INSTITUTO DE PREVENÇÃO E INVESTIGAÇÃO
DE ACIDENTES AERONÁUTICOS E MARÍTIMOS

Investigation into Marine Accident
Final Report

Occurrence

Marine Accident

[N. 02/ACCID-M/IPIAAM/2020]

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FOREWORD

The Institute for the Prevention and Investigation of Aeronautical and Maritime Accidents (IPIAAM) is the Cabo Verdean authority responsible for the investigation of accidents, incidents, and other occurrences related to the safety of civil aviation and maritime transport, aiming to identify their causes as well as elaborate and disseminate reports of such casualties.

IPIAAM operates independently of the authorities responsible for safety, of any regulatory body for civil aviation and maritime transport, and of any other party, whose interests may conflict with the tasks entrusted to it.

Safety investigation is a process conducted for the sole purpose of preventing the occurrence of accidents, which includes the gathering and analysis of information, identification of the causes, and the issuance of safety recommendations, when appropriate.

In accordance with the IMO Resolution MSC 255 (84) and article 2 of the Decree-law no. 62/2018 of 12 December, which created the IPIAAM and its statutes, the investigation and corresponding report do not seek to apportion blame or determine liability.

PRELIMINARY REPORT ON THE INVESTIGATION OF THE ACCIDENT WITH M/V “DEIMOS”, IN THE PORT OF VALE DE CAVALEIROS, FOGO, ON NOVEMBER 13, 2020

IMPORTANT NOTE:

THE SOLE PURPOSE OF THE INVESTIGATION OF ANY ACCIDENT CONDUCTED BASED ON RESOLUTION MSC.255 (84) – INTERNATIONAL STANDARDS AND RECOMMENDED PRACTICES FOR A SAFETY INVESTIGATION INTO A MARINE CASUALTY OR MARINE INCIDENT (CASUALTY INVESTIGATION CODE) – IS TO PREVENT CASUALTIES IN THE FUTURE BY DETERMINING THEIR CAUSES AND CIRCUMSTANCES.

CONTENT

ABBREVIATIONS

AIS	:	Automatic Identification System
BB	:	Port
EB	:	Starboard
ENACOL	:	National Fuel Company
ENAPOR	:	National Company for Port Administration
ILO	:	International Labor Organization
IMO	:	International Maritime Organization
IMP	:	Maritime Port Institute
INMG	:	National Institute of Meteorology and Geophysics
IOPP	:	International Oil Pollution Prevention Certificate
IPIAAM	:	Institute for the Prevention and Investigation of Aeronautical and Maritime Accidents
MPP	:	Main Engine
PM	:	Maritime Police
SOLAS	:	International Convention for the Safety of Life at Sea
STCW	:	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
VDR	:	Voyage Data Recorder
VHF	:	Very High Frequency
VIVO ENERGY	:	Cabo Verde Vivo Energy

1. INTRODUCTION

The IPIAAM, within the scope of its statutory powers, determined the investigation of the circumstances and causes in which an accident with the general cargo M/V “DEIMOS” (IMO: 8500898) occurred. Sailing under the flag of Panama and owned by the company “Arabella Enterprise Corp.”, the accident took place during the departure from the Port of Vale de Cavaleiros, Fogo, Republic of Cabo Verde. Such investigation states the conclusions and recommendations to different stakeholders intending to prevent and avoid similar accidents from occurring in the future.

In the current case, in accordance to the article 94 of the United Nations Convention on the Law of the Sea as well as other conventions of IMO and ILO, to which both countries are signatories, Cabo Verde, as the Port State, and Panama, as the Flag State, shall cooperate in the investigation of serious marine casualties and incidents, aiming to investigate the causes thereof and issue safety recommendations as well as take all measures to ensure the vessel’s safety at sea.

Considering the powers and duties of IPIAAM, as the national authority in charge of the investigation of accidents and incidents that occur in areas under the responsibility of Cabo Verde, in the sectors of civil aviation and merchant ship, the Board of Directors of IPIAAM determined the establishment of an investigation team, with necessary powers to initiate the investigation of the occurrences.

This report incorporates and was built on the Accident Investigation Code, under the IMO Resolution MSC.255 (84), a fundamental instrument for the investigation of marine accidents/incidents, which was adopted in the aforementioned investigation.

This report is technical and contains facts obtained from the interviews set up during the investigation period of those directly or indirectly involved in the accident, the entities with responsibilities in matters of maritime administration, port operations, technical and commercial management, as well as the principal members of the crew. The information provided is confidential and cannot be used in any other way than as laid down in the aforementioned Resolution of IMO, *i.e.,* to prevent accidents and/or similar incidents from occurring, or at least to reduce the risk, rather than seek to apportion blame or determine liability.

The use of this report for reasons other than those above-mentioned may be misleading and have adverse effects on the prevention of marine accidents.

The content of this report, which all interested parties must be aware of, is in accordance with both the information collected and the interviews carried out.

2. SUMMARY

On November 13, 2020, the 3088 gross tonnage M/V “DEIMOS”, IMO: 8500898, owned by the company “Arabella Enterprise Corp.”, sailing under the flag of Panama, was dragged away while leaving the Port of Vale de Cavaleiros, Fogo, Republic of Cabo Verde, under the effect of the weather conditions, as a result of the loss of power and the shutdown of her main engine, at 7:38 am. She ran aground, in the far west, at 8:17 am, after successive collisions of the hull with the bottom of the sea.

Before she ran aground, taking into account the inexistence or unavailability of a tugboat in the Port, in response to the distress call of the master of M/V “DEIMOS”, M/V “DJON DADE”, which was waiting to enter and moor at the Port, attempted to tow the vessel. However, those attempts were proved fruitless, taking into consideration the fact that M/V “DJON DADE” lacks the power and the versatility of a tugboat and due to the excessive weight of the cargo that was still on M/V “DEIMOS”.

Considering the unsuccessful attempts at towing the vessel and its consequent grounding, and given the potential hazard of the hull damage due to its collision with the bottom of the sea, the master of M/V “DEIMOS” decided to abandon the vessel, which got grounded inside the Port of Vale de Cavaleiros area.

On the same day of the grounding, at 9:20 am the entire crew had already been rescued and on land, without injuries.

There was no record of pollution by hydrocarbons.

Despite the experience and the adequate STCW certificates of the staff assigned to the engine room of M/V “DEIMOS”, it was not possible to diagnose the true cause of the main engine shutdown.

From November 20 to 26, 2020, under the coordination of the IMP, the fuels of M/V “DEIMOS” were transferred to different onshore reservoirs.

On December 3, 2020, Allianz Compañia de Seguros y Reaseguros SA, headquartered in Madrid, addressed a note to the Maritime Authorities of Cabo Verde, in which it claimed the constructive total loss of M/V “DEIMOS”, renounced the ownership of the vessel remains, denied any liability for her salvage, and attributed the responsibility for her removal to P&I Club.

The circumstances in which the accident occurred reveal a possible need to develop safety procedures, focusing on operations such as entry, mooring, unmooring, and departure from ports, as well as anchoring operations in the different port basins of Cabo Verde, using for this purpose simulators available at ISECMAR.

Specific recommendations were addressed to the maritime administration (IMP), port administration (ENAPOR), shipowner, and shipping companies aiming to:

1) improve awareness on the importance of the procedures for vessels of above 2000 gross tonnage, regarding thorough testing on their main propulsion systems before the maneuvers, due to the probability of propulsion failures and consequent risks of collision/allision, grounding, and maritime environment pollution;

2) assess the risks associated with mooring and unmooring maneuvers at the Port of Vale de Cavaleiros for vessels of above 2000 gross tonnage and evaluate the need to provide towing services during those maneuvers.

Furthermore, the investigation team set up to investigate this serious accident presents several scenarios based on similar vessels available in the simulators, in order to obtain practical information that allows a consistent presentation of recommendations for procedures that can contribute to substantially minimize the possibility of occurrence of such accidents, in the surroundings of the Port of Vale de Cavaleiros.

3. FACTUAL INFORMATION

As it was not possible to retrieve information from the VDR, the factual information was derived from: interviews with the vessel's crew and representatives of the shipping company; technical investigations on board; the engine room logbook; the bridge logbook; documents obtained from IMP, ENAPOR, and Panama Maritime Authority; visits carried out, *in loco;* as well as data from Marine Traffic.

Note: The times referred to in this report correspond to the local time zone.

3.1. VESSEL AND ACCIDENT DETAILS

3.1.1 VESSEL DETAILS

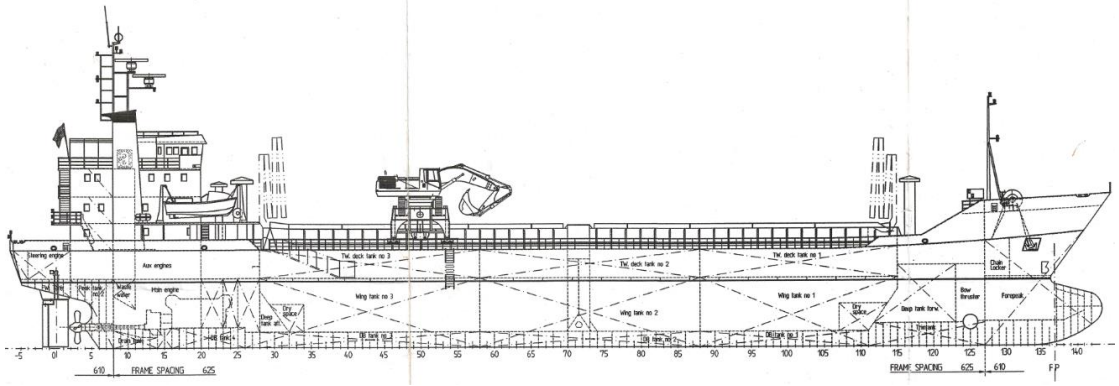


Figure 1: M/V DEIMOS *Photo: Panama Maritime Authority Archives*

NAME	:	DEIMOS
FORMER NAME	:	AASVIK
IMO NUMBER	:	8500898
CALL SIGN	:	3EOQ6
CLASSIFICATION SOCIETY	:	RINA
PREVIOUS CLASSIFICATION SOCIETY	:	RINA
PORT OF REGISTRATION	:	PANAMA
FLAG	:	PANAMA
PREVIOUS FLAG	:	GIBRALTAR
TYPE	:	GENERAL CARGO
YEAR OF CONSTRUCTION/REBUILDING	:	1986/2000
BUILDING LOCATION	:	Svendborg Skibsvaerft A/S - Svendborg, Denmark
MATERIAL	:	Steel
GROSS/NET TONNAGE	:	3088/1326
LENGTH OVERALL	:	94,40 m
LENGTH BETWEEN PERPENDICULARS	:	85,21 m
DEPTH	:	8,30 m
WIDTH	:	15,40 m
MAIN ENGINE	:	MAK 6M453B / 1800 kW / 600 RPM
AUXILIARY ENGINE	:	2 x CUMMINS KTA 1150G2/ 385 kW / 1500 RPM
PROPELLER	:	Variable Pitch Propeller
OWNER	:	Arabella Enterprises Corp.
SHIPOWNER	:	Arabella Enterprises Corp.
HULL AND MACHINERY INSURANCE	:	Allianz SA
PROTECTION AND INDEMNITY (P&I) INSURANCE	:	British Marine

3.1.2 PARTICULARITIES OF THE ACCIDENT

TYPE OF ACCIDENT	:	GROUNDING
DATE / TIME	:	November 13, 2020; 08:17 AM
LOCAL	:	Vale de Cavaleiros, Fogo, Cabo Verde
POSITION (LATITUDE/LONGITUDE)	:	N14º55´02.22 (14.9173) / W024º30´05.61 (-024.5016)
PERSONNEL INJURY	:	NONE
DAMAGE TO VESSEL	:	HULL AND PROPELLER DAMAGE - constructive total loss
DAMAGE TO THE ENVIRONMENT	:	NONE

3.2 TRIP DETAILS

ROUTE			:	Port of Vale de Cavaleiros (Fogo) / Port of Tarrafal (São Nicolau)
TYPE OF TRIP			:	International – Interisland
VESSEL DRAFT			:	4.3 m (amidships), 3.6 m (afore) and 5.0 m (aft),
CARGO (BILGE/DECK)			:	Cement and roof tiles / 1356.6 T of Iron
PERSONNEL ON BOARD			:	11 (10 crew members + pilot)

3.3 NARRATIVE OF THE EVENTS

On November 11, at 7:30 am, M/V "DEIMOS" moored at Port of Vale de Cavaleiros, Fogo. She arrived from Port of Sal-Rei, Boa Vista, and was scheduled to depart to the Port of Tarrafal, São Nicolau, on November 12, at 4 pm.

On November 12, at 11:30 am, the pilot arrived at Port of Vale de Cavaleiros, for the unmooring and departing maneuvers. However, when he learned there was a delay due to the unloading and that the master postponed the departure for the next day at 7:30 am, he decided to remain on board overnight. The following day, they would continue the journey to the Port of Tarrafal, São Nicolau, where the pilot would monitor the entering and mooring as well as the unloading and unmooring maneuvers of the vessel.

On November 13, at 6:45 am, the pilot was already at the bridge.

At 6:55 am, the vessel's main engine was started and at 07:25 am, the engine room transferred the command to the bridge, where the master, the pilot, and the first officer were, and the unmooring maneuver commenced normally.

At 7:30 am, the vessel unmoors parallel to the pier, as usual (leave bow first, turn starboard, control the stern movements towards the pier, and depart), considering that she usually moors port side at pier no. 3.

According to the normal procedure, the headlines are cast off and then the vessel is turned starboard, at an angle of approximately 45 degrees to the pier, using the bow thruster, until she is positioned to exit the port.

It should be noted that the vessel has a variable pitch propeller, thus, after the starting of the main engine and the stabilization of the operating parameters, the gearbox and the propeller shaft are coupled to it. After that, the command is transferred to the bridge.

The vessel's maneuver proceeded normally and she was moving ahead at a very slow speed towards the exit of the port area when around 7:35 am, the main engine began to gradually reduce rotation (DEIMOS-P1, Fig. 2), which caused its shutdown at 7:38 am

(DEIMOS-P2, Fig. 2) when the vessel was almost leaving the port area and with the tip of the breakwater on the starboard side.

