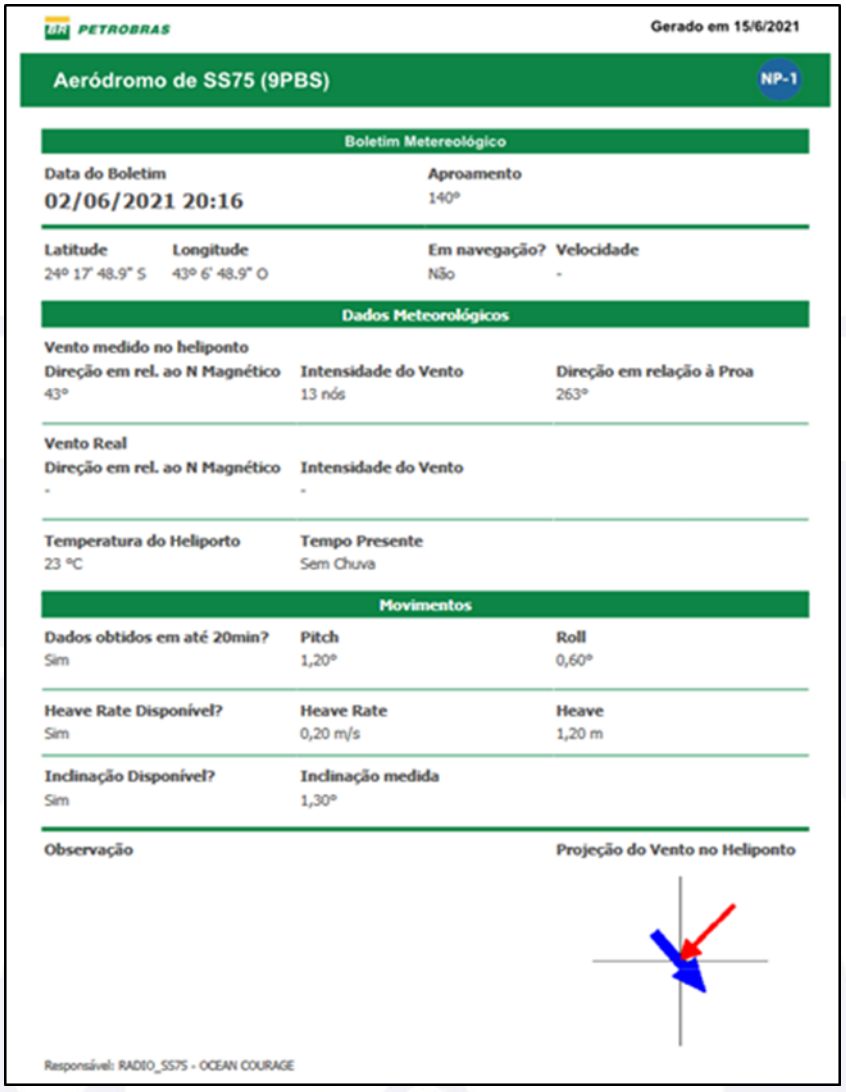
The aircraft's last inspection ("50-hour" type) was completed on 5 May 2021 on the premises of the *Omni Táxi Aéreo* maintenance organization, in *Rio de Janeiro*, State of *Rio de Janeiro*. The aircraft logged 14 hours of flight time after the said inspection.

The helicopter had flown 67 hours and 40 minutes since new.

No evidence was found of failures or malfunctions in the aircraft systems or components that could have contributed to the occurrence.

1.7. Meteorological information.

According to the SS-75 (9PBS) Meteorological Bulletin, the meteorological conditions were consistent with VFR flights. The wind strength measured at the helipad was 13 kt, with a direction of 043°, and there were no precipitations. In relation to the bow of the platform, the wind direction was 263° (Figure 3).



PETROBRAS

Gerado em 15/6/2021

Aeródromo de SS75 (9PBS) NP-1

Boletim Metereológico

Data do Boletim	Aproamento
02/06/2021 20:16	140°

Latitude	Longitude	Em navegação?	Velocidade
24° 17' 48.9" S	43° 6' 48.9" O	Não	-

Dados Meteorológicos

Vento medido no heliponto

Direção em rel. ao N Magnético	Intensidade do Vento	Direção em relação à Proa
43°	13 nós	263°

Vento Real

Direção em rel. ao N Magnético	Intensidade do Vento
-	-

Temperatura do Heliporto	Tempo Presente
23 °C	Sem Chuva

Movimentos

Dados obtidos em até 20min?	Pitch	Roll
Sim	1,20°	0,60°

Heave Rate Disponível?	Heave Rate	Heave
Sim	0,20 m/s	1,20 m

Inclinação Disponível?	Inclinação medida
Sim	1,30°

Observação

Projeção do Vento no Heliponto

Responsável: RADIO_SS75 - OCEAN COURAGE

Figure 3 - SS-75 (9PBS) Meteorological Bulletin.

The limitations regarding the movement of the semi-submersible platform were directly linked to the following factors:

- *Pitch: movement relative to the transverse axis (heel) of the maritime unit;*
- *Roll: movement relative to the longitudinal axis (swing) of the maritime unit;*
- *Inclination: inclination movement of the maritime unit;*
- *Heave: movement relative to the vertical axis (pitch) of the maritime unit; and*
- *Heave Rate: speed of the vertical axis.*

Based on the SS-75 (9PBS) Meteorological Bulletin, one inferred that the restrictions for the operation, with regard to *Pitch*, *Roll*, *Inclination*, *Heave*, and *Heave Rate* movements, did not constitute limiting factors for the helicopter's landing.

Similarly, the 21:00 UTC routine Meteorological Aerodrome Report (METAR), obtained from the Command of Aeronautics' Meteorological Network (REDEMET), with information from the maritime units of P-20 (9PBB), P-25 (9PLB), and Fixed Central of *Enchova* PCE-1 (SBEN), located, respectively, in the fields of *Marlim*, *Albacora* and *Enchova*, contained the following data:

SBMM 022100Z AUTO 03010KT 9999 NCD 24/20 Q1016 W///S4=

SBLB 022100Z AUTO 04007KT 9999 NCD 24/20 Q1016 W24/S4=

SBEN 022100Z AUTO 04010KT 9999 NCD 24/20 Q1016 W24/S4=

According to the reports, visibility was more than 10 km, No Clouds Detected (NCD), temperature of 24°C, wind direction between 030° and 040°, and wind speed between 7 kt. and 10 kt.

1.8. Aids to navigation.

NIL.

1.9. Communications.

According to the transcripts of the Multiple Purpose Flight Recorder (MPFR), one found that the crew made contact with the maritime unit radio operator, and received updated information on the weather conditions and on the helideck positioning.

1.10. Aerodrome information.

The 9BPS helideck located on the SS-75 *Ocean Courage* maritime unit was a Class 1, H2 Category helideck operating under Visual Flight Rules (VFR) during day- and night-time.

The helideck certification, under the responsibility of the ANAC, was formalized by the Ordinance nº 1082/SIA, dated 12 July 2010.

The floor was made of metal, with an octagonal shape, and the landing and takeoff area measuring 25.40 m x 24.16 m. It had a pavement resistance of 14.6 tons, and was capable of operating helicopters with a maximum wingspan of 22.8 m (Figure 4).

Figure 4 - *Ocean Courage* (9PBS) helideck.
Source: Brazilian Navy Ports and Coasts Directorate.

There was no evidence of any contributions from the maritime unit's infrastructure to the accident.

1.11. Flight recorders.

The aircraft was equipped with the SN A22396-002 MPFR D51615-142-090, from which the audio and the data were successfully extracted. The equipment was analyzed by SIPAER technicians on the premises of the Operator, and at the CENIPA's LABDATA (Flight Recorder Data Readout and Analysis Laboratory).

The recorded data of the aircraft's flight controls, engines, and systems indicated that the PR-OTF was operating normally at the time of the accident.

After analyzing the data contained in the MPFR, one confirmed that the equipment recorded the various parameters of the aircraft with accuracy. The powerplant indicators were operating normally, and there were no warnings of emergencies or mechanical failures.

1.12. Wreckage and impact information.

The investigators found two marks of the impacts of the main rotor against the platform surfaces. The first impact occurred between the main rotor and the crane operator cabin (Figure 5).

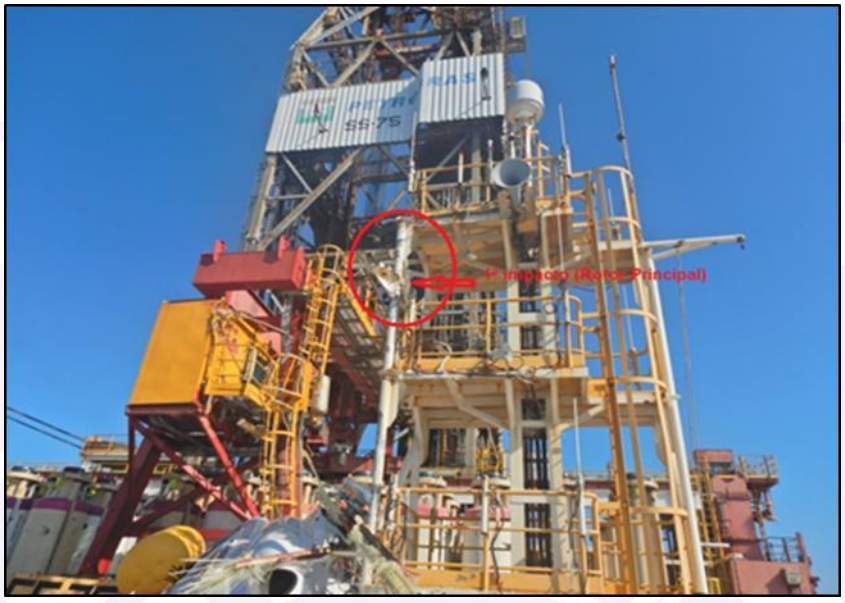


Figure 5 - Location of the first impact of the helicopter against the platform.