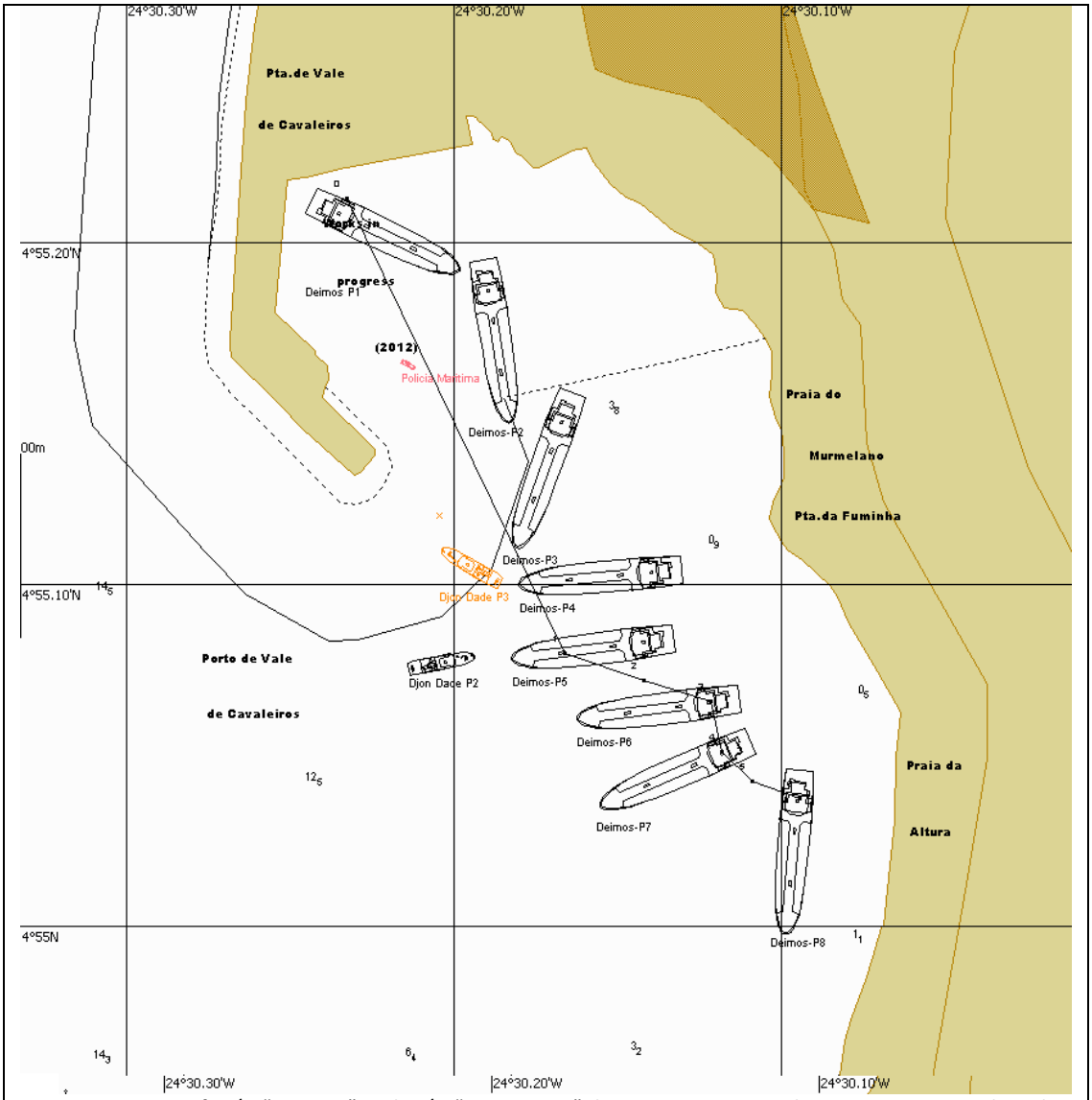


Figure 2: Position of M/V "DEIMOS" and M/V "DJON DADE" during unmooring and towing maneuvers, based on AIS (Deimos-P1, Deimos-P5, Deimos-P6, Deimos-P7, Deimos-P8, Djon Dade-P2 and Djon Dade-P3) and other simulated intermediate positions (Deimos-P2, Deimos-P3 and Deimos-P5).

Source: Navigation Simulator

At that time, the master, concerned about the safety of the vessel and the crew, ordered the starboard anchor to be dropped. However, as the vessel was still moving forward due to the inertia, the pilot and the master decided to not drop the anchor in that position (DEIMOS-P2, Fig. 2), in order to prevent the stern to go ashore or to the entrance of the pier, and then try to reach a safer position to anchor.

At 7:39 am, the vessel continued to move forward due to the inertia, but drifting dangerously towards the shore, thus, the person in charge of the dock was contacted via VHF, told about the existing situation, and requested to call the maritime police, as well as all available means to rescue the vessel.

At 07:40 am, the starboard anchor was dropped (DEIMOS-P3, Fig. 2), due to the little space and to the fact that the vessel continued drifting towards the shore, under the effect of the weather conditions.

At the same time, as the master of M/V “DEIMOS” learned that M/V “DJON DADE” was waiting to moor, he asked the pilot to request her assistance, to which M/V “DJON DADE” responded positively.

At 7:55 am, the maritime police managed to take a towing cable from M/V “DEIMOS” (DEIMOS-P3, Fig. 2), which was still moving under the effect of weather conditions, and delivered it to M/V “DJON DADE” (DJON DADE-P2, Fig. 2), which started the towing operation around 8:00 am, trying to pull M/V “DEIMOS” to a safe place to anchor.

However, given that M/V "DJON DADE" lacks the power and the versatility of a tugboat, and due to the unfavorable weather conditions and the little space existing between her bow and the tip of the breakwater, she was not able to circumvent the tip safely, in order to tow M/V “DEIMOS” to a safe area. At 8:15 am, the master of M/V “DJON DADE” (DJON DADE-P3, Fig. 2) informed the pilot on M/V “DEIMOS” (DEIMOS-P4, Fig. 2) that he was going to suspend the towing operation to better position the vessel, in order to proceed the towing operation in safer conditions.

While M/V “DJON DADE” was being repositioned, M/V “DEIMOS” was dragged away to the hills and ran aground by around 8:17 am, after which the vessel touched the bottom of the sea for the first time, just as she was in a perpendicular position to the beach Praia da Altura. The vessel hit the bottom several times. Water started entering the engine room bilge, on the stern.

Figure 3: M/V “DEIMOS” and M/V “DJON DADE” after the grounding.
Source: Maritime Authority Archives (Panama)

Due to the unsuccessful attempts of M/V “DJON DADE” to rescue the vessel, and considering the potential hazard of damaging the hull and the collision with the bottom of the sea, the master of M/V “DEIMOS” decided to abandon the vessel, which got grounded in the interior area of the Port of Vale de Cavaleiros, Fogo.

At 9:20 am, all the crew members were rescued and put ashore without injuries.

3.4 MASTER STATEMENT

- At 7:30 am (LT) on November 13, M/V “DEIMOS” began the unmooring operation, at the Port of Vale de Cavaleiros, Fogo, where she had been moored since November 11;
- At 7:35 am (LT), it was noticed that the main engine started to reduce rotation, by itself;
- At 7:38 am(LT), the main engine completely stopped;
- At 7:39 am(LT), the starboard anchor was dropped, but, due to the high waves pushing the vessel towards the shore, the mooring operation was unsuccessful;
- At 7:41 am (LT), they tried to throw a tow cable to the other vessel, “DJON DADE”, but that was not possible because of the heavy seas;
- At 7:42 am (LT) the collisions in the vessel's steering area (rudder, propeller) is noticed;
- At 7:45 am (LT), water is seen to be entering the engine room bilge, on the stern. Considering the potential hazard of the hull damage, its collision with the bottom of the sea, and the probable loss of the vessel, it was decided for the abandonment of the vessel.

3.5 SEQUENCE AND SCHEDULE OF THE EVENTS

Considering the exhaustive "Narrative of Events", which was necessary so all the details described by those who were involved could be included, it is now presented the sequential schedule of the events determined by the investigation:

- 6:45 am — Pilot on the bridge;
- 7:22 am — Starting of the maneuvers;
- 7:30 am — Vessel unmoors parallel to the pier;
- 7:31 am — Bow turned starboard, while the vessel’s stern movement is being controlled;
- 7:34 am — Vessel moving forward at a very slow speed towards the exit of the port area;
- 7:35 am — It is noticed the main engine reduced rotation;
- 7:36 am — Vessel almost leaving the port area, with the tip of the breakwater starboard side;
- 7:37 am — The main engine failure can be even more noticeable, due to its reducing rotation;
- 7:38 am — Main engine shutdown;
- 07:39 am — Vessel moving forward, due to the inertia, but drifting dangerously towards the shore. The person in charge of the dock was contacted via VHF and requested to call the maritime police as well as all available means to rescue the vessel;
- 07:40 am — The starboard anchor is dropped, but due to the little space the vessel continues to drift towards the shore, under the effect of weather conditions;
- 07:40 am — The pilot requests help from M/V “DJON DADE”, which was at the entrance of the port waiting to moor after the departure of M/V “DEIMOS”. The

master of M/V “DJON DADE” immediately stands ready to help and starts the rescue maneuver. The vessel continues to drift, due to the weather conditions;

- 07:55 am — The maritime police receive the towing cable from M/V “DEIMOS” and delivers it to M/V “DJON DADE”;
- 08:00 am – M/V “DJON DADE” begins to tow M/V “DEIMOS”, intending to bring her to anchor in a safe place;
- 8:15 am – M/V “DJON DADE” was not able to safely circumvent the tip of the breakwater and sail. Given the little space between her bow and the tip of the breakwater, the master decides to suspend the towing operation, to position the vessel in a safer condition and then continue the operation.
- 8:17 am – The vessel, which was in a perpendicular position to the beach, hits the bottom for the first time, and repeatedly. M/V “DJON DADE” tries, ineffectively, to rescue M/V “DEIMOS”. The master of M/V “DEIMOS” decides for the abandonment of the vessel;
- 9:20 am – All crew rescued and on land without injuries.

3.6 VESSEL CREW

At the time of the accident, M/V “DEIMOS” crew consisted of 10 members. The master holds two nationalities — Cuban and Spanish — and the rest of the crew members are Cuban citizens.

The principal crew, namely the master, the first officer, the second officer, the chief engineer, and the second engineer officer, are experienced professionals holding certificates in accordance with the international legislation and with the Flag State, as presented below:

- The master holds a certificate of competence to serve on vessels of 3000 gross tonnage or more, renewed and issued by the Cuban State, on October 9, 2015, valid until October 9, 2020, and extended until January 9, 2021.
- The first officer (1/O) holds certificates renewed and issued by the Cuban State, on April 16, 2019, valid until April 16, 2024.
- The second officer official (2/O) holds certificates renewed and issued by the Cuban State, on July 12, 2016, and valid until August 12, 2021.
- The chief engineer officer (C/E) holds a certificate of competence to serve on vessels powered by main propulsion machinery above 3000 kW, renewed and issued on October 09, 2015, valid until October 09, 2020, and extended until January 09, 2021.
- The second chief engineer officer (2/E) holds a certificate of competence to serve on vessels powered by main propulsion machinery above 3000 kW, renewed and issued on April 14, 2016, and valid until April 14, 2021.

3.7 RELEVANT CERTIFICATES

DESIGNATION	ISSUING	VALIDITY	LAST INSPECTION
Cargo Vessel Safety Radio Certificate (A1+A2+A3)	30/05/2018	31/01/2021	28/02/2020
Vessel Safety Construction Certificate (SAFCON)	09/10/2019	31/01/2021	08/04/2020
Vessel Safety Equipment Certificate (SAFEQ)	30/05/2018	31/01/2021	08/04/2020
International Oil Pollution Prevention Certificate (IOPP)	03/10/2019	15/06/2022	08/04/2020
International Air Pollution Prevention Certificate (IAPP)	30/05/2018	31/01/2021	08/04/2020
International Sewage Pollution Prevention Certificate (ISPP)	03/10/2017	31/01/2021	
International Load Line Certificate (ILL)	30/05/2018	31/01/2021	08/04/2020
International Energy Efficiency Certificate (IEE)	15/06/2017		
Maritime Labor Certificate (MLC 2006)	23/11/2017	22/11/2022	28/09/2020
International Ballast Water Management Certificate	21/11/2017	15/06/2022	08/04/2020
Class Certificate	06/06/2019	31/01/2021	08/04/2020
Safety Management Certificate SMC (ISM)	03/12/2017	2/11/2022	28/09/2020
International Vessel Security Certificate (ISSC)	30/11/2017	22/11/2022	28/09/2020

3.8 LAST TRIPS ROUTES[1]

Before the accident, M/V "DEIMOS" made regular trips to Fogo island, and usually moored at pier no. 3 at the Port of Vale de Cavaleiros. Based on the information extracted from Marine Traffic, the vessel made the following trips, from August to November 2020:

3.8.1 FOGO – SÃO NICOLAU – LAS PALMAS — SETÚBAL

Figure 4: Arrival and departure from the Port of Vale de Cavaleiros, from 07 to 09 of September 2020. Source: Marine Traffic.

Route	Port:	Vale de Cavaleiros	→	Tarrafal	→	Las Palmas	→	Setúbal
	Arrival:	07/09/2020 (07:58am)		10/09/2020 (07:22am)		16/09/2020 (06:38am)		20/09/2020 (04:04pm)
	Departure:	09/09/2020		11/09/2020		16/09/2020		23/09/2020

[1] Obs: Local time (LT).

		(07:42am)		(12:25pm)		(04:36pm)		(12:19pm)

3.8.2 SETÚBAL — LAS PALMAS – BOAVISTA – FOGO

Figure 5: Arrival and departure from Port of Vale de Cavaleiros, from 07 to 09 of October 2020. Source: Marine Traffic.

Route	Port:	Setúbal	→	Las Palmas	→	Sal Rei	→	Vale de Cavaleiros
	Arrival:	20/09/2020 (04:04pm)		27/09/2020 (04:14am)		05/10/2020 (07:45am)		07/10/2020 (07:48am)
	Departure:	23/09/2020 (12:19pm)		28/09/2020 (05:21pm)		06/10/2020 (08:43am)		09/10/2020 (05:30pm)

3.8.3 FOGO — LAS PALMAS — AVEIRO — LAS PALMAS

Route	Port:	Vale de Cavaleiros	→	Las Palmas	→	Aveiro	→	Las Palmas
	Arrival:	07/10/2020 (07:48am)		15/10/2020 (12:44am)		24/10/2020 (04:34pm)		03/11/2020 (07:52pm)
	Departure:	09/10/2020 (05:30pm)		18/10/2020 (05:46pm)		30/10/2020 (06:56am)		04/11/2020 (19:30)

3.8.4 LAS PALMAS – BOAVISTA – FOGO — FOGO

Figure 6: Arrival and departure from Port of Vale de Cavaleiros, from 11 to 13 of November 2020. Source: Marine Traffic.

Route	Port:	Las Palmas	→	Sal Rei	→	Vale de Cavaleiros	→	Grounding location
	Arrival:	03/11/2020 (07:52pm)		09/11/2020 (08:12am)		11/11/2020 (07:06am)		07/10/2020 (08:17am)
	Departure:	04/11/2020 (07:30pm)		10/11/2020 (12:43pm)		13/11/2020 (07:30am)		-

3.9 VESSEL ENTRY NOTIFICATION

On November 8, 2020, M/V "DEIMOS" agent, Polar, Lda., notified the Maritime Authority representatives of the island (Notification no. 13/20) about the vessel arrival at the Port of Vale de Cavaleiros on November 11, 2020, at 7:00 am (LT), to unload a cargo of cement and roof tiles, and then departure to Tarrafal (São Nicolau), on November 12, 2020.