With the impact, the aircraft entered an uncontrolled clockwise spin around its own axis, which caused the second impact of the main rotor against a service structure, culminating in an abrupt fall and total stop on the platform. There was substantial damage to the tail rotor blades and to both engines. The main rotor blades were destroyed (Figure 6).

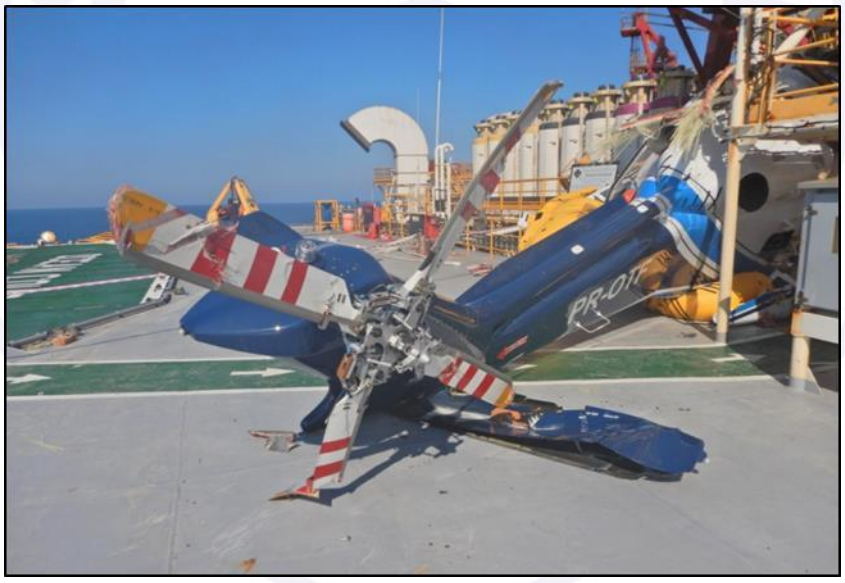


Figure 6 - View of the damage to the PR-OTF tail rotor blades.

On the helideck floor, there were several fragments of the blades that were expelled from the aircraft's turbines (Figure 7).

Figure 7 - Stator of the aircraft's left-hand engine turbine.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

The Aerospace Medicine Institute (IMAE) of the Brazilian Command of Aeronautics (COMAER) issued a Technical Report in support of the investigation with the purpose of analyzing the physiological phenomena experienced by the pilots involved in the accident.

According to the Report, spatial disorientation and sensory illusions, which in the early days of aviation were extremely frequent in aircraft accidents, still contribute nowadays to accidents in operations without visual references.

On night-time flights, if the pilot does not have visual references on the ground, he may not perceive the position of the horizon. This situation is aggravated on flights over the sea, since the surface of the water may mirror the sky, creating false visual references around the entire aircraft.

On night-time flights over offshore platforms, the pilot has few external references to orient him, and needs to be prepared to identify the phenomena of sensory illusions and the possibility of spatial disorientation. The human sensory systems related to orientation, such as vision, the proprioceptive system, and the vestibular system, work very well under terrestrial conditions, but have proven to be inadequate for air and space conditions.

Of these "sensors", the one that, due to its own operating characteristics, is the least suitable for these conditions is the vestibular system, particularly the semicircular canals. The false information generated by them, in various "blind flight" conditions, is absolutely indistinguishable from the true information necessary to maintain an aircraft in coordinated flight.

Vision, the proprioceptive system, and the vestibular system work in an integrated manner, with a hierarchical predominance of vision in the interpretation of the information received that is processed by the brain. For terrestrial conditions, in general, this system is reliable, but in the conditions specific to flight without external visual references, it is inadequate.

Illusions (false sensory information) are as common as they are extremely dangerous in flight. Their occurrence is directly related to human physiology under the specific environmental conditions of flight. The main origin of these illusions lies in the semicircular canals.

The rational protection for pilots consists of:

- understanding how the semicircular canals work;

- recognizing this human limitation for flying without visual references; and
- trusting the aircraft's instruments, ignoring one's own sensory information.

In this educational process to convince pilots of these facts, education and physiological training play an extremely important role in the method of preparing crew members who will perform night-time flights.

The *autokinesis* phenomenon occurs when the gaze is fixed on an isolated point of light, with no other nearby visual references, in a dark or low-light environment. After some time, this point of light is perceived as if it were "moving", because, when moving the eyes in search of a reference, the false impression is generated that the point is moving.

This phenomenon can cause considerable confusion for pilots who fly at night. *Autokinesis* can be attenuated by increasing the brightness and size of the light or the number of lights.

There are some preventative measures that must be followed by crew members when flying at night, which will contribute to better night vision, such as:

- avoid inhaling carbon monoxide (avoid smoking and smokers);
- have a diet rich in vitamin A;
- avoid bright lights, use protective glasses during the day; and
- control the internal lighting in the cabin, and use oxygen on flights above 5,000 ft.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

The crew consisted of two pilots, who were scheduled to fly fortnightly in accordance with the contractor's orders.

The passenger, who was also a crew member, would only help with changing the pilots' seats according to the piloting stations, with the helicopter resting on the helideck.

The PIC worked as a Captain and Instructor in the company, and the SIC also performed the role of Captain.

When the SIC joined the company, he took training flights with the PIC. After that period, they no longer flew together, and only had contact with each other on a few occasions.

According to reports obtained from fellow company employees, the PIC was considered an experienced, committed professional, and was seen as a reference by the other pilots. He had worked at the company for over 11 years.

In the workplace, the SIC was described by colleagues as a charismatic person with good interpersonal relationships, and was considered an experienced pilot.

As for the flight, the estimated time of departure was 18:15 local time, but there was a delay in the PIC's arrival at SBJR, due to traffic congestion on the roads accessing the airport. The PIC decided to park at a local shopping center and walk the approximately three-kilometer distance to the aircraft. As a result, the aircraft engines were started up at 18:45 local time, 30 minutes later than originally planned.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

The pilots and the passenger disembarked normally through the aircraft doors.

1.16. Tests and research.

NIL.

1.17. Organizational and management information.

According to information provided by the operator, the *Omni Taxi Aéreo* company focused on serving the Oil and Gas Industry by transporting passengers and cargo to offshore platforms and vessels. At the time of the accident, it had contracts with PETROBRAS, and utilized aircraft such as S-92, AW 139, and S-76 for that purpose.

Offshore aeromedical transport, which was one of the services provided by the company and part of its Operational Specifications, was an effective means of rescue that provided fast and safe rescue service in locations of difficult access.

The company's PTO included, in its item 1.5, the training of aeromedical operations, which used as a reference the IAC (Civil Aviation Instruction) nº 3134-0799, with provisions for the Public Air Transport of Patients. The PTO, as well as the IAC, did not provide for practical training for the aforementioned operations, in particular, night-time landing on an offshore platform to fulfill the service provision contract signed between the parties.

The helicopter fleet served the main companies of the country's exploration and production chain, with its most prominent customers being the large oil companies operating in Brazil and their equipment suppliers and service providers.

Omni Taxi Aéreo was certified to perform non-scheduled public air transport of passengers in on-demand *onshore* and *offshore* operations; provision of helicopter maintenance services; transport of internal and external cargo, and provision of a training center and technical services to respond to oil and hydrocarbon pollution incidents.

1.18. Operational information.

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

The PIC was the PF (Pilot Flying), effectively controlling the aircraft from the right-hand seat. The SIC was the PM (Pilot Monitoring), and occupied the left-hand seat.

With regard to the PIC's performance in the simulator training of 05 May 2021, there were comments in the pertinent records on the concept of stabilized approach, with special attention to night-time flights, including the possibility of spatial disorientation and optical illusion phenomena.

However, the flight records did not inform precisely what had occurred during the training. The simulator's Instructor commented that the PIC operated the aircraft safely, complying with the profiles prescribed in the landing and takeoff manual. The PIC’s performance was considered satisfactory.

It is worth noting that, in offshore aviation, the frequency of day-time flights was much higher than that of night-time flights, given that operations after sunset were restricted to medical emergencies on board the maritime units, with no passenger or cargo transports on this type of flight. Therefore, only a small group of pilots performed this type of training and remained qualified to meet the need.

According to data provided by the very operator, the number of actual landings at night in the last two years prior to the accident was limited to 15 (fifteen), compared to more than 12,000 daytime landings offshore.

Regarding the accomplishment of training flights, the investigation found that the operator had difficulty scheduling night-time flights with the contracting company due to the unavailability of platforms to accommodate this type of operation. In the last few years prior to the accident, the contracting company had suspended or postponed this type of training, which caused a gap of approximately 2 years in the training program.

Initially, the training flight had been scheduled for 30 May 2021, but it ended up being rescheduled for 02 June 2021.

These training sessions were to be monitored by an Instructor with enough frequency and experience in this type of operation. However, since the initial flight was postponed, and the Instructor originally designated was not available for the new date, the crew in question was summoned and notified the day before.

The objective of the flight was to accomplish the night-time training in accordance with the PTO, Revision nº 22 of 17 March 2020, item 1.9, in force at the time of the accident:

> 1.9 – NIGHT-TIME TRAINING
>
> a - OBJECTIVE:
>
> To provide the knowledge and experience necessary to ensure that the crew member safely performs a night-time flight.
>
> b - APPLICABILITY
>
> Applies to crew members who perform night-time operations.
>
> NOTE: The training is carried out by a company instructor according to the periodicity established in the RBAC 135.247

As planned, the PIC was to fly the helicopter to the platform, where a shift of piloting positions in the cabin would be made, and the SIC would perform three takeoffs and three landings, in compliance with the Chapter 1 of the respective PTO (Figure 8):

1.7	OPERAÇÃO PBN	Inicial		8 horas	2 anos
		Periódico		4 horas	2 anos
1.8	SOBREVIVÊNCIA	HUET e Sobrevivência no Mar		8 horas	2 anos
		Sobrevivência na Selva		8 horas	2 anos
1.9	NOTURNO	Voo		3 decolagens e 3 pousos (RBAC 135.247 (a)(2))	90 dias
1.10	INSTRUTOR	Solo	Inicial	2 horas (tem INV A) 8 horas (não tem INV A)	2 anos
			Periódico	Não Aplicável	
			Transição	2 horas	
		Voo	Inicial	3 horas treinamento + exame de observação	2 anos
			Periódico	Exame de Observação	
			Transição	3 horas treinamento + exame de observação	

Figure 8 - Training provided for in the PTO.

Thus, according to information from the company, the PIC, who was acting as the Instructor, would fly the aircraft to the platform where the crew members would shift their seats, and the SIC would carry out his part in the training flight.

It is important to note that the Section 135.247 (a)(2), cited in the company's PTO (Figure 8), was no longer in force in the RBAC-135, since it had been revoked with the issuance of the Amendment 04 on 22 October 2018.

In the Amendment 03, dated 18 February 2014, the referred Section read the following:

> 135.247 Recent experience: pilot in command
>
> (a) No certificate holder is allowed to employ a person, and no person is allowed to work as a pilot in command of an aircraft carrying passengers, unless, within the 90 days preceding the operation, such person:
>
> (1) has performed 3 takeoffs and 3 landings effectively operating the controls of an aircraft of the same category and class or, if a rating for the aircraft type is required, of the same type of aircraft in which the operation will be performed; and
>
> (2) for night operations, has complied with the provisions of subparagraph (1) of this paragraph at night.

In the Amendment 04, on the other hand, the text referred to the RBAC-61 requirements, with the recent-experience requirement in force on the date of the occurrence being defined as follows:

> 135.247 Recent experience: pilot in command
>
> (a) Except as provided in paragraph (b) of this section, the certificate holder is only allowed to employ a person and such a person is only allowed to work as a pilot in command of an aircraft if the referred person meets the recent experience requirements of section 61.21 of the RBAC- 61.

In relation to night-time training on offshore platforms, the Command of Aeronautics' Instruction (ICA) 100-4 of the DECEA, dealing with "*Special Air Traffic Rules and Procedures for Helicopters*", established the following requirements for the operation:

> [...]
>
> 6.3 NIGHT-TIME FLIGHT
>
> 6.3.1 On a heliport located on an offshore platform, operations are only permitted between sunset and sunrise for:
>
> a) Helicopter in mission/training for the transportation of seriously ill or injured individuals, provided that the requirements established in this publication for night-time VFR or IFR flights, as applicable, are met.
>
> NOTE: The training missions mentioned in this item must follow the ANAC's provisions on the subject. (*emphasis added*)
>
> b) Helicopters used for oil and gas research, drilling, and production activities, in cases of urgency or which may constitute an emergency. On these flights, only the transportation of specialized professionals and/or equipment and materials to deal with the urgency or emergency situation is permitted, in compliance with the other provisions of this publication.
>
> NOTE: *Urgency* refers to the following situations which, if corrective measures are not taken, may result in their evolution to an *emergency* situation:
>
> - situations that may endanger the environment;
> - situations that may seriously endanger the physical integrity of the offshore platform;
> - situations that may seriously endanger the physical integrity of the inhabitants of the offshore platform; and
> - situations that may endanger the navigation of other vessels in the open sea.
>
> 6.3.1.1 In addition to the provisions of 6.3.1, when the landing on the affected offshore platform does not provide the necessary level of safety, this operation may be carried out from a maritime unit close to the one in an emergency or urgent situation, provided that the operational requirements for the aircraft, crew, and helipad are met, and the integrity of the air operations, aircraft, crew, and third parties is ensured.
>
> 6.3.1.2 Additionally, the aircraft and crews involved in operations between sunset and sunrise must meet the crew and training requirements for this type of operation, in accordance with the national regulations (emphasis added).

On 25 March 2022, the ANAC published the Supplementary Instruction (SI) nº 135-005, Revision A, establishing the instructions and procedures for aeromedical operations performed by air operators governed by the RBAC-135. No instructions were identified in the aforementioned SI regarding the training missions provided for in the NOTE to item 6.3.1 of the ICA 100-4.

As for the flight, the aircraft's engines were started up at 18:45 (local time).

According to data gathered in an interview, the flight planning had been prepared by the coordination sector and sent by email to the PIC, with information about the platform, photographs, meteorological data, and movements.

The briefing was held by the PIC on the way to the aircraft, based on the information provided by the contractor and on the guidelines received by email from the Chief of Equipment.

In the briefing, not all aspects relevant to the operation of the aircraft were discussed, such as emergency and go-around procedures.

The passenger, who was also a pilot, did not participate in the briefing.

The SIC was the first to arrive at the aircraft. While waiting for the PIC, he performed the pre-flight. According to the SIC, since the printed checklist was not found, he chose to perform the procedures based on his experience.

By the way, the item 2.2.1 - *Pilot In Command's Responsibilities - of the* SOP 08 Leonardo AW 139, revision nº 06, dated 14 May 2021, of the Omni Táxi Aéreo S/A, read that the PIC would be responsible for ensuring that all necessary documents relevant to the flight should be carried on board the aircraft, even if he delegated this duty to another person:

> *The PIC shall be responsible for ensuring that all necessary documents relevant to the flight are carried on board the aircraft, whether or not the duty for checking documents has been delegated to another individual.*

The audio transcripts of the cockpit voice recorder confirmed the information that the checklist and the Quick Reference Handbook (QRH) were not found.

Likewise, it was not possible to verify, in the recovered audios, that the approach briefing had been held, as established in the item 4.22.1, *Before Descent Checks*, of the SOP 08, in force at the time of the accident, as follows:

> 4.22 OFFSHORE PROCEDURES
>
> 4.22.1 BEFORE DESCENT CHECKS
>
> [...]
>
> APPROACH BRIEFING ..... PERFORM
>
> *A detailed briefing is done, regarding the conditions of the descent, whether it is under IFR or VFR rules, descending en route or in a turn, in VMC or IMC conditions and the expected altitude to acquire the visual conditions to continue the landing. Check other aircrafts (sic) using the TCAS and plan to descend taking care about them.*
>
> [...]

Similarly, on the final approach, the vertical descent speed should be monitored by the PM according to the following criteria contained in the item 4.25.5 *FINAL APPROACH* of the SOP 08:

> PM
>
> *Vertical descent speed greater than 350 fpm ..... RATE OF 500 FPM*
>
> *Announce any obstacles on final approach ..... SHIP ON FLIGHT PATH*
>
> PF
>
> *Crossing LDP ..... DECISION*

With regard to the operational procedures for operating on ships and platforms, the SOP 08, in force at the time, established in its Section 2, item 2.16.5, *Traffic Pattern for Oil Rigs and Vessels*, the following guidelines:

> *If necessary, ask the radio-operator to be prepared to flash the lights of the helideck, to help the reconnaissance, when flying on top.*
>
> *Check the helideck report and the clues for prevailing wind to establish the wind direction, the course of downwind leg and also the QDM of the final approach.*
>
> *The traffic pattern to recognize a helideck on an oil rig or vessel on visual approach should run at 700 ft. /80 kt. Perform the checklist for landing 3NM before top position.*

A passage at 700 feet to identify a MU may not allow the pilots to observe the ICAO call sign for the helideck and the roost. If there is any doubt about the identification of MU, ask the radio operator to blink like green helideck lights.

The control of the aircraft on the legs of the UM traffic circuit must be performed through the use of coupled FD in ALT, IAS and HDG modes.

The PM monitors the speed and barometric altitude of the flight all the way until the "gate".

After the "gate", it monitors speed and altitude by RADALT.

The speed of 80 KIAS must be used from the start of the identification point.

The descent must be the result of a highly coordinated action between the FP and PM:

At wings level, the PF requests and the PM executes the TARGET altitude change before starting descents.

The PF drops to the new altitude using the collective trim beeper continually (10-ft step) to a new altitude, under strict PM supervision.

The path must follow the legs as shown below (right or left side turns as indicated by wind on UM).

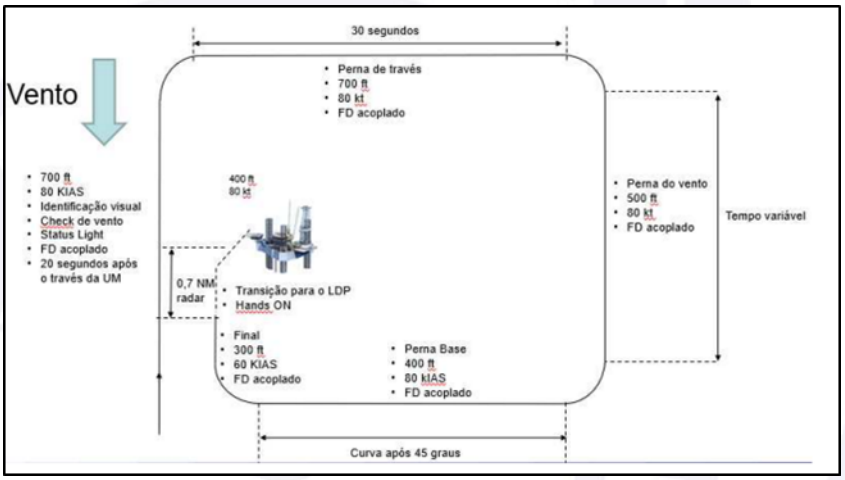


Figure 9 – Traffic pattern for platform and ships.
Source: SOP 08 LEONARDO AW 139.