3.10 MAIN ENGINE OPERABILITY

At 6:55 am, on November 13, 2020, the main engine was started following the usual procedures. At 7:25 am, after checking all operating parameters, the command was transferred from the engine room to the bridge.

The unmooring maneuver was being conducted normally when around 7:35 am, a sudden decrease in the main engine rotation caused its shutdown. At that moment, the chief engineer was in the engine room.

As all the operating parameters were normal and since there were no active alarms, several new attempts were made to start the main engine, which turned out to be unsuccessful since it was shutting down when reaching 300 rpm. Thus, they considered

the main engine inoperable for the unmooring maneuvers and for sailing, which was immediately communicated to the vessel's master.

The chief engineer assured that the main engine had been operating normally, it had never presented any problem before, and he was unaware of the possible causes that led to its shutdown, as he had never been in a similar situation before. He also stated that the N/M "DEIMOS" implemented a "Planned Maintenance System" for the machines and equipment, complying with the mandatory statutory and classification society requirements, manufacturers' recommendations, and the experience of the crew. Most of the machines and equipment are overhauled and inspected after a predetermined number of working hours, laid down on the maintenance plan.

3.11 Weather Conditions, Sea States, and High Tide[2]

According to weather information from INMG (Bulletin no. 20201112), the weather forecast[3] and sea state for the western/eastern Leeward region, from November 12, 2020 (12:00 pm - LT) to November 14, 2020 (12:00 pm - LT) were as it is presented below:

Day/Month/Year	Weather Conditions	Sea State
12/11/2020 (12:00 pm - LT) to 13/11/2020 (12:00 pm - LT)	NE Wind 3 to 4, occasionally 5 in the western side in the afternoon, locally variable 2 at night/early morning. Visibility temporarily moderate (<5 naut. mile) in the eastern area of the archipelago due to the dry haze during the morning;	N/NE waves 1.0 to 2.5 meters, gradually increasing in the northern coastal areas /interisland sectors, becoming NW 2.0 to 3.0 meters in the West of the country;
13/11/2020 (12:00 pm - LT) to 14/11/2020 (12:00 pm - LT)	NE Wind 3 to 4, locally variable 2 at night/dawn, temporarily 5 in the western sector in the morning; Visibility temporarily moderate (<5 naut. mile) due to the dry haze.	NW waves 1.5 to 2.5 meters, 2.0 to 3.5 meters in the West of the Archipelago, locally 1.0 to 2.0 meters, in Southeast/Southern coastal areas.

The high and low tides on November 11, 12, and 13, 2020, in accordance with the Port of Praia Tide Chart (Santiago), were as shown in the table below[4]:

Day/Month/Year	Hour : Minutes	Height (meters)
11/11/2020 (Wednesday)	03 : 56 am	1,2
	10 : 26 am	0,5
	04 : 48 pm	1,2
	10 : 88 pm	0,5
12/11/2020 (Thursday)	04 : 53 am	1,3
	11 : 18 am	0,4
	05 : 37 pm	1,3

[2] *As there is no specific Tide Chart for the Port of Vale de Cavaleiros, the Tide Table of the Port of Praia was used as a reference.*

[3] *Wind intensity in "Beaufort" scale and wave height in meters.*

[4] *Due to the variation in the mean sea level, higher water level heights were expected (by around 0.1 m).*

	11 : 32 pm	0,4
13/11/2020 (Friday)	05 : 45 am	1,4
	12 : 03 pm	0,3
	06 : 22 pm	1,4

3.12 Response to the Accident

3.12.1 Administrative and Operational Risk Prevention Measures

Soon after the vessel ran aground, the Captain of the Leeward Ports (C-PS) and his staff visited the Port of Vale de Cavaleiros. Under the terms of the applicable legislation and in coordination with the Port Authority, ENAPOR, as stated in the preliminary report of the Maritime Port Institute (IMP), the following administrative and operational measures were taken to prevent port navigation risks and environmental pollution:

— Displacement of the tugboats “PRAIA MARIA” (on November 13) and “MONTE CARA” (on November 14) to the Port of Vale de Cavaleiros and in emergency preparedness;

— Submission of a removal notification to the master, the owner, and the agent of the vessel;

— Collection of information about the nature of the vessel’s bottom and the circumstances of her grounding through diving operations in the area of the accident;

— Placement of the towline and visual inspection of the engine room;

— Analysis of the technical and safety conditions of emergency operations for towage and removal maneuvers;

— Transfer of approximately 70 tons of fuel (diesel) from the tanks, which was concluded on November 25.

3.12.2 Diving Operation

Due to the weather conditions on-site, the diving operation only occurred the day after the accident on November 13, 2020. The few resources available on the island were utilized to check the conditions of the vessel’s bottom and to start transferring the oily water and the fuels on the vessel, aiming to prevent and reduce the risks of pollution to the marine ecosystem and the dangers to public health that could have resulted from the accident.

The divers found fishing gear wrapped in parts of the propeller and shaft, as shown in the following image:

Figure 7: Propeller and Shaft of M/V “DEIMOS” wrapped in fishing gear. Source: Videos - Dive Operation

3.12.3 REMOVAL OF FUEL FROM M/V “DEIMOS”

Under the coordination of the Maritime Port Institute (IMP), from 20 to 26 of November 2020, the fuel was removed from the M/V “DEIMOS”, as outlined below:

- as stated in the “declaration of diesel transfer” signed by the master of M/V “DEIMOS”, approximately sixty-four thousand liters (64,000 L) of clean diesel were transferred to the tanks of the tugboat “Monte Cara”, property of ENAPOR SA;
- about twenty-eight thousand and six hundred liters (28,600 L) of clean diesel and about seventeen thousand and six hundred liters (17,600 L) of contaminated diesel (presence of water and oil) were transferred to portable tanks placed on land on the Port of Vale de Cavaleiros. In total, one hundred ten thousand and two hundred liters (110,200 L) of fuel and oily water was transferred from the vessel to land, under the oversight of the local Port Administration, and at the owner local agent and/or legal representatives’ expenses. The fuel was distributed as follows:

ENACOL – Praia: 1 tank of 5,000 liters of clean diesel fuel;

ENACOL – Mosteiros: 1 tank of 10,000 liters of clean diesel fuel;

VIVO ENERGY – Brava: 1 tank of 10,000 liters of clean diesel fuel;

ENACOL – São Filipe: 1 tank of 10,000 liters of dirty diesel fuel;

VIVO ENERGY – São Filipe: 1 tank of 10,000 liters of dirty diesel fuel;

ENACOL – Praia: 5 tanks of 1,000 liters of dirty diesel fuel;

VIVO ENERGY – Praia: 22 drums of clean diesel fuel;

VIVO ENERGY – Praia: 73 drums of oily water;

VIVO ENERGY – Praia: 43 empty drums;

3.12.4 The Decision of the Insurance Company

On December 3, 2020, Allianz Compañia de Seguros y Reaseguros SA, headquartered in Madrid, addressed a note to the Maritime Authorities of Cabo Verde, namely Maritime Port Institute, in which it informed that based on its Experts and Curators Insurance Actuaries report, of November 23, 2020, Allianz declared the constructive total loss of M/V “DEIMOS”, renounced the ownership of her remains, denied liability for her salvage, and attributed the responsibility for her removal to P&I Club.

3.13. Relevant Applicable Law

At the time of the accident, M/V “DEIMOS” held the required certifications to carry out international voyages as a general cargo vessel and had already been making Inter-Island voyages in Cabo Verde, being, therefore, bound by the following laws:

NATIONAL

— Maritime Code of Cabo Verde, approved by Legislative Decree no. 14/2010, of November 15;
— International Convention of the Safety of Life at Sea, 1974, as amended (SOLAS, 1974); (Resolution no. 20/2003);
— International Convention on Tonnage Measurement of Ships, 1969 (TONNAGE, 1969) – Decree no. 1/1996);
— International Convention of Load Lines, 1966 (LLC, 1966) — Decree no. 14/2010);
— International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW, 1978); (Decree no. 132/88);
— Convention on the International Regulations for the Prevention of Collisions at Sea, 1972, as amended (COLREG, 1972) — Decree 14/2010;
— International Convention for the Prevention of Pollution from Ships, 1973, as amended by the 1978 Protocol, as amended (MARPOL, 73/78); (Decree no. 7/1996 and Decree no. 35/1997);
— Legislative Decree no. 1/2013, which amends the Cabo Verdean Ports Law, approved by Legislative Decree no. 10/2010, November 1;
— Regulatory Decree no. 21/2013, which amends the Regulation of Ports of Cabo Verde, approved by Regulatory Decree no. 15/2010, December 20;
— Regulatory Decree no. 19/2014 - Regulation for pilotage services within the Ports of Cape Verde, February 25;

— Decree-Law no. 47/98, September 7, which regulates maritime rescue.

INTERNATIONAL

— International Convention of the Safety of Life at Sea, 1974, as amended (SOLAS, 1974);
— International Convention on Tonnage Measurement of Vessels, 1969 (TONNAGE, 1969);
— International Convention of Load Lines, 1966 (LLC, 1966);
— International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended (STCW, 1978);
— Convention on the International Regulations for the Prevention of Collisions at Sea, 1972, as amended (COLREG, 1972);
— International Convention for the Prevention of Pollution from Vessels, 1973, as amended by the 1978 Protocol, as amended (MARPOL, 73/78);
— Convention on Facilitation of International Maritime Traffic, 1965 (FAL, 1965)
— International Convention on Salvage, 1989 (SALVAGE, 1989).

3.14. MOORING AND UNMOORING CONDITIONS IN PORT

The Port of Vale de Cavaleiros has the following characteristics:

NUMBER OF PIERS	LENGTH (M)	WIDTH (M)	DREDGING LEVEL (M) ZH
1	20	10	-5
2	70	10	-5
3	95	25	-5

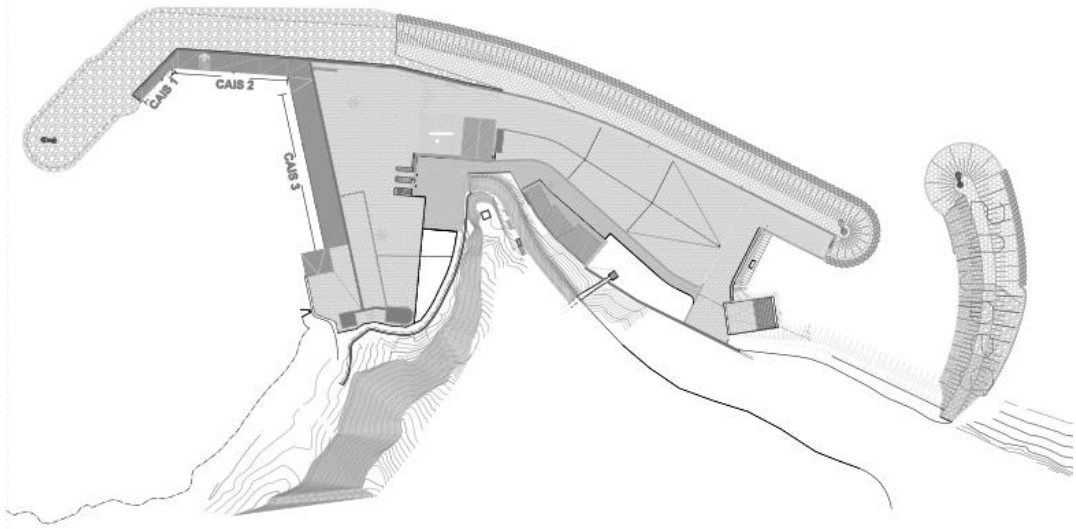


Figure 8: “Port of Vale de Cavaleiros”, Source: http://www.enapor.cv/page/porto-vale-cavaleiros

According to information obtained during the investigation, pier no. 3 is 100 meters long and can receive vessels up to 90 meters long.

However, under request from different companies, ENAPOR has been allowing, exceptionally, vessels measuring 94 to 95 meters long to moor on pier no. 3, as long as berth no. 2 is not occupied by any other vessel.

The vessels always moor and unmoor with the support of a small boat, which transports the mooring lines from the vessel to the pier and *vice versa*. The pilots are always

transported from and to the vessels with the support of the local maritime police. Since there are no tugboats nor permanent pilots at the pier, whenever required, they travel from Santiago or São Vicente, for operations that demand vessels of such characteristics.

4. ANALYSIS

4.1. PURPOSE

The main objective of this section is to determine the contributing factors and causes of the accident, in order to make recommendations, which can contribute to prevent similar occurrences in the future.

4.2. MASTER'S STATEMENT

M/V "DEIMOS" master's report states a factual and sequential description of the events. However, relevant information about what happened after 7:40 am were excluded, specifically the following: at 7:55 am, the maritime police delivered M/V "DEIMOS" towing cable to M/V "DJON DADE"; at 08:00 am M/V "DJON DADE" started towing M/V "DEIMOS" to take her to a safe anchor position; at 8:15 am, M/V "DJON DADE" was not able to safely avoid the tip of the breakwater and proceed, so the master decides to suspend the towing, to better position the vessel and then continue the operation; at 8:17 am, the vessel, which was in a perpendicular position to the beach, effectively hits the bottom, several times, and it was decided for the abandonment of the vessel; at 9:20 am, the abandonment operation was concluded, and the entire crew was rescued and on land.

4.3. M/V "DEIMOS" SEAWORTHINESS

M/V "DEIMOS" seaworthiness depends, mostly, on requirements and standards of the international conventions, the Flag State, and the classification society. Usually, the Flag State and classification societies carry out inspections concerning compliance with those standards, which may also be carried out by the Port State, within the scope of *Memoranda* of Understanding. The shipowners and charterers may also conduct their own inspections if they deem it necessary.

In line with the inspection records, the Port State in Aveiro (Portugal) inspected M/V "DEIMOS" on October 14 2019. In addition, the Flag State in Las Palmas - Gran Canaria (Spain) provided its annual inspection from the 20th to the 21st of June 2020. None of the reports indicated any significant deficiencies relevant to the vessel's seaworthiness. The annual Flag State inspection report states that the vessel was in satisfactory operating and maintenance conditions and that the crew was familiarized with the tasks for maritime safety and security.

For that matter, the vessel held a Cargo Vessel Safety Construction Certificate and an International Load Line Certificate. Both were valid and issued by the classification society, RINA.

4.4. MAIN ENGINE SHUTDOWN

The M/V "DEIMOS" propulsion system has a mono propeller and comprises the main engine, the gearbox, the propeller shaft, and the propeller, as shown in the following schematic:

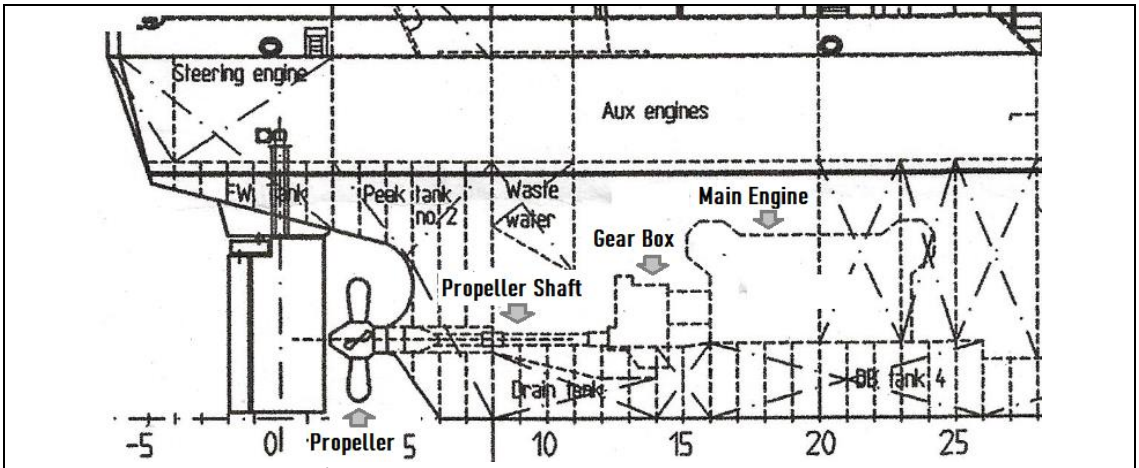


Figure 9: M/V DEIMOS Propulsion Schematic. Source: Navigation Simulator

As stated by the chief engineer, before unmooring, they followed all the usual procedures for the preparation and starting of the main engine. At around 06:55 am, the main engine started normally using air and fuel.

At 7:25 am, after checking all of the operating parameters, the engine room transferred the command to the bridge, with the main engine running.

At 7:30 am, the vessel unmoored in a position parallel to the pier, with the aid of the bow thruster, until it was positioned close to the exit of the pier, with the main engine running. Approximately five minutes later, the main engine suddenly reduced rotation and consequently shut down at 7:38 am.

Generally, a vessel shutdown has the following causes: fuel cracks and leakages in fuel pipes, in case of improper fuel treatment; starting air valve leakage; moving parts of the main engine are blocked or stuck; failure in the electrical system due to false alarms; human error due to the bad handling of the engines, equipment, and auxiliaries; improper maintenance and monitoring.

The chief engineer ensures that the operating parameters of the main engine were normal, there was no active alarm, and that, in all the attempts made to start it, the engine was on air and fuel, but stopping when reaching 300 rpm.

Taking into account the chief engineer’s experience and his confidence that the main engine was operational, had never presented any problem before and its shutdown is not related to operational and maintenance problems, the main engine moving parts blocked or stuck, by external factors, are considered to be the cause of the sudden and excessive overload of the main engine as well as its subsequent shutdown.

During the investigation, no evidence was found that the main engine was operating from 7:30 am to 7:38 am, coupled to the propeller shaft, and with the propeller pitch at the zero position.

As reported, at 7:35 am, the main engine was under excessive load, as a consequence of an increase in the pitch angle and the vessel heading outside the port area.

Evidence obtained during the diving operation shows that, while unmooring, the propeller and its shaft had fishing gear wrapped around them, including nets, cables, hooks, among others (see Figure 7).

As the main engine was coupled to the propeller and shaft, which were wrapped in fishing gear, it would not be able to continue operating for a long time, as the crankshaft would end up causing its shutdown.

Based on the above-mentioned, the conclusion drawn from the investigation is that the factual cause of the main engine's shutdown was the significant amount of net and fishing gear wrapped in the propeller and shaft.

4.5. DUTIES OF THE NATIONAL MARITIME AUTHORITY

In accordance with the Maritime Code of Cabo Verde, approved by Legislative Decree no. 14/2010, of November 15, all vessels may freely navigate within the territorial waters of Cabo Verde, to enter or exit national ports, respecting the restrictions and requirements set out in the aforementioned Code and special legislation, namely, customs, health, and immigration. Pilotage is mandatory for all vessels, in ports and places considered as so by the competent national authorities.

Under current legislation, it is also the responsibility of IMP, as the port regulatory authority, to ensure compliance with legislation on port security, to prevent, control, and minimize the effects or consequences of incidents or accidents that may harm or cause injury to people or damage to property.

In accordance with the 1989 “International Convention on Salvage (SALVAGE)”, States Parties shall adopt the necessary measures to enforce the master’s duty to render assistance to any person in danger of being lost at sea, provided that he can do so without serious danger to his vessel and persons thereon.

In this regard, when the Maritime Authority representatives in Fogo became aware of the accident, they requested the support of the Leeward Port Captaincy, in order to adopt the necessary measures so that the masters of the closest ships and tugs could render the due assistance to M/V “DEIMOS”.

Furthermore, the master of M/V “DJON DADE”, which was at the entrance of the port waiting to moor after the departure of M/V “DEIMOS”, immediately stood ready to help and began the rescue maneuver, although unsuccessfully;

In response to the request of the Maritime Authority representatives, the tugboat “PRAIA MARIA” arrived at Fogo around 05:00 pm on November 13, 2020, and the tugboat “MONTE CARA” arrived on November 14, 2020. Both delays were due to the distance the tugboats had to travel, respectively, from the Port of Praia (Santiago) and Porto Grande (S. Vicente) to the Port of Vale de Cavaleiros.

4.6. DUTIES OF THE PORT ADMINISTRATION

Pursuant to the Regulation for pilotage services within the Ports of Cabo Verde, approved by Regulatory Decree no. 19/2014, it is up to the Port Administration the provision of pilotage services, which is mandatory in all national ports and for all vessels of 500 gross tonnage and above, and it is provided upon request addressed to the Port Administration.

However, passenger vessels calling the ports on a regular basis, among which their master has specific preparation and certification as well as ports and pilotage knowledge and experience to provide pilotage service at the mandatory port area, are exempted from the obligation of pilot service.

Additionally, according to Regulatory Decree no. 21/2013, which amends the Regulation of Ports of Cabo Verde, approved by Regulatory Decree no. 15/2010, of December 20, towing assistance is required in all ports for all vessels above 2000 gross tonnage, unless there are no towing means or they are not available. However, the Port Administration may exempt a vessel from towing service, after considering all the aspects implied in each case, such as the type, propulsion, size, draft, maneuverability, and seaworthiness of the vessel, and the traffic and weather conditions.

4.7. MASTER AND SHIP-OWNER RESPONSIBILITIES

According to Regulatory Decree no. 21/2013, which amends the Regulation of Ports of Cabo Verde, approved by Regulatory Decree no. 15/2010, of December 20, the master is responsible for the vessel’s sailing operations, maneuvers, anchoring, mooring, or unmooring in a port, with or without towing assistance services. It is also the responsibility of the master, or the pilot on duty, to request the number and characteristics of the tugboats required for the mooring, unmooring, or other maneuvers of, to the Port Administration or to a tugboat officer duly licensed, taking into account the dimension and characteristics of the vessel.

However, the mooring and unmooring operations of vessels above 2000 gross tonnage, in the Port of Vale de Cavaleiros, have been conducted without the assistance of a tugboat. Furthermore, during the investigation, no evidence about any tugboat request from those who have this prerogative was found with the competent authorities.

Under the terms of the “International Convention on Maritime Rescue (SALVAGE), 1989”, the master of the vessel has the authority to conclude contracts for salvage operations on behalf of the vessel’s owner and is obliged to fully co-operate with the salvor during the course of the salvage operations, exercising due care to prevent or minimize damage to the environment.

Therefore, after the main engine shutdown, the master of M/V “DEIMOS”, concerned with the safety of his vessel and her crew, asked the pilot to request assistance from M/V “DJON DADE”, which was waiting for authorization to enter the Port of Vale de Cavaleiros.

4.8. RESPONSIBILITIES OF THE SALVOR

The salvor shall owe a duty to the owner of the vessel to carry out the salvage operations with due care, exercising due diligence to prevent or minimize damage to the environment, and without serious danger to his vessel and the persons on board, under the terms of the "International Convention on Maritime Rescue (SALVAGE), 1989.

Thus, the master of M/V “DJON DADE” provided the requested assistance and tried to tow M/V “DEIMOS” to a safe place to anchor. However, considering that M/V "DJON

DADE" lacks the power and versatility of a tugboat, and due to the weather condition and the little space between her bow and the tip of the breakwater, she was not able to safely avoid the named tip nor to tow M/V “DEIMOS” to a safe area. On account of that, the towing operation was suspended, to avoid putting the vessel and the crew in serious danger.

4.9. MANEUVERING SIMULATION

In order to have a better understanding of the vessel’s maneuvers, the team set up to investigate this serious accident analyzed several scenarios using a navigation simulator with vessels similar to those involved in the operation, in order to obtain practical information that allows a consistent presentation of recommendations of procedures that can contribute to substantially minimize the possibility of occurrence of similar accidents in the Port of Vale de Cavaleiros.

NOTE: The vessel available and used for the simulations was the one with the closest displacement to M/V “DEIMOS”, which has a displacement of 5325 tons.

4.9.1. Scenario 1 [5]

M/V “DEIMOS” main engine in operation, unmoors normally at 7:30 am, and around 7:35 am, the main engine starts to reduce rotation and consequently stops moments later.

1) UNMOORING SIMULATION USING THE BOW THRUSTER AND THE MAIN ENGINE:

The normal procedure for unmooring was simulated. The vessel was moored in pier no. 3 and the mooring lines were still tied up in the bollards. The unmooring maneuver began and only the headlines were cast off; with the help of the bow thruster, the vessel got away from the pier, at an angle of 45 degrees. After that, the stern lines were cast off, with the rudder angle applied to 20 degrees to starboard and the main engine engaged at slow speed ahead. At 7:33 am, the vessel was in the position shown in Figure 10.

[5] See details of vessels and simulated conditions in Appendix A.

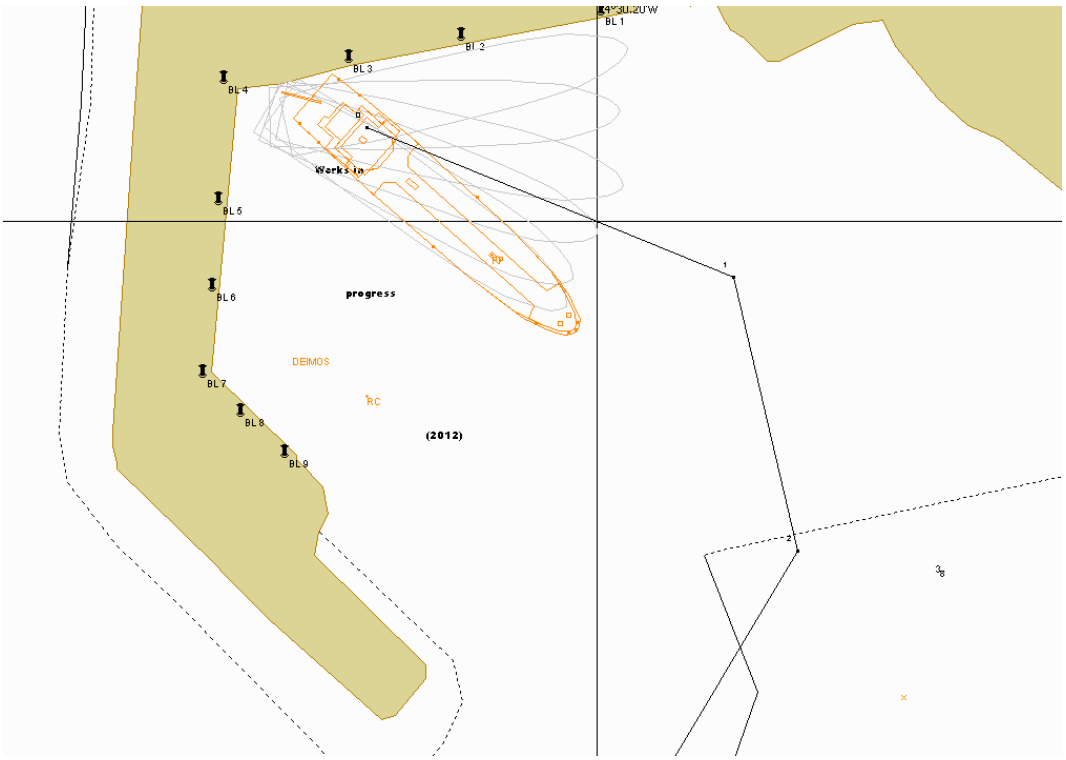


Figure 1: Vessel's position at 7:33 am (131º), using “Bow Thruster” and main engine. Source: Navigation Simulator.

At 7:35 am, the vessel was already in the position indicated in Figure 11 when the main engine RPM reduced, and the vessel kept moving forward due to the inertia until 7:38 am, when the main engine effectively shut down, in the position shown in Figure 12.

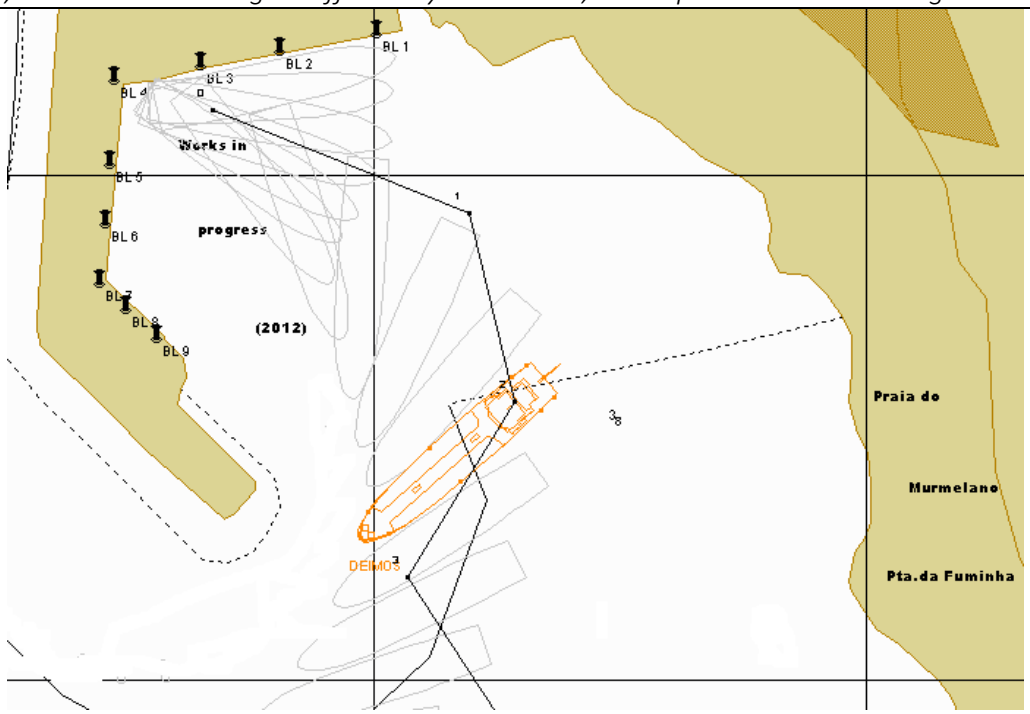


Figure 2: Vessel position at 7:35 am after the main engine RPM was reduced. Source: Navigation Simulator.