APPROACH AND LANDING

Maintain the aircraft flying with FD modes engaged HDG, ALT and IAS until final approach. At the base leg, reduce altitude to 400 ft. At final approach, reduce altitude to 300 ft. and speed to 60 kt, always using FD modes.

The PF must be aware because with 60 KIAS, the FMS can decouple the FD modes without pilot control.

At 0.7 NM (radar distance) from the helideck, make a gradual transition from instrument flight to visual flight. PM must continually talk the altitude and speed. Press FD STDBY push-button switch on cyclic grip and transition flight to achieve LDP manually.

With the helideck completely in sight, the crew decides for landing or a possible go around. If a go around has been decided, it should be done with a domain power of 85% of torque, with no turn until 1000 ft."

Warning: This procedure should only be used with no remaining doubt in oil rig or vessel identification.

In flight, after identifying the UM (maritime unit), the PR-OTF joined the traffic pattern by the right and entered the final leg from the stern of the platform, continuing on the approximate heading of 056°, that is, heading up wind, but with a left component, since the

wind direction, according to the METAR of the area, was 040°. The PIC chose this approach axis to allow landing on his side.

During the approach, as seen in Figure 10, the maritime unit remained to the PIC's right-hand side, until the aircraft passed by a crane located on the left-hand side of the platform. After clearing this obstacle, the helicopter turned to the right to avoid flying over the Obstacle Sector with Limited Heights (SOAL) and to maintain visual references.

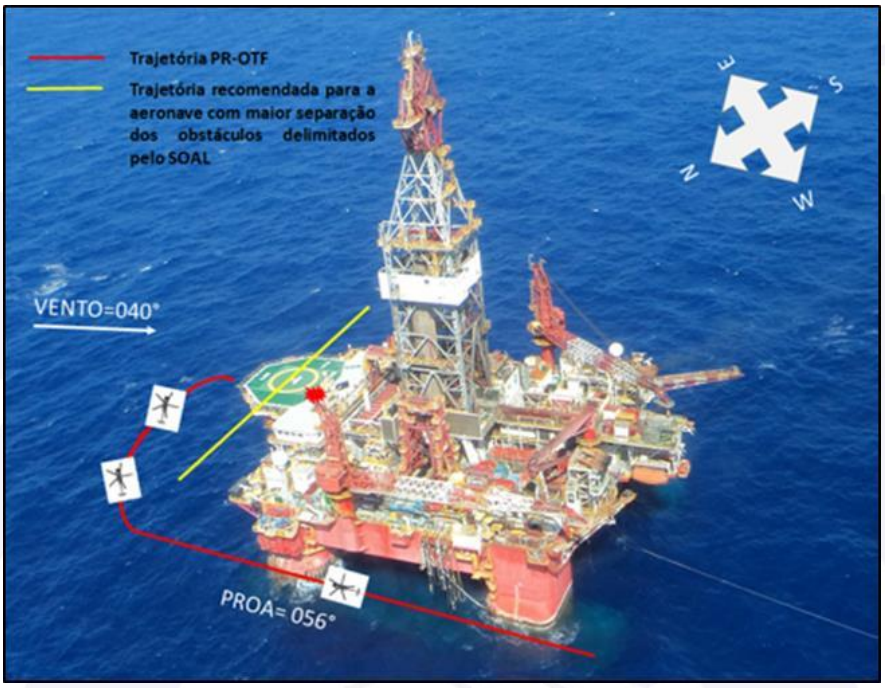


Figure 10 - Approach profile of the PR-OTF aircraft toward the SS-75.

At that moment, the wind component began to align with the tail of the helicopter, something which was not recommendable.

Then, in an already unstable condition and at a height above the one expected, the aircraft entered the helideck area and, in the transition to hovering flight, there was loss of control of the helicopter after ample variations in height, heading, and power.

Thus, despite the attempted go-around, the PR-OTF turned to the right, and its main rotor blades initially collided against the riser crane operator's cabin and subsequently against the service structure located on the right-hand side.

It is important to highlight that the longitudinal alignment with the "H", as shown in Figure 10, indicated the trajectory for the aircraft with the greatest separation from the obstacles delimited by the SOAL, for a landing within the limits of the touchdown area, that is, it was the safest approach axis, and should be considered as the preferred approach trajectory.

The SOP 08 did not have a clear definition capable of indicating deviations from a stabilized approach.

In accordance with the DECEA's glossary, a *Stabilized Approach* could be defined as:

> A flight procedure and technique that aims to ensure that the approach and final descent for landing are carried out in accordance with the intended flight path and without the need for excessive maneuvers, such as sharp turns or sudden changes in the rate of descent when close to the runway. In these cases, if "destabilization" occurs, a go-around shall be performed.

During the landing circuit, no assertive action was observed on the part of the PM to alert the PF as to the need to perform a go-around in the air, given the evidence observed

during the approach, such as sudden changes in vertical speed, ramp, and height (80 ft.) near the platform.

The final approach profile executed by the PR-OTF, with the respective values, from the height of 300 ft., is shown in Figures 11, 12, 13, 14 and 15.

It was possible to verify that the approach profile progressed normally at Points 1 and 2, with the aircraft at the heights of 300 ft. and 200 ft., respectively.

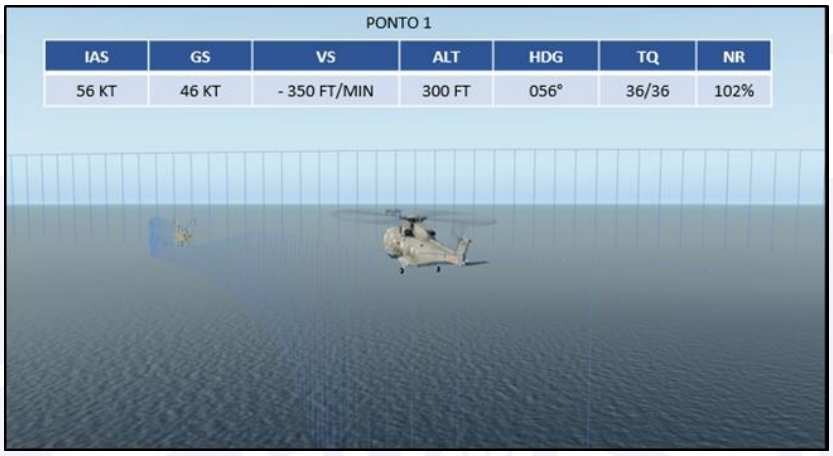


Figure 11 - Point 1 of the final approach flown by the PR-OTF.

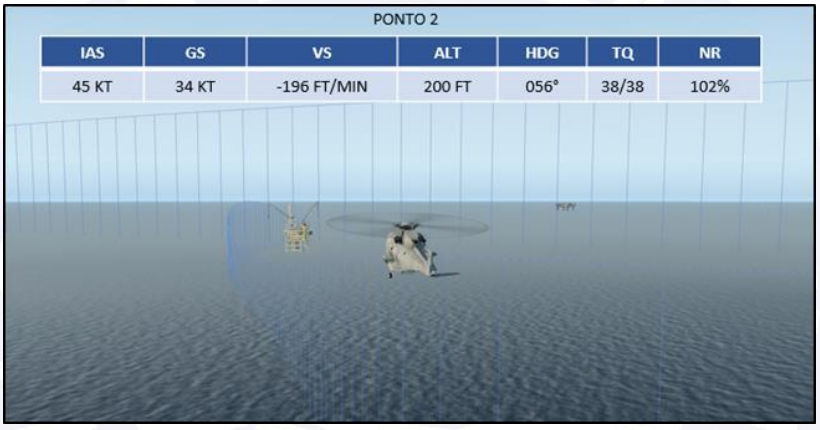


Figure 12 - Point 2 of the final approach flown by the PR-OTF.

At Point 3, the helicopter descended to 80 ft., that is, below the height of the SS-75 platform. In this condition, the aircraft maintained a magnetic heading of 060°, an indicated airspeed of 37 kt., and a rate of descent of 25 ft. /min. The aural alert "*150 ft.*" was also emitted, followed by "*Check Height*".

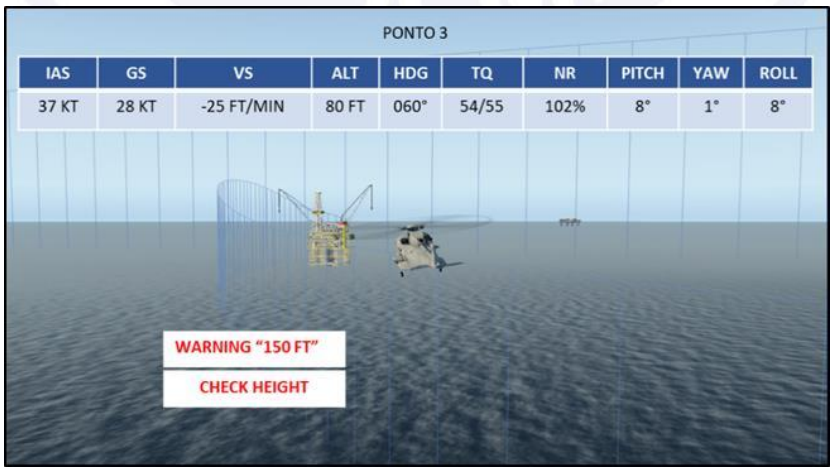


Figure 13 - Point 3 of the final approach flown by the PR-OTF.