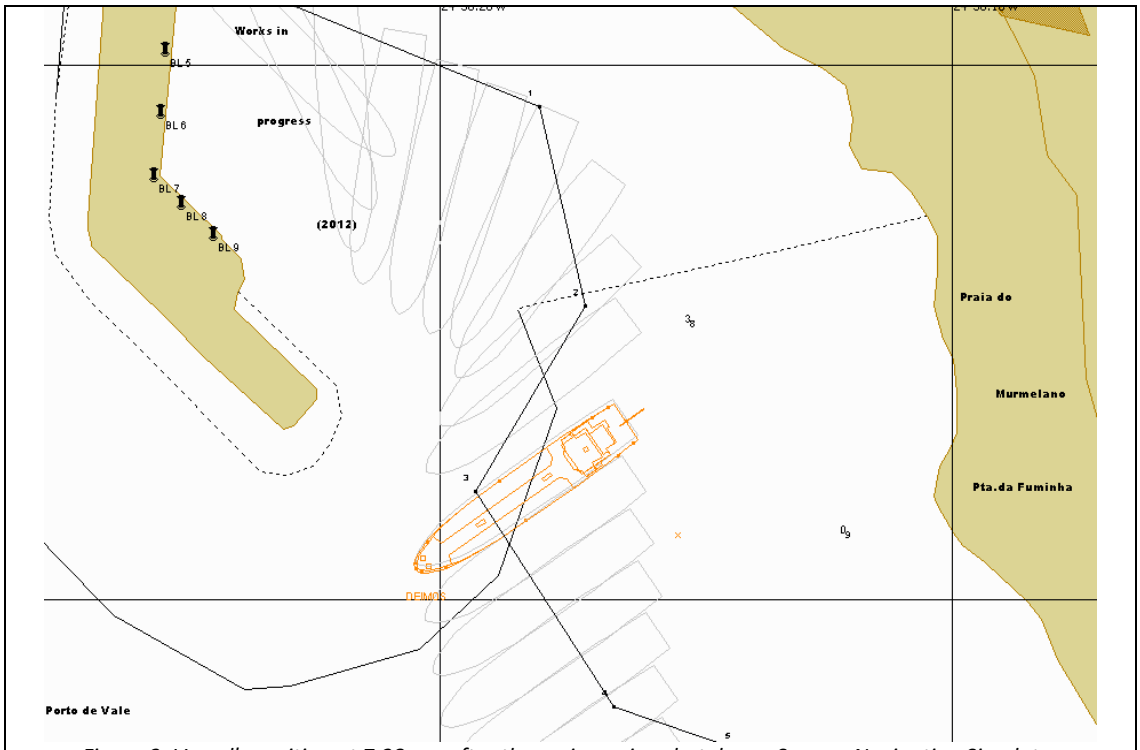


Figure 3: Vessel's position at 7:38 am after the main engine shut down. Source: Navigation Simulator

2) SIMULATION OF THE VESSEL SAILING WITH THE MAIN ENGINE INOPERATIVE

The vessel, still moving forward due to the inertia, stops at 7:40 am in the position shown in Figure 13, with the bow heading 282 degrees. In that position, the starboard anchor was dropped with about 32 meters of chain in the water (length equivalent to 5 times the depth).

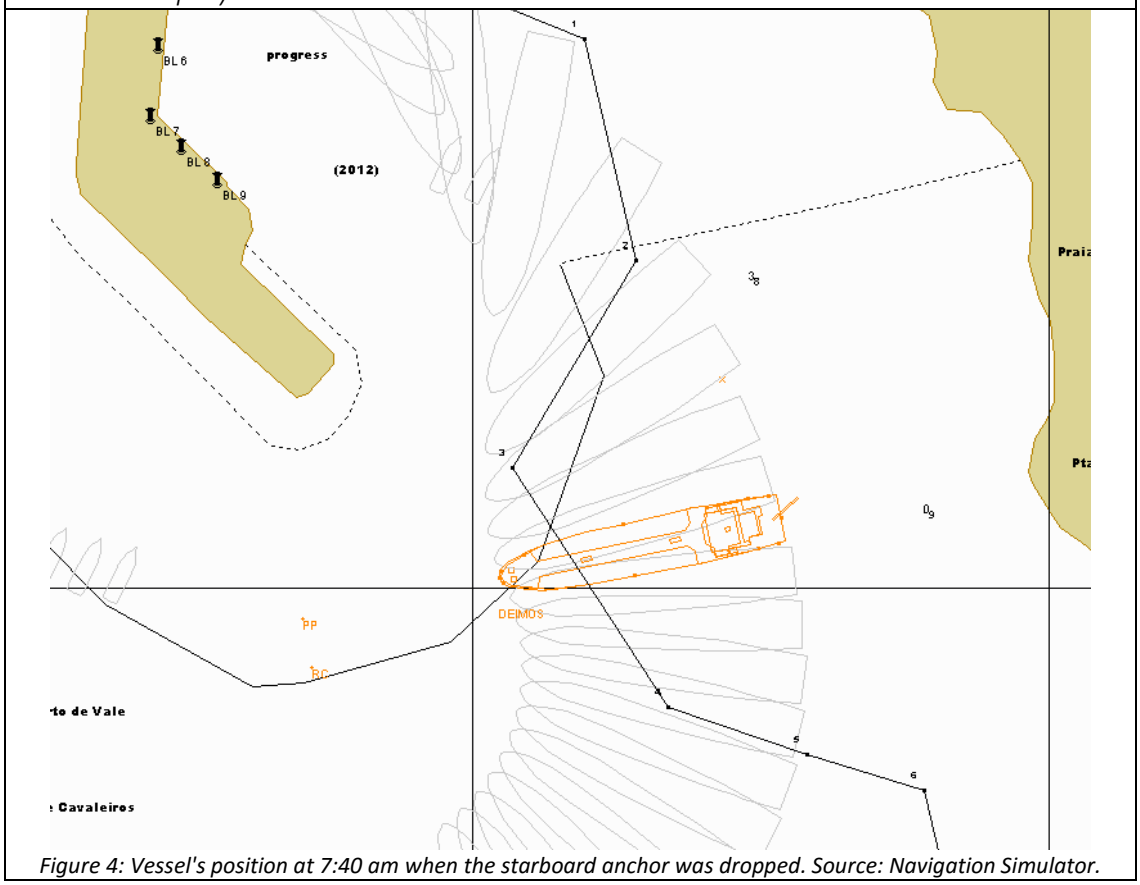


Figure 4: Vessel's position at 7:40 am when the starboard anchor was dropped. Source: Navigation Simulator.

The vessel’s main engine stands inoperative, and she keeps drifting to port, slow astern, under the weather conditions.

At this stage, it was dismissed the use of a tugboat.

After 2 hours, the vessel remains in the position shown in Figure 14, secured by the starboard anchor of about 32 meters of chain with 15 tons of tension and a shackle breaking strength of 64 tons.

Conclusion: Under those conditions, the vessel does not run aground.

However, as shown in Figure 15, if they had used a chain greater than 32 meters, the vessel would have run aground around 8:16 am. That is, since the distance from the anchor dropping position to the ground position equals 135 meters if the chain dropped was 40 meters long the distance would have been greater than 130 meters, as long as it is added to the length of the vessel (94.40 meters length overall) the 40 meters of chain.

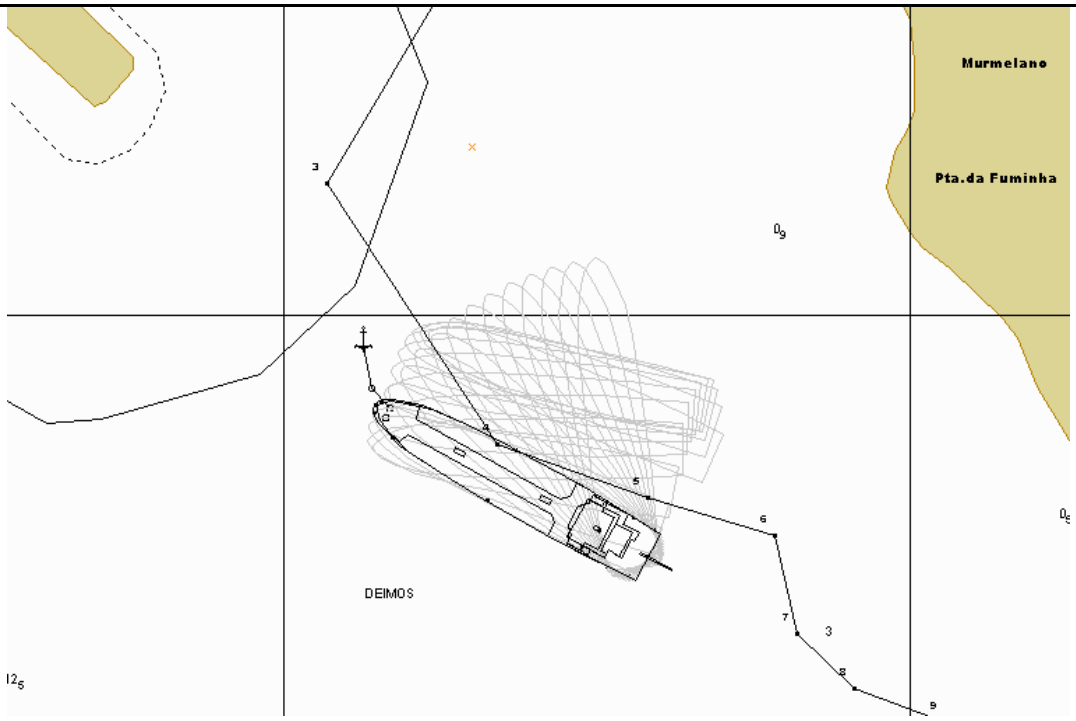


Figure 5: Position of the vessel drifting, about two hours later, secured by the starboard anchor and with 32 meters of chain. Source: Navigation Simulator.

Figure 6: Position of the vessel grounding around 8:16 am, secured by the starboard anchor and with 40 meters of chain. Source: Navigation Simulator.

3) Simulation of the Vessel Sailing with the Main Engine Inoperative and two Anchors Dropped

When the vessel was in position Lat=14º 55.108' N and Long=024º 30.156' W (Figure 16), at 7:40 am, the starboard anchor was dropped, and, right after, the port anchor.

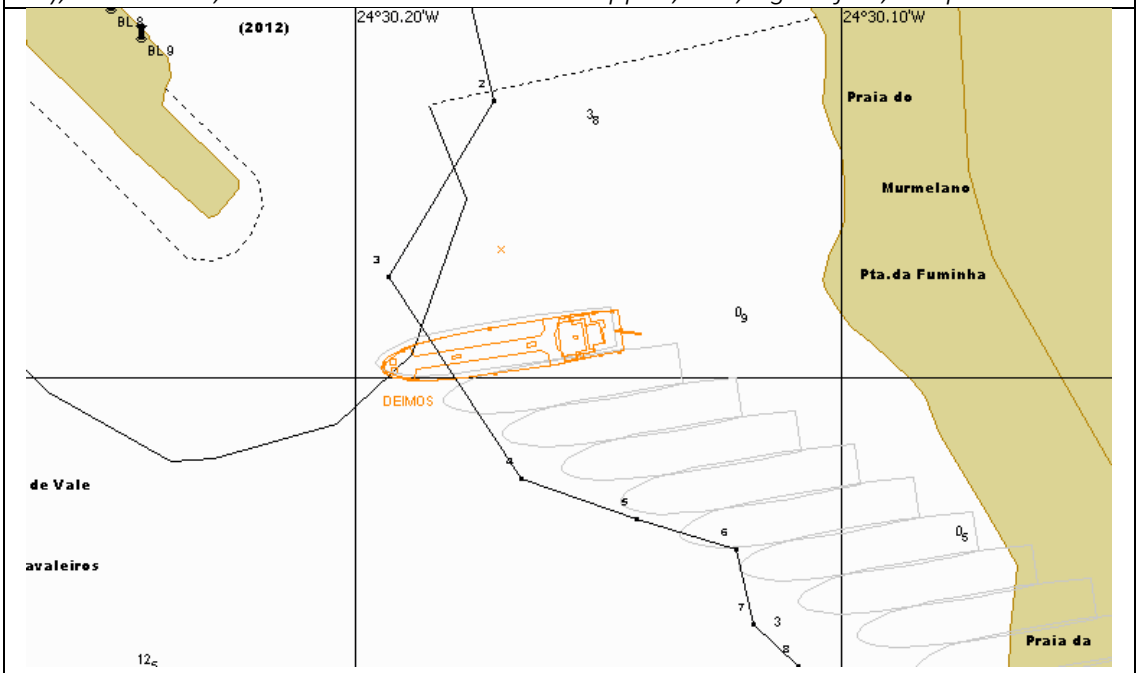


Figure 7: Position of the vessel at 07:40 am, with the starboard and port anchors dropped. Source: Navigation Simulator

At 07:45 am, the vessel is in the position shown in Figure 17, secured by the two anchors and withstanding the weather conditions (Current → 110º/1.5 kn, Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction→ 290º).

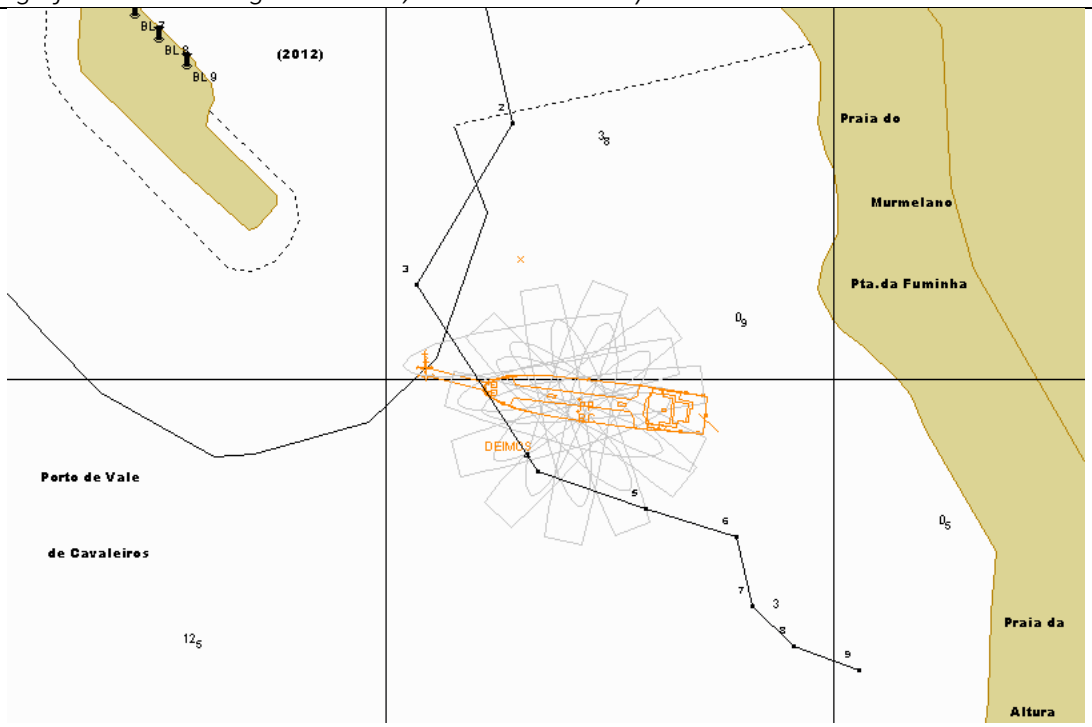


Figure 8: Vessel's position at 7:45 am, with the starboard and port anchors dropped. Source: Navigation Simulator.