The SOP 08's topic 5.5.2.4 - *Offshore Helideck Landing Procedures*, item 5.5.2.4.2 – *Procedures*, prescribed that the helicopter should maintain a ground speed of 15 kt at the *Landing Decision Point* (LDP).

At point 4, it was possible to observe that the heading had changed to 096°, with a pitch angle of 29°. It was found that, at this point, the PR-OTF had a rate of climb of 432 ft. /min.

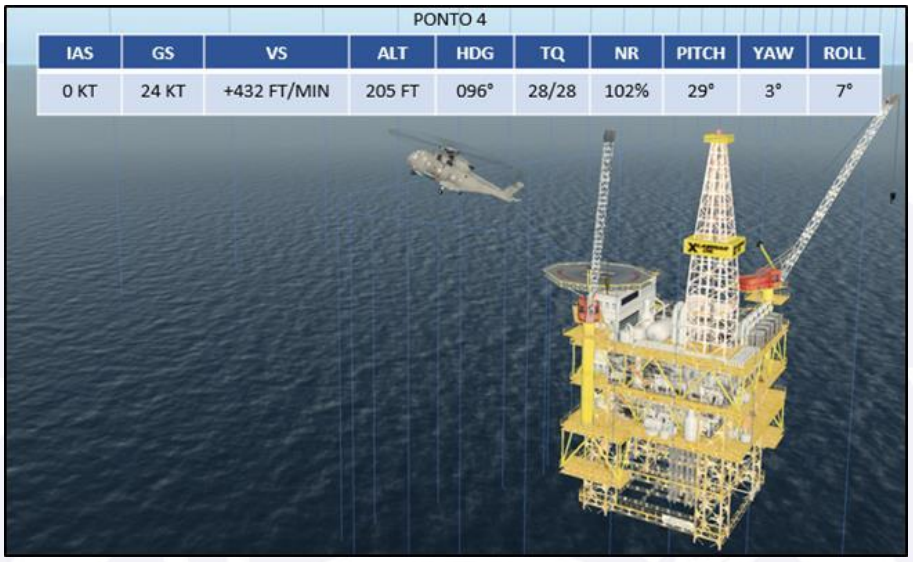


Figure 14 - Point 4 of the final approach flown by the PR-OTF.

From this position of 45° in relation to the helideck, the SOP 08 would recommend that the pilots should act on the collective in a smooth fashion, flying forward, sideways, and downward in the direction of the landing point.

In such a scenario, the SOP 08 advised that the pitch angle could not exceed 10°, and that heading variations should be limited to between 30° and 45° of the heading initially planned for landing. During the landing attempt, the Vertical Speed (VS) reached -4,656 ft./ min, the magnetic heading varied up to 145°, with a Pitch of 24°, yaw angle of 32°, and a roll of 10°.

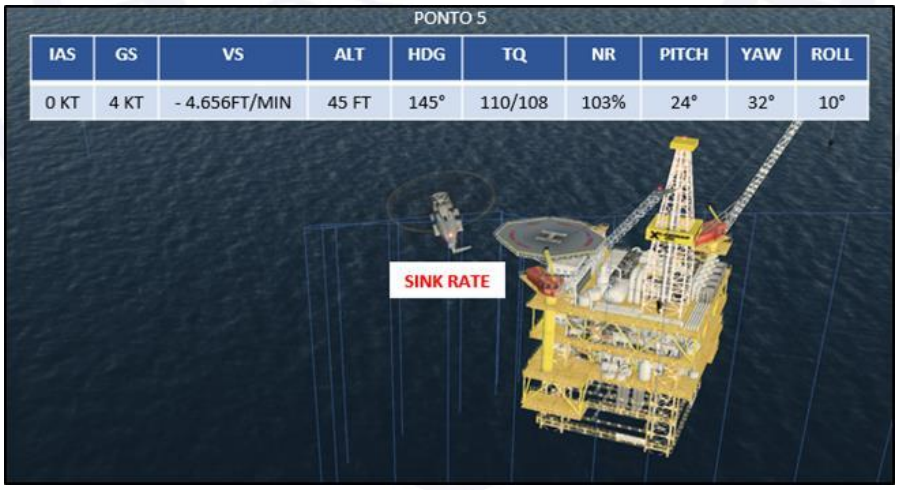


Figure 15 - Point 5 of the PR-OTF's final approach.

1.19. Additional information.

SOP 08 Leonardo AW 139, revision nº 06, dated 14 May 2021, Omni Táxi Aéreo S/A.

5.5.2.4 *Offshore Helideck Landing Procedures*

5.5.2.4.1 *Profile*

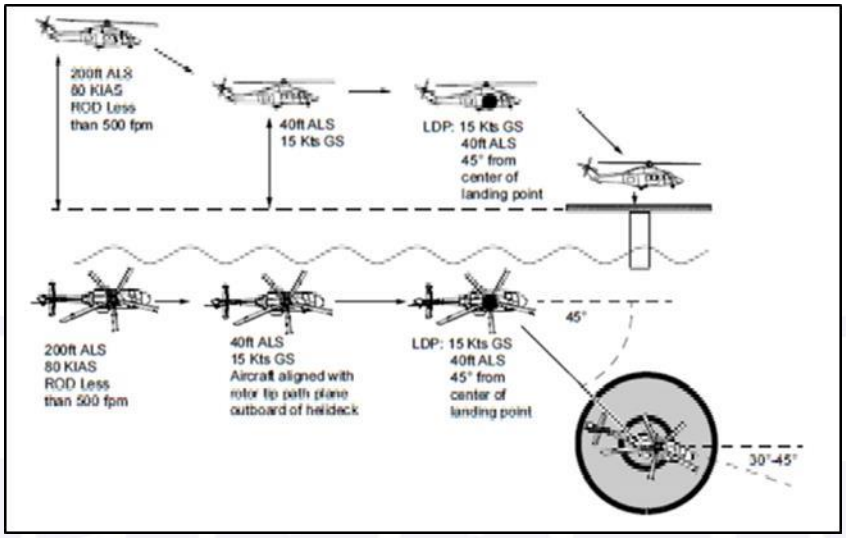


Figure 16 - *Offshore Helideck Landing Profile* - PF in the right-hand seat.
Source: *SOP 08 Leonardo AW 139*, revision nº 06.

5.5.2.4.2 *Procedures*

Landing direction	If possible, orientate the aircraft for an approach into the prevailing wind.
Pre-landing checks	Complete.
AWG switch	NORMAL.
LDG LT and LDG LT2 switches	As required.
Pilot Altimeter	Set QNH (landing surface elevation should be known).
HEATER (if used)	Confirm SOV 1 & 2 switches selected to NORMAL. Select HTR switch to OFF, note ITT decrease and confirm HEATER ON advisory extinguished.
Rotor speed	Set 102%.
PARK BRAKE	Apply, PARK BRAKE ON advisory message illuminated on CAS.
Initial point	Establish an approach to pass through 200ft ALS at 80 KIAS and a rate of descent of no more than 500 fpm.
Approach	Progressively reduce speed and height to achieve LDP at 15kts GS and 40ft ALS and approach into wind with the helideck to the side of the PF. Maintain the rotor tip path plane outboard, but close to the edge of the helideck and the aircraft center line parallel to the edge of the helideck.
LDP	Maintain 15 kts groundspeed and 40 ft ALS level, the LDP is achieved when the aircraft is at an angle of approximately 45° from the center of the landing point.
Landing	From the 45° position fly the aircraft forwards, sideways and downwards towards the landing point, decreasing collective slightly. When descending through 30ft ALS reduce nose up attitude to maximum 10°. Continue to a hover over the helideck.
Touchdown	Over the landing position descend vertically and use collective to cushion touchdown and touch down with 30° to 45° heading offset, if wind speed is less than 10 kts. If wind speed is greater than 10 kts maintain heading with respect to the heading at LDP. Do not exceed 20 kts crosswind. Maximum allowed GS at touchdown 5kts.
PARK BRAKE	.As required.
LDG LT & LDG LT2 switches	OFF, if used.

Figure 17 - Procedures.
Source: adapted from SOP 08 *Leonardo AW 139*, revision nº 06.

Offshore Helicopter Recommended Practices (OHRP) - Report 690

The Report 690 and respective annexes, dealing with recommended practices for offshore helicopters, provided tools to help manage commercial helicopter transport operations in offshore operations safely, effectively, and efficiently. According to the International Association of Oil & Gas Producers (IOGP), the document reflected the industry best practices developed in collaboration between oil and gas companies, aviation industry associations, and helicopter operators. The adoption of such documents was intended to provide support for the effective management of risks to material and personnel safety in offshore aviation.

It is important to point out that these were not requirements established by the aeronautical authorities, but that some of these practices were adopted by companies contracting helicopter operators for offshore operations.

- *IOGP REPORT 690-2 - Aircraft Operations.*

The item 32 *Flight procedures - helicopter stabilized approaches* of the Report 690-2 recommended that the aircraft operator should establish stabilized approach criteria in order to identify deviations, so that a missed approach procedure ca be performed in a preventative fashion.

FLIGHT PROCEDURES

32. Flight procedures – helicopter stabilized approaches

32A. Purpose

Ensuring a safe flightpath with early identification of deviations and timely corrective action.

32B. Expectations

The Aircraft Operator has established and documented stabilized approach procedures

32C. Processes and practices

32C.1 Stabilized approach procedures are documented that define when to conduct a missed approach or abort a landing if deviation criteria for a stabilized approach are not met.

32C.2 The development of these procedures are based on HeliOffshore Flightpath Management Recommended Procedures.

32C.3 Stabilized approach procedures are specific to the aircraft type or use a Type Certificate Holder-issued FCOM when available.

32C.4 Procedures are characterized by defined speeds, climb/descent rate, vertical flight-path and configuration, through a series of defined 'gates' as necessary.

32C.5 Stabilized approach criteria confirm that:

- 32C.5.1 The aircraft is on the correct flight path and only requires small changes in heading, attitude and power to remain on the correct flight path.
- 32C.5.2 The aircraft is in the correct landing configuration and all briefings and checklists have been conducted.
- 32C.5.3 The power setting is appropriate for the aircraft configuration, not below the manufacturer's minimum if specified in the RFM or FCOM, when available.
- 32C.5.4 Flight crew procedures include monitoring of the flight path and the requirement to announce deviations and subsequent actions using specified criteria.

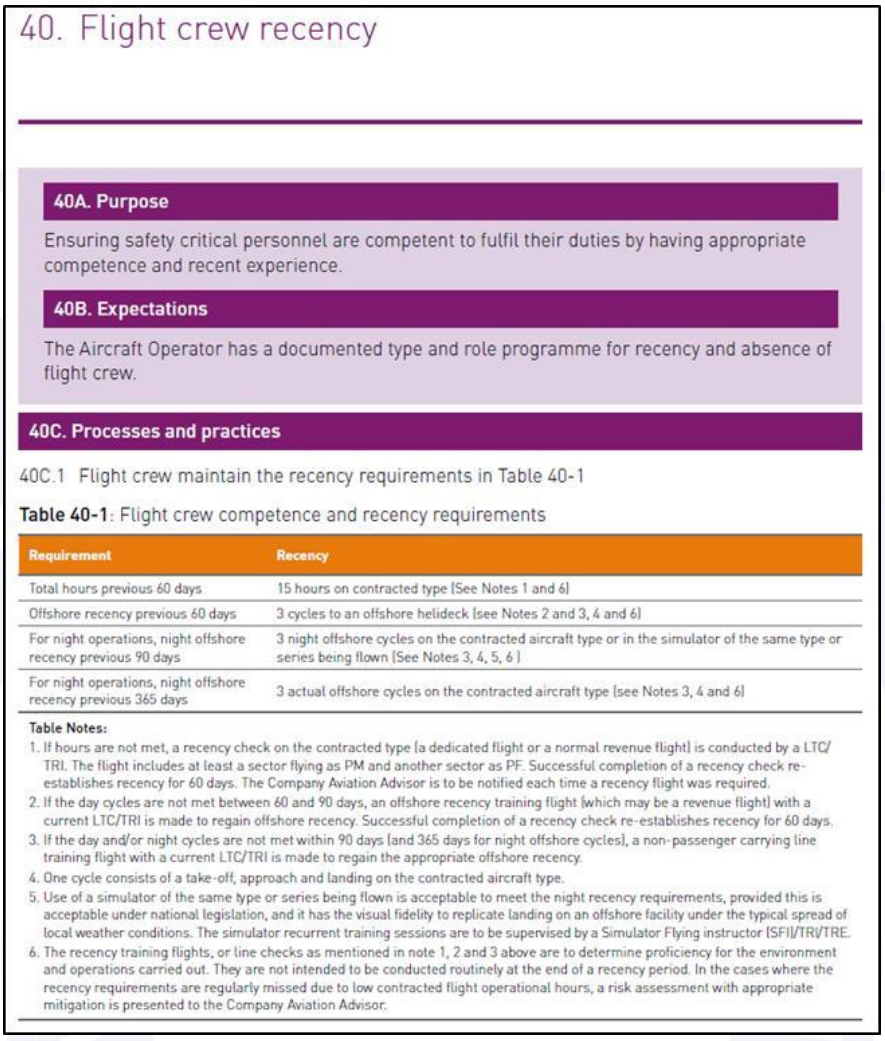
32C.6 All instrument approaches are flown in accordance with the published instrument procedure. Unique approach procedures or abnormal conditions that require a deviation from stabilized approach criteria require a special briefing.

32C.7 Procedures are in place for no-fault, mandatory go-arounds if any approach not be stabilized, and pilots practice all-engine operating (AEO) go-arounds as part of their proficiency training.

32C.8 The aircraft operator uses HFDM and LOSA analysis of stabilized approaches, landings, and departures within its SMS to assist with the identification of specific risks in the conduct of flight procedures.

Figure 18 - *Flight procedures - helicopter stabilized approaches.*
Source: IOGP REPORT 690-2 - *Aircraft Operations*.

The Item 40 - *Flight crew recency* - recommended that pilots, within a 90-day interval, accomplish 3 night-time flight cycles in offshore operations, in the aircraft flown by them or in the simulator of that same helicopter model.



40. Flight crew recency

40A. Purpose

Ensuring safety critical personnel are competent to fulfil their duties by having appropriate competence and recent experience.

40B. Expectations

The Aircraft Operator has a documented type and role programme for recency and absence of flight crew.

40C. Processes and practices

40C.1 Flight crew maintain the recency requirements in Table 40-1

Table 40-1: Flight crew competence and recency requirements

Requirement	Recency
Total hours previous 60 days	15 hours on contracted type (See Notes 1 and 6)
Offshore recency previous 60 days	3 cycles to an offshore helideck (see Notes 2 and 3, 4 and 6)
For night operations, night offshore recency previous 90 days	3 night offshore cycles on the contracted aircraft type or in the simulator of the same type or series being flown (See Notes 3, 4, 5, 6)
For night operations, night offshore recency previous 365 days	3 actual offshore cycles on the contracted aircraft type (see Notes 3, 4 and 6)

Table Notes:

1. If hours are not met, a recency check on the contracted type (a dedicated flight or a normal revenue flight) is conducted by a LTC/TRI. The flight includes at least a sector flying as PM and another sector as PF. Successful completion of a recency check re-establishes recency for 60 days. The Company Aviation Advisor is to be notified each time a recency flight was required.
2. If the day cycles are not met between 60 and 90 days, an offshore recency training flight (which may be a revenue flight) with a current LTC/TRI is made to regain offshore recency. Successful completion of a recency check re-establishes recency for 60 days.
3. If the day and/or night cycles are not met within 90 days (and 365 days for night offshore cycles), a non-passenger carrying line training flight with a current LTC/TRI is made to regain the appropriate offshore recency.
4. One cycle consists of a take-off, approach and landing on the contracted aircraft type.
5. Use of a simulator of the same type or series being flown is acceptable to meet the night recency requirements, provided this is acceptable under national legislation, and it has the visual fidelity to replicate landing on an offshore facility under the typical spread of local weather conditions. The simulator recurrent training sessions are to be supervised by a Simulator Flying instructor (SFII/TRI/TRE.
6. The recency training flights, or line checks as mentioned in note 1, 2 and 3 above are to determine proficiency for the environment and operations carried out. They are not intended to be conducted routinely at the end of a recency period. In the cases where the recency requirements are regularly missed due to low contracted flight operational hours, a risk assessment with appropriate mitigation is presented to the Company Aviation Advisor.

Figure 19 - *Flight crew recency*.
Source: IOGP REPORT 690-2 - *Aircraft Operations*.

Airplane Flying Handbook (FAA-H-8083-3C) - Chapter 11: Night-Time Operations:

- *Black Hole*

In accordance with the handbook issued by *Federal Aviation Administration* (FAA), the phenomenon known as "*Black Hole*" occurs during an approach and landing over the sea or unlit terrain, in which runway lights are the only sources of illumination. Without peripheral visual references to assist, orientation becomes difficult. The landing site may appear out of position (higher or lower) and, in the worst case scenario, may result in a landing short of the runway.

Should an electronic or visual approach slope indicator be available, one should use it. If navigation aids are not available, flight instruments can assist in maintaining controlled flight. Whenever one is not sure of the position of the runway or altitude, one should go around.

Flight over terrain (or sea) where there are only a few lights causes the runway to recede or appear to be further away. In such a condition, the tendency is to fly below the normal approach path.

Maritime Authority Regulation (NORMAM) 27/DPC, 2nd Revision, 4th Modification, dated 2021

The Article 0104 of the NORMAM 27/DPC, 2nd Revision, 4th Modification, dated 2021, contained the following definitions: (emphasis added)

> a) Final Approach and Takeoff Area (AAFD) – it is the area in which the final phase of the approach maneuver for hovering or landing is completed and in which the takeoff maneuver is initiated.
>
> [...]
>
> n) Helideck – it is a helipad located on a fixed or floating structure over water. It is also called an *offshore* helipad.
>
> [...]
>
> z) Obstacle-Free Sector (SLO) – it is a sector of at least 210°, in which the existence of obstacles above 0.25m in relation to the plane of the helideck is not permitted.
>
> aa) Height-Limited Obstacle Sector (SOAL) – it is a sector of 150º, adjacent to the SLO, in which obstacles with height limitations in relation to the helideck level are permitted.
>
> bb) "H" Identification Sign - the letter "H" is the identification sign for a helideck installed on a vessel/offshore platform. The longitudinal alignment with the "H" indicates the trajectory for the aircraft with the greatest separation from the obstacles delimited by the SOAL, for a landing within the limits of the touchdown area, that is, it is the safest approach and should be considered the preferred approach trajectory.
>
> [...]
>
> Notes:
>
> [...]
>
> 3) Whenever the helicopter is not maneuvered entirely within the SLO on its landing trajectory, the risk of collision with obstacles increases significantly.
>
> 4) In an aircraft accident with five fatalities that occurred in Brazil in 2003, the aircraft's tail rotor hit the mast of a vessel because the helicopter was not maneuvered entirely within the SLO during the landing trajectory selected. In 2012 and 2017, two other events involving the tail rotor hitting obstacles outside the SLO and SOAL occurred for the same reason.