At 8:00 am, the vessel keeps floating near Praia da Altura, secured by the two anchors. At 11:00 am, the vessel keeps floating in position Lat=14º 55.083’ N and Long=024º 30.143’ W, secured by the two anchors.

Conclusion: Under those conditions, the vessel does not run aground.

4.9.2 Scenario 2[6]

M/V “DEIMOS” main engine inoperative and being towed by M/V “DJON DADE”, which aims to take her to a safe place to anchor.

1) SIMULATION OF THE TOWING OF M/V “DEIMOS” BY M/V “DJON DADE”:

The towing starts at 8:00 am. A 33 meters long nylon cable is connected to the bow and stern of M/V “DEIMOS” and M/V “DJON DADE”, respectively, the rudder is at an angle of 20 degrees to port and the main engine is full speed ahead, as shown in Figure 18.

[6] See details of vessels and simulated conditions in Appendix B.

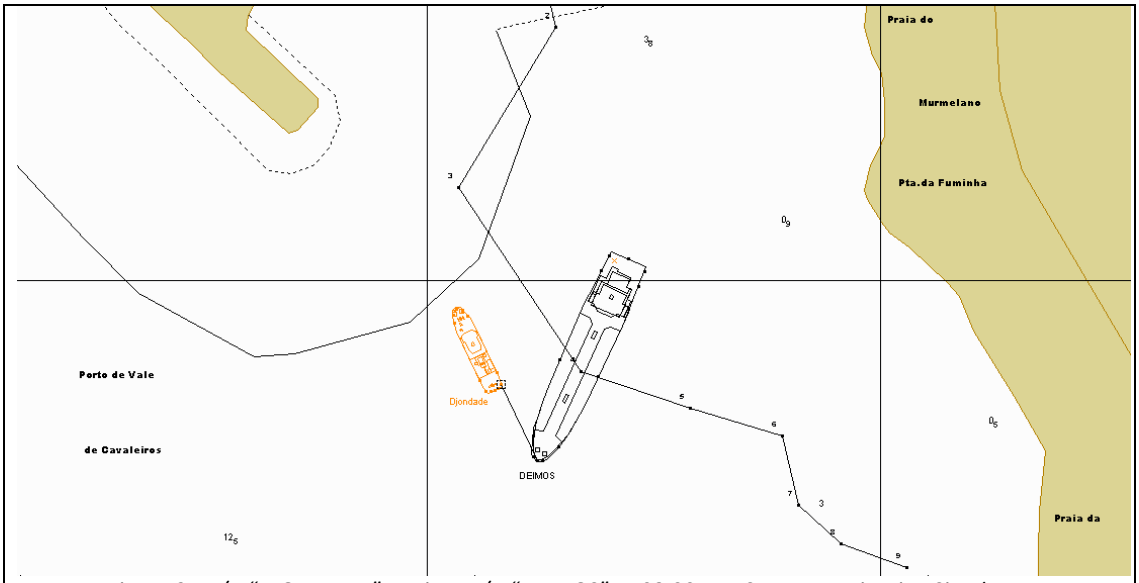


Figure 9: M/V “DJON DADE” towing M/V “DEIMOS” at 08:00 am: Source: Navigation Simulator.

At 8:15 am, as shown in Figure 19, M/V “DJON DADE” tried to avoid the tip of the breakwater. At the risk of running aground, the master suspended the towing operation, to better position the vessel.

Drifting and without the assistance of M/V “DJON DADE”, M/V “DEIMOS” touched the bottom of the sea 2 minutes later.

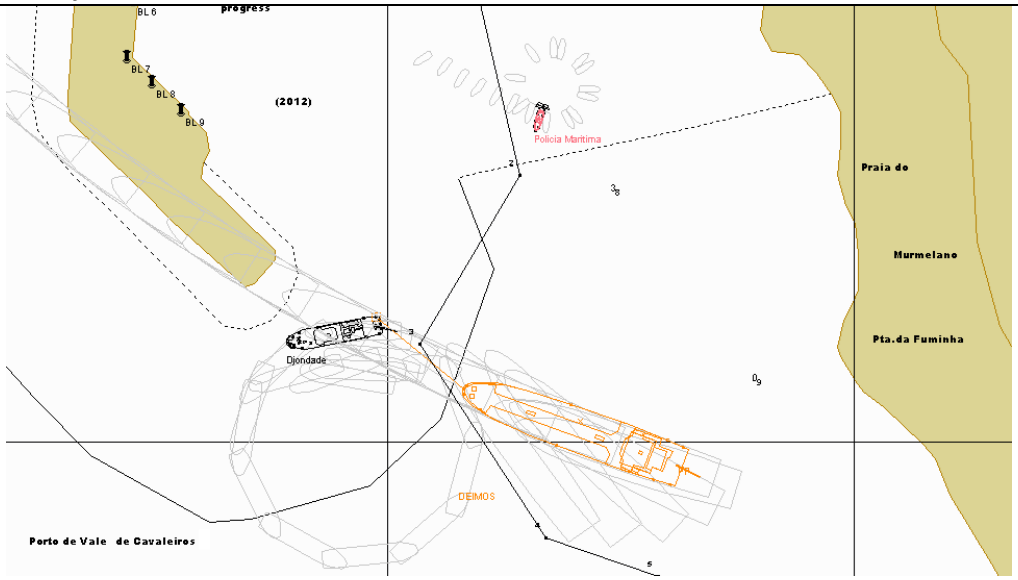


Figure 10: Position of M/V “DJON DADE” and M/V “DEIMOS” at 08:15 am Source: Navigation Simulator.

2) SIMULATION OF TOWING USING M/V “DEIMOS” BOW THRUSTER

M/V “DJON DADE” (Lat=14º 55.080' N and Long=024º 30.185' W) attempt to tow M/V “DEIMOS” (Lat=14º 55.080'N and Long=024º 30.125'W), using the bow thruster in the navigating and maneuvering of the vessel, at 8:00 am, as shown in Figure 20, and considering that M/V “DEIMOS” had the starboard anchor dropped, which was raised after the towing cable had been connected.

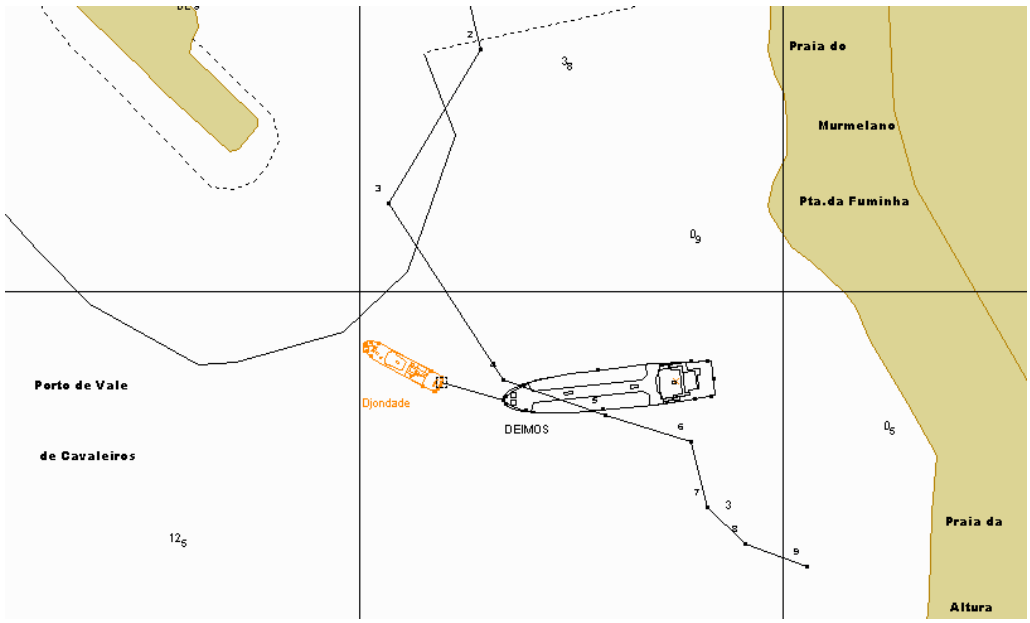


Figure 11: Position of M/V "DJON DADE" and M/V "DEIMOS" at 08:00 am: Source: Navigation Simulator.

In the simulated conditions (Current → 110º/1.5 kn, Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction → 290º), it is verified that both vessels (M/V "DJON DADE" and M/V "DEIMOS") kept moving astern, approaching Praia da Altura and M/V "DEIMOS" would have run aground at 8:05 am, as shown in Figure 21.

Conclusion: Under the weather conditions indicated above, it would not be possible to avoid the grounding.

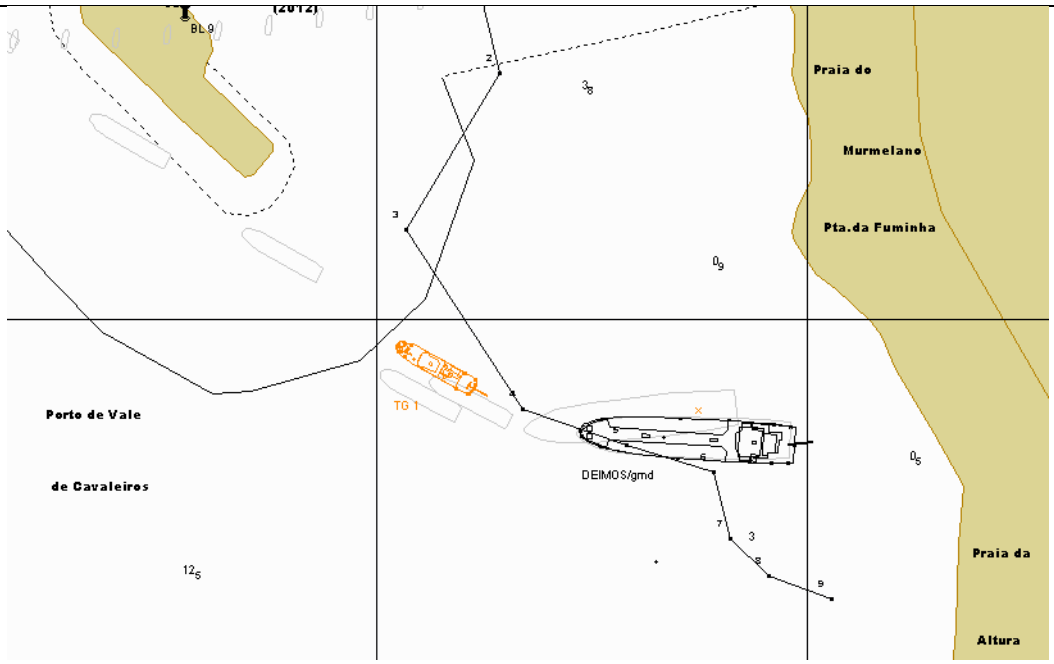


Figure 12: Position of M/V "DJON DADE" and M/V "DEIMOS" at 08:05 am: Source: Navigation Simulator.

However, if the vessel had its speed altered to 1 knot, in the same conditions previously mentioned, namely, M/V "DEIMOS" using the bow thruster, it is assumed that the grounding could have been avoided. Figure 22 illustrates the position of both vessels, at 8:15 am.

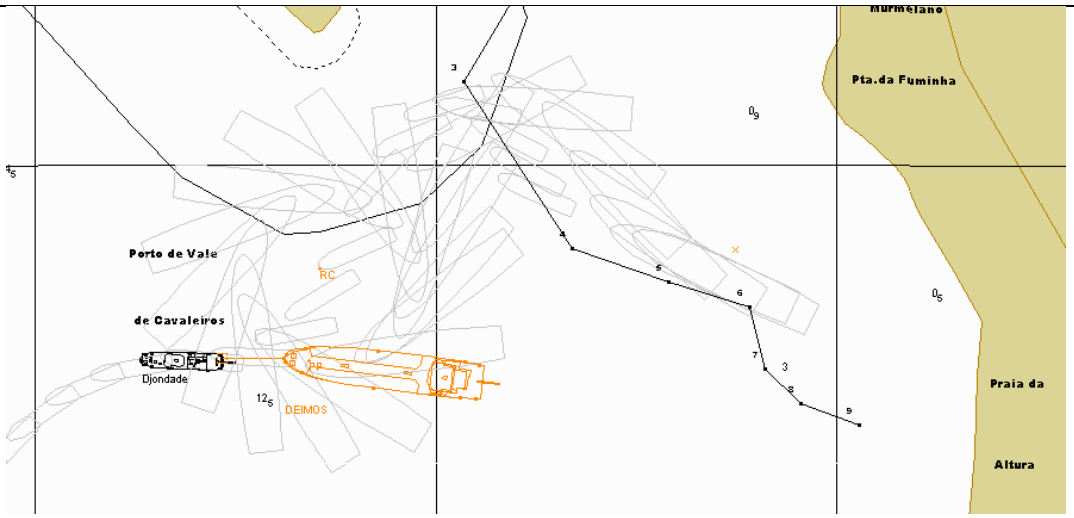


Figure 13: Position of M/N "DJON DADE" and M/V "DEIMOS" at 8:15 am:. Source: Navigation Simulator.

4.9.3 SCENARIO 3[7]

M/V "DEIMOS", with an inoperative main engine, towed by a tugboat that aims to take her to a safe place to anchor.

Simulation of the towing by the tugboat "Praia Maria":

In the simulation, the towing started at 8:00 am (Figure 23), the nylon cable is connected at the bow of M/V "DEIMOS" and the 30 meters long cable is at the stern of the tugboat. Both main engines were half ahead.

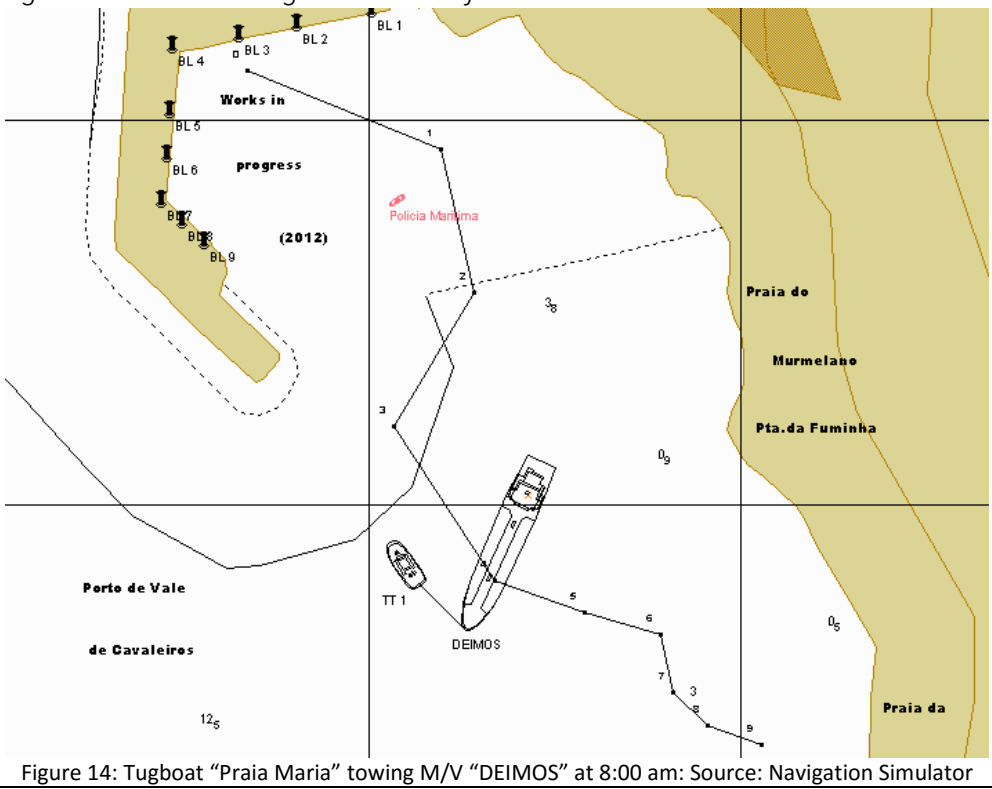


Figure 14: Tugboat "Praia Maria" towing M/V "DEIMOS" at 8:00 am: Source: Navigation Simulator

[7] See details of vessels and simulated conditions in Appendix C.

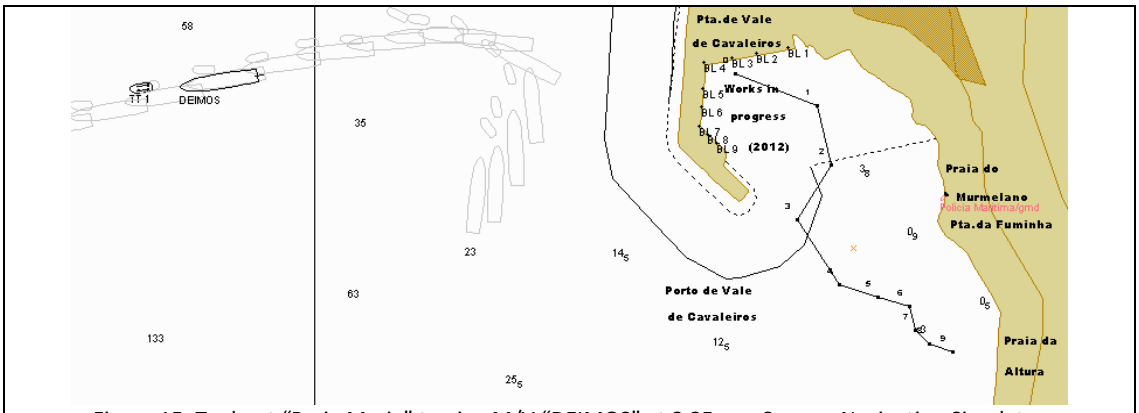


Figure 15: Tugboat “Praia Maria” towing M/V “DEIMOS” at 8:25 am: Source: Navigation Simulator

As shown in Figure 24, at 8:25 am, M/V “DEIMOS”, towed by the tugboat “PRAIA MARIA”, would have been able to anchor in a safe area, to await the main engine to get repaired.

5. CONCLUSIONS

— The main contributing factor of M/V “DEIMOS” grounding was the main engine shutdown, caused by the nets wrapped in the propeller and the shaft, preceded by unsuccessful towing and anchoring operations attempts;
— The main cause of the main engine shutdown was the fishing gear wrapped in the propeller and shaft;
— Weather conditions were also contributing factors to the grounding. Under a drift’s speed less than 1 knot, maintaining the other weather conditions, the towing of M/V “DEIMOS” by M/V “DJON DADE” would have been successfully carried out;
— It was not possible to determine where and when the propeller and shaft got wrapped in the fishing gear, neither their derivation;

— Despite the experience and the adequate STCW certificates of the crew assigned to the engine room, it was not possible to diagnose the true cause of the main engine shutdown, at that moment;

— If M/V “DEIMOS” had been towed by a tugboat right after the main engine shutdown, the grounding could have been avoided;

— If the starboard anchor had been dropped with approximately 32 meters of chain at the position the vessel was in around 7:40 am, probably M/V “DEIMOS” would not have run aground;

— The probability of avoiding the grounding would have been even greater if the starboard and port anchor had been dropped with approximately 32 meters of chain, each;
— It is up to the masters, the final decision on the need of tugboats assistance in ports, in which vessel’s characteristics requires assistance during the maneuvers;
—It was not possible to ascertain whether the bow thruster remained operational after the engine shut down, nor is there any evidence that it was used during the anchoring and towing operations attempts.

6. SAFETY RECOMMENDATIONS

Marine safety investigations into marine casualties and marine incidents are conducted with the objective of preventing marine casualties and marine incidents in the future through the identification of their causes, and the proposition of corrective measures. This objective is achieved through the identification of safety deficiencies and then through the issuance of safety recommendations that lead to their correction.

Thus, in accordance with the IMO Resolution MSC 255 (84), adopted on May *16*, 2008, about the Safety Investigation into a Marine Casualty or Marine Incident, and with the article 2 of the Decree-law no. 62/2018 of December 12, which created the IPIAAM and its statutes, this section describes the safety recommendations issued to minimize the operational safety matters identified during the investigation.

Note: Safety recommendations do not seek to apportion blame or determine liability.

6.1. MARITIME PORT INSTITUTE

— To ensure and effectively monitor compliance with the national legislation, namely concerning the demand for vessels in national ports, in line with the characteristics and certification of vessels and ports respectively, as the competent Maritime Authority;

— To establish weather conditions (wind force and sea state) under which permission should be granted to vessels entering and/or departing from national ports.

6.2. NATIONAL COMPANY FOR PORT ADMINISTRATION

— Establish entrance, mooring, unmooring, and departure procedures for vessels in national ports, including, but not limited to, testing the engines’ working conditions, and keep both anchors, port and starboard, ready to be dropped;

— Guarantee in the national ports tugboats and pilots to conduct mooring and unmooring maneuvers for vessels, which characteristics and size require those services;

6.3. SHIPPING COMPANIES

— Fully comply with the maritime legislation and the Capeverdean ports’ law.

— Update/Establish entrance, mooring, unmooring, and departure procedures for vessels in national ports, including, but not limited to, testing the engines’ working conditions, and keep both anchors, port and starboard, ready to be dropped;

REFERENCES

- *Maritime Code of Cabo Verde, approved by Legislative Decree no. 14/2010, of November 15;*
- *Accident Investigation Code, of the International Maritime Organization (IMO) – MSCMEPC.3/Circ.2, of June 13, 2008/Resolution MSC.255 (84);*
- *Legislative Decree no. 1/2013, which amends the Cabo Verdean Ports Law, approved by Legislative Decree no. 10/2010, November 1;*
- *Regulatory Decree no. 21/2013, which amends the Regulation of Ports of Cabo Verde, approved by Regulatory Decree no. 15/2010, December 20;*
- *Regulatory Decree no. 19/2014 - Regulation for pilotage services within the Ports of Cape Verde, February 25;*
- *Decree-Law no. 47/98, September 7, which regulates maritime rescue.*
- *Decree-Law no. 12/2007, of March 20.*

APPENDICES

APPENDIX A – DETAILS OF SCENARIO 1

- ***FEATURES OF THE VESSEL SIMULATED AS M/V "DEIMOS":*** *Vessel type → Coastal tanker; Displacement → 5325.0 t; Max Speed → 13.6 kn; Length → 88.8 m; Breadth → 16.5 m; Bow Draft → 5.2 m; Stern Draft → 5.7 m; Height of eye → 13 m; Type of Engine → Medium Speed Diesel (1 x 2115 KW); Type of Propeller → CPP; Thruster bow → Yes; Thruster stern → No.*

Figure 16: Costal tanker (Dis. 5325 t). Source: Navigation Simulator

— ***SIMULATED CONDITIONS DURING THE FIRST 3 MINUTES****: Current → 110º/1.5 kn); Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction → 290º; Seabed → Sand; Depth → 5 m; Vessel coordinates → Lat. 14º 55,210 N and Lon. 024 º 30,240 W; Distance between the vessel and the pier no. 1 → 242º/70 meters; Distance between the vessel and the pier no. 3 → 10º/76 meters; Simulation duration → 3 minutes.*

— ***SIMULATED CONDITIONS DURING THE FIRST 5 MINUTES:*** *Current → 110º/1.5 kn; Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction → 290º; Seabed → Sand; Depth → 6.5 m; Vessel coordinates → Lat. 14º 55,150 N and Lon. 024°30176W; Distance between the vessel and the pier no. 1 → 320º/108 meters; Distance between the vessel and the pier no. 2 → 335º/191 meters; Distance between the vessel and the pier no. 3 → 000º/191 meters; Simulation duration → 5 minutes.*

APPENDIX B – DETAILS OF SCENARIO 2

- ***FEATURES OF THE VESSEL SIMULATED AS M/V "DEIMOS":*** *Vessel type → Coastal tanker; Displacement → 5325.0 t; Max Speed → 13.6 kn; Length → 88.8 m; Breadth → 16.5 m; Bow Draft→ 5.2 m; Stern Draft → 1.7 m; Height of eye → 13 m; Type of Engine → Medium Speed Diesel (1 x 2115 KW); Type of Propeller → CPP; Thruster bow → Yes; Thruster stern → No.*

Figure 17: Costal tanker (Dis. 5325 t). Source: Navigation Simulator

— ***SIMULATED CONDITIONS DURING THE FIRST 30 MINUTES WITH M/V "DEIMOS":*** *Current → 110º/1.5 kn; Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction → 290º; Seabed →Sand; Depth →5.5 m; Vessel coordinates (start of towing operation) →Lat. 14º 55.116 N and Lon. 024°30.163W; Distance between the vessel and the pier no. 1 (start of towing operation) →313º/138 m; Distance between the vessel and the pier no. 2 (start of towing operation) →333º/313 m; Distance between the vessel and the pier no. 3 (start of towing operation) → 351º/300 m; Simulation duration → 30 minutes.*

— ***FEATURES OF THE VESSEL SIMULATED AS M/V "DJON DADE":*** Vessel type → Fishery Training Vessel; Displacement → 283 Ton; Max Speed → 13,1; Length → 36,7 m; Breadth → 6,6; Bow Draft→ 1,5; Stern Draft → 3,4; Height of eye → 6 m; Type of Engine → Slow Speed Diesel 1x883 Kw; Type of Propeller → CPP; Thruster bow → yes; Thruster stern → no.

Figure 18: Fishery Training Vessel (Dis. 283 t). Source: Navigation Simulator

— ***SIMULATED CONDITIONS DURING THE FIRST 30 MINUTES WITH M/V "DJON DADE":*** *Current →110º/1.5 kn; Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction → 290º; Seabed → Sand; Depth → 6 m; Vessel coordinates (start of towing operation) → Lat. 14º 55,092 N and Lon. 024°30.186W; Distance from the vessel to the tip of Pier no. 1 (start of towing operation) → 321º/145 m; Distance between the vessel and the pier no. 2 (start of towing operation) → 333º/227 m; Distance between the vessel and the pier no. 3 (start of towing operation) → 357º/223 m; Simulation duration → 30 minutes.*

APPENDIX C – DETAILS OF SCENARIO 1

*- **FEATURES OF THE VESSEL SIMULATED AS M/V “DEIMOS”:** Vessel type → Coastal tanker; Displacement → 5325.0 t; Max Speed → 13.6 kn; Length → 88.8 m; Breadth → 16.5 m; Bow Draft→ 5.2 m; Stern Draft → 1.7 m; Height of eye → 13 m; Type of Engine → Medium Speed Diesel (1 x 2115 KW); Type of Propeller → CPP; Thruster bow → Yes; Thruster stern → No.*

Figure 19: Costal tanker (Dis. 5325 t). Source: Navigation Simulator

***— SIMULATED CONDITIONS DURING THE FIRST 20 MINUTES WITH M/V “DEIMOS”:** Current → 110º/1.5 kn; Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction → 290º; Seabed → Sand; Depth → 5.5 m; Vessel coordinates (start of towing operation) → Lat. 14º 55.116 N and Lon. 024°30.163W; Distance from the vessel to the tip of Pier no. 1 (start of towing operation) →313º/138 m; Distance between the vessel and the pier no.2 (start of towing operation) → 333º/313 m; Distance between the vessel and the pier no.3 (start of towing operation) → 351º/300 m; Simulation duration →20 minutes.*

***— FEATURES OF THE VESSEL SIMULATED AS THE TUGBOAT “PRAIA MARIA”:** Vessel type → ASD Tug 1 (bp 53t); Displacement →366.0 Ton; Max Speed →11.2 kn; Length → 25.3 m; Breadth → 10.4 m; Bow Draft→ 2.7 m; Stern Draft → 3.9 m; Height of eye → 7 m; Type of Engine High-Speed Diesel (2 x 1566 kW); Type of Propeller → Z-Drive FPP; Thruster bow → None; Thruster stern → no.*

Figure 20: ASD Tug 1 (bp 53t) (Dis. 366,0 t). Source: Navigation Simulator

*- **SIMULATED CONDITIONS DURING THE FIRST 25 MINUTES WITH“PRAIA MARIA”:** Current → 110º/1.5 kn; Wind→ 290/20 kn; Significant wave height→ 1.5 m; Direction → 290º; Seabed →Sand; Depth →6 m; Vessel coordinates (*start of towing operation*) →Lat. 14º 55,092 N and Lon. 024°30.186W; Distance from the vessel to the tip of Pier* no. *1 (*start of towing operation*) → 321º/145 m; Distance from the vessel to the tip of Pier* no. *2 (*start of towing operation*) →333º/227 m;* Distance between the vessel and the pier no. *3 (*start of towing operation*) →357º/223 m; Simulation duration →25 minutes.*

ATTACHMENTS

ANNEX1: VESSELS INVOLVED IN THE RESCUE OPERATIONS

M/V "DJON DADE"

VESSEL NAME	CALL SIGN	PORT OF REGISTRATION	GROSS/NET TONNAGE	KEEL
DJON DADE	D4BY	S. Vicente	418,71(T)/194,908T)	1968
IMO NUMBER	**LENGTH**	**WIDTH**	**DEPTH**	**HULL**
6908802	38,79 (m)	9,35 (m)	4,40 (m)	Steel
PROPULSION MACHINE	**POWER**	**YEAR OF CONSTRUCTION**	**GENERATORS**	**EMERGENCY GENERATOR**
DEUTZ RBV6M545	745.7 (kW)	1969	2x125KVA-128CV	-