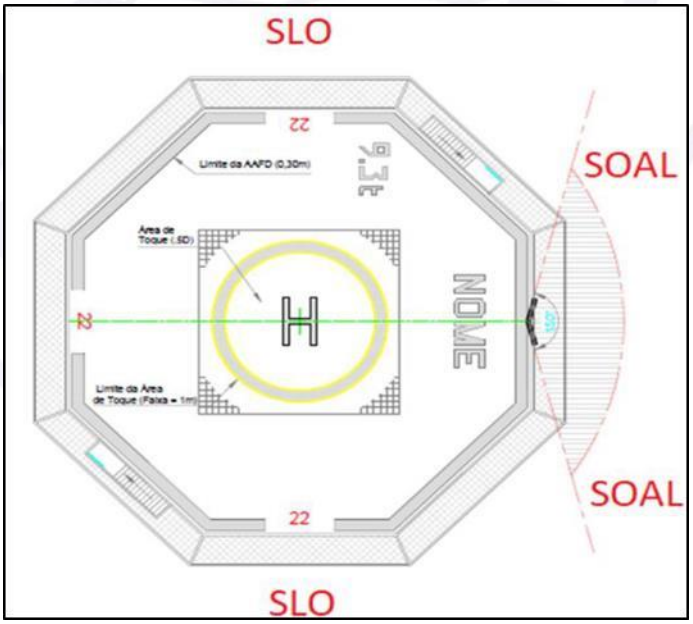


Figure 20 - SLO and SOAL identification.
Source: Adapted from NORMAM 27 Rev.1

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was a training flight for the SIC, with night-time offshore takeoffs and landings on the SS-75 platform, with 03 POB (2 pilots and 1 passenger, who was also a pilot).

The flight was intended to provide the knowledge and experience necessary to ensure that the SIC could safely perform a night-time flight, in order to recover the recent experience requirement established in the RBAC-135.

No evidence was found of failures or malfunctions in the aircraft systems and their components that might have contributed to the occurrence. Similarly, there were no signs of any contribution from the SS-75 infrastructure to the accident.

Due to the delay of the PIC's arrival at SBJR, the start-up of the engines occurred approximately 30 minutes later than expected. Therefore, one cannot rule out that this situation may have contributed to a change of the PIC's emotional state, favoring a condition of stress and anxiety not only on account of physical exhaustion, but also due to the desire to “make up for” the time that had been lost.

This delay also compromised the preparation of the mission, since the PIC, based on the information provided by the contractor and the instructions received by the Chief of Equipment sent by email, delivered the briefing on the way to the aircraft. The said briefing did not cover all aspects relevant to the operation of the aircraft, such as emergency and missed approach procedures.

The passenger, who was also a pilot, did not participate in the briefing.

As for the pilots' experience, it was observed that the operator had no records to confirm that the PIC had carried out any real night-time take-off and landing trainings on a helideck. On the other hand, the SIC, according to an unconfirmed report, had carried out his only real night-time landing training on a maritime platform in 2018.

With regard to qualifications, the PIC had the appropriate valid type and operation ratings, and had successfully completed the approved training program. Although the requirement for recent experience was considered to have been met in a flight performed in a simulator on 05 May 2021, in which night-time landings were simulated, it was not possible to confirm whether he was qualified to perform the type of flight proposed, given that there was no clarity in the ANAC regulations regarding compliance with the respective requirement, since the Aeronautical Authority did not have a settled stance on that matter.

The lack of a specific ANAC regulation on the requirements for recent experience in night-time operations on an offshore platform may have led the operator to conclude that performing landings and takeoffs in a Flight Simulation Training Device (FSTD) at night could replace the experience required for this type of operation.

Relatively to the SIC, he would perform night-time landing training from the platform, being monitored by the PIC/IN.

None of the pilots had experience in offshore operations at night. Likewise, they demonstrated not having the necessary proficiency to perform the mission, without the supervision of an Instructor qualified in the type of flight to which they were assigned.

It is important to highlight that, at the time of the accident, the night-time landing and takeoff training on an offshore platform performed in a simulator would not provide them with the ability to replicate, with the desired verisimilitude, the same conditions of a night-time flight in a real situation.

On account of the difficulties encountered by the operator in scheduling flights with the contracting company, this type of training was discontinued, resulting in a hiatus of approximately 2 years in the accomplishment of this type of operation.

In addition, although the DECEA's ICA 100-4 established that night-time training missions on helipads located on offshore platforms should follow the ANAC's provisions on the subject, a gap was found in the Regulatory Agency's legislation regarding the accomplishment of this type of mission.

The training in question should have been monitored by an Instructor with a higher frequency in this type of operation. However, since the planned flight was postponed and the instructor initially designated for the mission was not available to be re-scheduled, the crew in question was summoned and notified the day before.

By allocating inexperienced crew members for this type of mission and without the presence of an Instructor with prior training in real night-time landings, the operator failed to identify the dangers and did not carefully assess the risks involved in a flight of this nature, for which the pilots were not properly prepared. This revealed inadequate planning by the operator regarding the allocation of human resources for the conduction of the aerial activity.

In such circumstances, the collision with obstacles on the platform was considered an undesirable risk, with high degrees of probability and severity, despite the favorable weather conditions for the flight.

At the same time, there were indications that issues of physiological nature affected the performance of the crew members, since, according to the Technical Report from the IMAE, in night-time flights, if the pilot does not have visual references with the ground, it is possible that the line of the horizon will not be perceived, making it difficult to maintain a stable flight.

In turn, the approach axis selected by the crew also contributed to further increasing the difficulty to maintain visual references, since, from the moment the helicopter passed by the crane located to the right of the chosen trajectory, the darkness of the sea occupied the majority of the PIC's field of vision, causing the helicopter's heading to change.

Also according to the Technical Report, in night-time flights over offshore platforms, the pilot has few external references for self-orientation, and needs to be prepared to identify the phenomena of sensory illusions and the possibility of spatial disorientation.

Visual illusions are especially dangerous because pilots rely on their eyes to obtain the desired information. Darkness or low visibility increase the pilot's susceptibility to error. For terrestrial conditions, in general, this visual system is reliable, but in the conditions specific to flights without external visual references, this guidance system is inadequate, forcing the pilot to use the flight instruments.

With regard to the flight dynamic, the transcriptions of the cockpit voice recorder audios confirmed the information that the checklist and QRH were not found. The absence of these publications may have caused a reduction in the pilots' attention, which generated lapses associated with automatic processes, since they failed to perform the *Approach Briefing*, a standard procedure that should have been undertaken before the descent (*Before-Descent Checks*).

In flight, after identifying the maritime unit, the PR-OTF joined the traffic pattern by the right and entered the final leg at the stern of the platform, proceeding on an approximate heading of 056°, that is, heading upwind, but with a left component, since the wind direction, according to the METAR of the area, was 040°.

The PIC chose this approach axis, mainly due to the wind direction. This profile, however, compromised the maintenance of visual references in the transition from the LDP to the landing site on the helideck.

The trajectory was selected without consideration of other factors, such as the longitudinal alignment with the “H” of the helideck. From this perspective, the aircraft would maintain greater separation from the obstacles delimited by the SOAL, something that would be more advisable for night-time flights. Whenever, on its landing trajectory, the helicopter is not maneuvered entirely within the Obstacle-Free Sector, the risk of collision with obstacles increases significantly.

Thus, upon analysis of the final moments of the flight, it was found that the approach proceeded normally up to an altitude of 200 ft., as can be seen at Point 2 in Figure 12.

However, when the PR-OTF was at Point 3 (Figure 13), it descended to an altitude of 80 ft., that is, below the height of the SS-75, indicating that the approach ramp was not stabilized. In that condition, the helicopter maintained a magnetic heading of 060°, at an indicated speed of 37 kt. and a rate of descent of 25 ft. /min. On the occasion, the aural alert of “*150 ft.*” was also emitted, followed by “*Check Height*”. Despite these alerts, no assertive action was taken to start a missed approach procedure.

That being said, the phenomenon known as “*Black Hole*” may have occurred in this segment of the flight over the sea, since the platform lights were the only available light sources. Without peripheral visual references to help, orientation became more difficult, leading to the tendency to fly below the recommended profile for a normal approach.

Therefore, considering the concept of a stabilized approach, in which the final descent for landing should be performed in accordance with the intended flight path and without the need for excessive maneuvers, it can be inferred that a go-around would be the recommended procedure in that condition, given the destabilization experienced by the helicopter.

It is noteworthy that no proactive action was observed on the part of the PM to alert the PF of the need to perform a go-around, given the aircraft profile outside the parameters required for a stabilized approach.

Notwithstanding the fact that the item 32 *Flight procedures - helicopter stabilized approaches* of the IOGP Report 690-2 recommends that the aircraft operator should establish stabilized approach criteria to identify deviations, in order to start a missed approach procedure in a preventative fashion, the SOP 08 *Leonardo AW 139*, revision nº 06, dated 14 May 2021, in force at the time of the event, did not have a clear definition with well-defined criteria for a stabilized approach.

Despite several indications of an inappropriate trajectory, the PR-OTF continued the approach and, at Point 4, it maintained an indicated speed of 0 kt., with a rate of climb of 432 ft. /min, and an altitude of 205 ft. At that moment, there was a change in heading to 096°, with the helicopter being subjected to a tailwind component, since the GS (Ground Speed) was 24 kt.

In this respect, the topic 5.5.2.4 - *Offshore Helideck Landing Procedures*, item 5.5.2.4.2 - *Procedures*, of the SOP 08 *Leonardo AW 139*, revision nº 06, prescribed that, in the LDP, the helicopter should maintain a ground speed of 15 kt.

At that point, in addition to being in disagreement with the normal parameters prescribed for a successful landing, the PR-OTF featured a *Pitch* of 29°, suggesting the presence of a possible disorientation. In this scenario, during the landing attempt (Point 5), the VS reached -4,656 ft. /min, the magnetic heading varied up to 145°, with a Pitch of 24°, a yaw of 32°, and a banking (Roll) of 10°.

Had the provisions of the SOP 08 been observed, the pitch angle would not have exceeded 10°, and the heading variations would have been limited to between 30° and 45° of the heading initially planned for landing. In the case at hand, in the final segment of the

approach and landing procedure, the pitch varied between 056° and 145°, that is, approximately 90°.

Therefore, in this condition of loss of control, the PR-OTF entered the final trajectory towards the helideck. In such a scenario, there still was an overdue and ineffective attempt to go around. Yet, the PR-OTF turned to the right, and the main rotor blades collided first against the riser crane operator's cabin and, then, against the service structure located on the right. Subsequently, the main rotor collided with the structures of the offshore platform.

3. CONCLUSIONS.

3.1. Findings.

a) the pilots held valid CMAs (Aeronautical Medical Certificates);

b) the pilots held valid ratings for A139 aircraft type and IFRH (IFR Flight – Helicopter);

c) it was not possible to confirm whether the PIC was qualified;

d) the SIC was under training for acquisition of recent experience;

e) the PIC and SIC had done simulator training on 05 May 2021 and 01 February 2021, respectively;

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

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

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

i) one found no evidence of failures or malfunctions in the aircraft systems and their components;

j) the weather conditions were consistent with the type of flight;

k) the operator had difficulty scheduling night-time flights with the contractor due to the unavailability of platforms to accommodate this type of mission;

l) the mission was carried out without the presence of an instructor qualified in night-time operations on offshore platforms;

m) there was a takeoff delay;

n) neither the checklist nor the QRH was found in the helicopter by the crew before the flight;

o) the mission briefing was held on the way to the aircraft, without covering all aspects relevant to the aircraft operation;

p) during the flight, the Approach Briefing was not held; the said briefing was a standard procedure that should have been undertaken before descent (*Before Descent Checks*);

q) on the final approach, the PR-OTF descended to a height of 80 ft., that is, below the height of the SS-75;

r) the PR-OTF did not follow the approach and landing profile recommended in the *Omni Táxi Aéreo S/A*'s SOP 08 Leonardo AW 139, revision nº 06, dated 14 May 2021;

s) in the attempt to go around, the PR-OTF turned to the right, and the main rotor blades collided with the platform structure;

t) the PIC and the passenger were not injured. The SIC and a maritime unit's employee, who was on the helideck, suffered serious injuries; and

u) the aircraft sustained substantial damage.

3.2. Contributing factors.

Attention – a contributor.

On the final trajectory towards the maritime unit, the focusing of the pilot's attention on the approach course compromised his personal alert system, reducing his ability to respond effectively and accurately to the pieces of evidence that the helicopter was experiencing an unstabilized approach.

With regard to the flight dynamic, the absence of both the checklist and the QRH may have led to a decrease of the pilots' attention, which led to lapses associated with automatic processes, since they failed to perform the *Approach Briefing*, a standardized procedure that should have been undertaken before the descent (*Before Descent Checks*).

Attitude – a contributor.

On the final approach for landing, even with the "*150 ft.*" and "*Check Height*" alerts being issued, indicating that the aircraft was below the height of the platform (80 ft.), no corrective action was taken toward initiating a missed approach.

The crew decided to take off even though they had not found either the QRH or the checklist on board the helicopter.

Training – a contributor.

With regard to the training flights, it was found that the operator had difficulty scheduling night-time flights with the contracting company due to the unavailability of platforms accommodating this type of mission.

In the years prior to the accident, the contracting company had suspended or postponed this type of training, which resulted in a period of approximately 2 years without this type of operation, revealing the inefficiency of the systematized processes aimed at improving the operational skills of the pilots.

In addition, the training carried out in the flight simulator proved to be insufficient to provide adequate performance and efficiency in the context of this type of operation.

Crew Resource Management – a contributor.

During the whole landing circuit, no assertive action was observed on the part of the PM to alert the PF on the need to perform a go-around in the air, given the evidence observed in the context of an unstabilized approach.

Disorientation – undetermined.

On various occasions during the final approach trajectory, the aircraft showed excessive variations in attitude and speed, reaching a pitch of 29° with an IAS of 0 kt, in the transition to landing on the helideck, which suggests the occurrence of disorientation.

Emotional state – undetermined.

One cannot rule out that the circumstances leading to the takeoff delay may have contributed to changes in the PIC's emotional state, resulting in a state of stress and anxiety not only due to physical exhaustion, but also due to the desire to make up for the lost time.

Handling of aircraft flight controls – a contributor.

The aircraft entered the helideck area in an unstable condition and at a height higher than expected and, in the transition to hovering flight, loss of control of the helicopter occurred, after wide variations in height, heading, and power.

Illusions – undetermined.

There is the possibility that on the final approach over the sea, the phenomenon known as "*Black Hole*" occurred, since the platform lights were the only light sources available. Without peripheral visual references to help, orientation became more difficult, causing the tendency to fly below the recommended profile for a normal approach to be materialize with the helicopter reaching 80 ft. in the vicinity of the platform.

Piloting judgment – a contributor.

The selected approach axis compromised the maintenance of visual references in the transition from the LDP to the landing spot on the helideck.

Likewise, there was a delay in the decision to go around, since the decision was made after the LDP.

- Motivation – undetermined.

The crew's commitment to accomplishing the mission, despite the obstacles observed before and during the flight, such as the absence of an instructor qualified in night-time operations on platforms, the takeoff delay, the lack of a checklist and lack of a QRH, the unstabilized approach, in addition to the fact that the PIC was seen as a reference by the other pilots, may have increased the crew's motivation, to the point of contributing to inadequate operational performance.

Perception – undetermined.

The PIC may have endured an impairment of his ability to recognize external sensations arising from the night-time operation over the sea, a condition that led him to a possible disorientation and visual illusion.

Flight planning – undetermined.

Given that the mission briefing was held on the way to the helicopter, without covering all the aspects relevant to the operation of the aircraft, such as emergency and go-around procedures, one inferred that there was inadequacy in the preparatory procedures of the flight.

Management planning – a contributor.

There was inadequacy on the part of the operator's planning in relation to the allocation of human resources for the development of the air activity in question, given that an inexperienced crew was assigned to this type of mission without the presence of an instructor with prior training in real night-time landing on a maritime platform.

Insufficient pilot's experience – a contributor.

The pilots did not have the necessary experience to operate a helicopter without the supervision of a qualified instructor, in the circumstances experienced during the night-time operation in a maritime unit.

Decision-making process – a contributor.

The crew had difficulty perceiving, analyzing, and acting appropriately in relation to the risks involved in landing at night on the platform, even after having experienced an unstable condition during the final trajectory. These difficulties led them to make an inadequate judgment about continuing the approach for landing on the maritime unit.

Support systems – undetermined.

The lack of a clear definition, including well-defined criteria for a stabilized approach, in the SOP 08 *Leonardo AW 139*, revision no. 06, dated MAY 14, 2021, in force at the time of the event, may also have contributed to the difficulty presented by the pilots in recognizing the condition of instability experienced during the final trajectory.

The absence of a specific ANAC's regulation on the requirements for recent experience of night-time operations on offshore platforms may have led the operator to conclude that performing landings and takeoffs in FSTDs could replace the experience required for this type of operation.

Although the DECEA's ICA 100-4 prescribed that night-time training missions on helipads located on offshore platforms should follow the ANAC's provisions on the subject, a gap was found in the Regulatory Agency's legislation regarding the conduction of this type of mission.

4. SAFETY RECOMMENDATIONS

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident.

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

To Brazil's National Civil Aviation Agency (ANAC), it is recommended:

A-078/CENIPA/2021 - 01 Issued on 09/17/2024

Analyze, in coordination with the DECEA (Department of Airspace Control), the feasibility of including, in its regulations or specific norms, guidelines for the necessary training prescribed in the ICA 100-04 for offshore night-time operations on maritime platforms.

A-078/CENIPA/2021 - 02 Issued on 09/17/2024

Analyze the relevance of establishing specific requirements for the acquisition and maintenance of recent experience in helicopters performing offshore night-time operations.

A-078/CENIPA/2021 - 03 Issued on 09/17/2024

Disseminate the lessons learned in this investigation to companies carrying out night-time aeromedical operations on offshore platforms, so that their training programs meet the necessary requirements and guidelines to allow safe accomplishment of the activity.

To the Department of Airspace Control (DECEA), it is recommended:

A-078/CENIPA/2021 - 04 Issued on 09/17/2024

Refine the coordination mechanisms with the ANAC, in order to avoid non-compliance with specific rules and procedures established in its normative instructions, such as the one found in ICA 100-4, which is the subject of analysis in this report.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

After the accident, the operator conducted internal studies, and issued the SOP 43 - "*Offshore Night-time Flight*", with the purpose of providing pilots with more details on night-time operations and establishing shorter intervals for training flights.

An agreement was established between the offshore operators that have contracts with the contracting company, so that the training process for night-time flights is made regular and effective.

On 23 March 2022, the ANAC published the *Supplementary Instruction* n° 135-005, Revision A, establishing procedures for Aeromedical Operations conducted by Air Operators under the RBAC-135.

On September 17th, 2024.