Figure 21: "DJON DADE", Source: https://www.marinetraffic.com/pt/photos/of/vessels/vesselid:747782/vessels

MARITIME POLICE VESSEL

VESSEL NAME	CALL SIGN	PORT OF REGISTRATION	GROSS/NET TONNAGE	KEEL
IMO NUMBER	**LENGTH**	**WIDTH**	**DEPTH**	**HULL**
PROPULSION MACHINE	**POWER**	**YEAR OF CONSTRUCTION**	**GENERATORS**	**EMERGENCY GENERATOR**

Figure 22: Source:

TUGBOAT PRAIA MARIA

VESSEL NAME	CALL SIGN	PORT OF REGISTRATION	GROSS/NET TONNAGE	KEEL
PRAIA MARIA	D4HN	Cabo Verde	365	???
IMO NUMBER	**LENGTH**	**WIDTH**	**DEPTH**	**HULL**
9784817	25	12	-	-
PROPULSION MACHINE	**POWER**	**YEAR OF CONSTRUCTION**	**GENERATORS**	**EMERGENCY GENERATOR**

-	-	2016	-	-

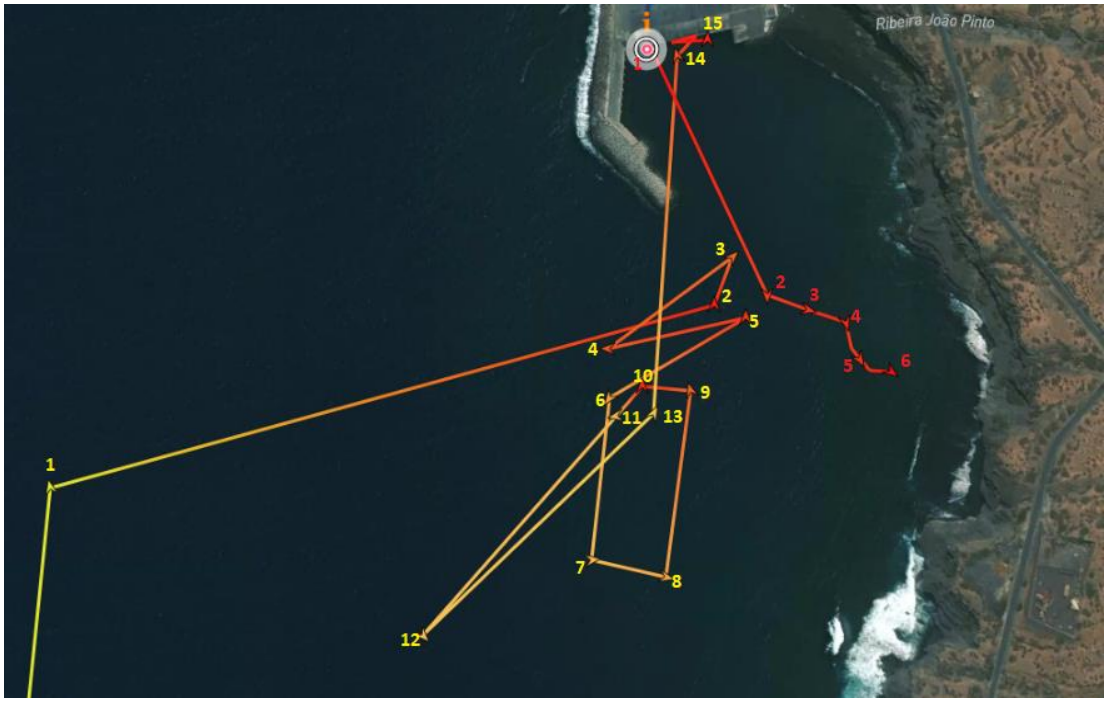
Figure 23:: “PRAIA MARIA”, Source: https://www.vesselfinder.com/vessels/MONTE-CARA-IMO-9179050-MMSI-617017000

TUGBOAT “MONTE CARA”

VESSEL NAME	CALL SIGN	PORT OF REGISTRATION	GROSS/NET TONNAGE	KEEL
MONTE CARA	-	Cabo Verde	429	1999
IMO NUMBER	**LENGTH**	**WIDTH**	**DEPTH**	**HULL**
9179050	35 (m)	11 (m)	-	Steel
PROPULSION MACHINE	**POWER**	**YEAR OF CONSTRUCTION**	**GENERATORS**	**EMERGENCY GENERATOR**
-	-	1999	-	-

Figure 24: Tugboat “MONTE CARA”, Source: VesselFinder

ANNEX 2 - PAST TRACK[8] OF M/V "DEIMOS" & M/V "DJON DADE"



1. **PAST TRACK M/V DEIMOS (RED NUMBERS)**

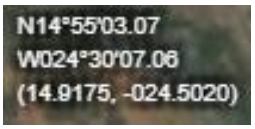
Position 0:	**Day:**	13 Nov 2020	N14°55'13.15 W024°30'14.19 (14.9203, -024.5039)
	Speed:	0.2 kn	
	Course:	275°	
	Time:	08:43 UTC	
	Source:	Sat-AIS	

Position 1:	**Day:**	13 Nov 2020	N14°55'04.81 W024°30'09.94 (14.9180, -024.5028)
	Speed:	0.9 kn	
	Course:	180°	
	Time:	09:03 UTC	
	Source:	Sat-AIS	

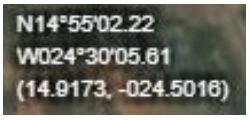
Position 2:	**Day:**	13 Nov 2020	N14°55'04.34 W024°30'08.51 (14.9179, -024.5024)
	Speed:	0.6 kn	
	Course:	104°	
	Time:	09:07 UTC	
	Source:	Sat-AIS	

[8] Source: Marine Traffic

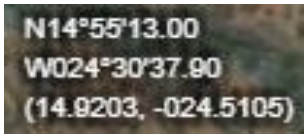
Position 3:	**Day:**	13 Nov 2020	
	Speed:	0.5 kn	
	Course:	164°	
	Time:	09:20 UTC	
	Source:	Sat-AIS	

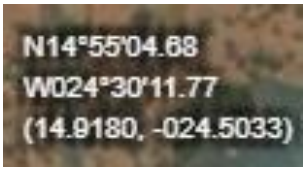
Position 4:	**Day:**	13 Nov 2020	
	Speed:	0.8 kn	
	Course:	227°	
	Time:	09:25 UTC	
	Source:	Sat-AIS	

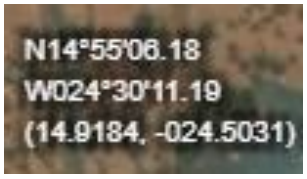
Position 5:	**Day:**	13 Nov 2020	
	Speed:	0.5 kn	
	Course:	218°	
	Time:	09:42 UTC	
	Source:	Sat-AIS	

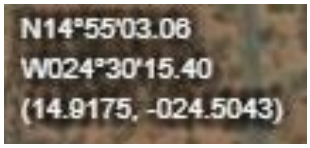
Position 6:	**Day:**	13 Nov 2020	
	Speed:	0.1 kn	
	Course:	125 °	
	Time:	10:06 UTC	
	Source:	Sat-AIS	

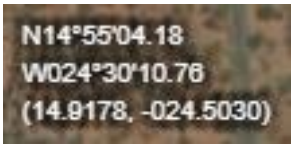
2. **PAST TRACK M/V DJON DADE (YELOW NUMBERS)**

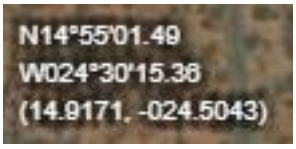
Position 1:	**Day:**	13 Nov 2020	
	Speed:	9.2 kn	
	Course:	348°	
	Time:	08:48 UTC	
	Source:	Sat-AIS	

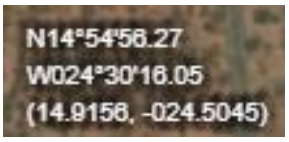
Position 2:	**Day:**	13 Nov 2020	
	Speed:	0.3 kn	
	Course:	0°	
	Time:	09:01 UTC	
	Source:	Sat-AIS	

Position 3:	**Day:**	13 Nov 2020	
	Speed:	1.7 kn	
	Course:	46°	
	Time:	09:09 UTC	
	Source:	Sat-AIS	

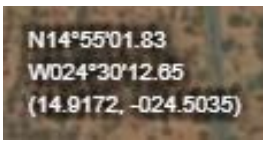
Position 4:	**Day:**	13 Nov 2020	
	Speed:	1.3 kn	
	Course:	271°	
	Time:	09:12 UTC	
	Source:	Sat-AIS	

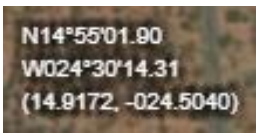
Position 5:	**Day:**	13 Nov 2020	
	Speed:	0.8 kn	
	Course:	0°	
	Time:	09:15 UTC	
	Source:	Sat-AIS	

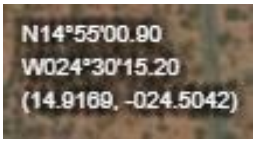
Position 6:	**Day:**	13 Nov 2020	
	Speed:	3.6 kn	
	Course:	217°	
	Time:	09:19 UTC	
	Source:	Sat-AIS	

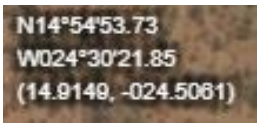
Position 7:	**Day:**	13 Nov 2020	
	Speed:	4.5 kn	
	Course:	83°	
	Time:	09:24 UTC	
	Source:	Sat-AIS	

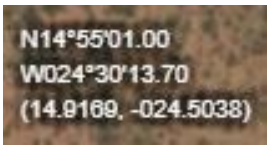
Position 8:	**Day:**	13 Nov 2020	
	Speed:	3.7 kn	
	Course:	104°	
	Time:	09:30 UTC	
	Source:	Sat-AIS	

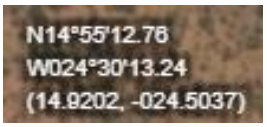
Position 9:	**Day:**	13 Nov 2020	
	Speed:	1.6 kn	
	Course:	342°	
	Time:	09:33 UTC	
	Source:	Sat-AIS	

Position 10:	**Day:**	13 Nov 2020	
	Speed:	0.5 kn	
	Course:	0°	
	Time:	09:37 UTC	
	Source:	Sat-AIS	

Position 11:	**Day:**	13 Nov 2020	
	Speed:	4.4 kn	
	Course:	259°	
	Time:	09:43 UTC	
	Source:	Sat-AIS	

Position 12:	**Day:**	13 Nov 2020	
	Speed:	4.8 kn	
	Course:	136°	
	Time:	09:46 UTC	
	Source:	Sat-AIS	

Position 13:	**Day:**	13 Nov 2020	
	Speed:	5.8 kn	
	Course:	28°	
	Time:	09:48 UTC	
	Source:	Sat-AIS	

Position 14:	**Day:**	13 Nov 2020	
	Speed:	1.2 kn	
	Course:	344°	
	Time:	09:52 UTC	
	Source:	Sat-AIS	

Position 15:	**Day:**	13 Nov 2020	
	Speed:	0.4 kn	
	Course:	0°	
	Time:	09:54 UTC	
	Source:	Sat-AIS	

ANNEX 3 - INMG WEATHER BULLETIN

INMG
INSTITUTO NACIONAL DE METEOROLOGIA E GEOFÍSICA

Direção de Meteorologia e Clima
Centro de Análises e Previsões Especiais
Meteorologia Marítima metmar.cape.inmg@gmail.com

INFORMAÇÃO METEOROLÓGICA PARA A NAVEGAÇÃO E PESCA
(INTENSIDADE DO VENTO EM ESCALA BEAUFORT; ALTURA DAS ONDAS EM METROS)

BOLETIM Nº20201113

1 – FENÓMENOS ADVERSOS/AVISOS: Ondulação (Swell) NW 2.0 – 3.5m a Noroeste/Norte do Arquipélago, afectando gradualmente Zonas Costeiras Norte/Oeste em Barlavento/Sotavento Ocidental e Sectores Inter-Ilhas em Barlavento Oriental.

2 – SITUAÇÃO GERAL E EVOLUÇÃO:

- Alta 1027 34N54W, com pouca alteração.
- Baixa 1014 39N18W, movendo NE, dissipando.
- Tempestade Tropical "**Theta"**, perto de 32N25W em 13/09 UTC, movendo Leste 10 kt. Pressão mínima estimada 993 mb, vento máximo sustentado 50 kt com rajadas 60 kt.
- ZCIT de 13N17W, 08N30W, 05N40W.

3 – PREVISÃO 24 HORAS (13/11/2020 1200 HL – 14/11/2020 1200 HL):

BARLAVENTO OCIDENTAL: Vento NE 4, ocasionalmente 5 em Sectores durante o dia, localmente 3 à noite/iníco do dia. Ondas NW 2.0 – 3.5m, localmente 1.0 – 2.5m em Zonas Costeiras Sudeste/Sul e Sectores Inter-Ilhas. Visibilidade temporariamente moderada (<5Mil.Naut.) devido a bruma seca em Sectores.

BARLAVENTO ORIENTAL: Vento NE 3 – 4, localmente 2 durante a madrugada. Ondas NW 2.0 – 3.5m, localmente 1.0 – 2.5m em Zonas Costeiras Sudeste/Sul. Visibilidade temporariamente moderada (<5Mil.Naut.) devido a bruma seca.

SOTAVENTO OCIDENTAL/ORIENTAL: Vento NE 3 – 4, localmente VAR 2 à noite/madrugada. Ondas NW 1.0 – 2.5m, diminuindo nas Zonas Costeiras Sudeste/Sul, 2.0 – 3.5m a Oeste do Arquipélago. Visibilidade temporariamente moderada (<5Mil.Naut.) devido a bruma seca, a Leste do Arquipélago.

4 – PREVISAO 24 HORAS (14/11/2020 1200 HL – 15/11/2020 1200 HL):

BARLAVENTO OCIDENTAL/ORIENTAL: Vento NE 4, temporariamente 5 em Sectores na Zona Ocidental durante o dia, localmente 3 à noite/madrugada. Ondas NNW/NE 2.0 – 3.5m, diminuindo gradualmente, localmente 1.0 – 2.5m em Zonas Costeiras Sul, incluindo Sectores Inter-Ilhas na Zona Ocidental. Visibilidade temporariamente moderada (<5Mil.Naut.) a Leste do Arquipélago.

SOTAVENTO OCIDENTAL/ORIENTAL: Vento NE 3 – 4, ocasionalmente 5 em Sectores na Zona Ocidental durante o dia, localmente 2 à noite/início do dia. Ondas N/NE 1.0 – 2.5m, 2.0 – 3.5m mais a Oeste do Arquipélago. Visibilidade temporariamente moderada (<5Mil.Naut.) a Leste do Arquipélago.

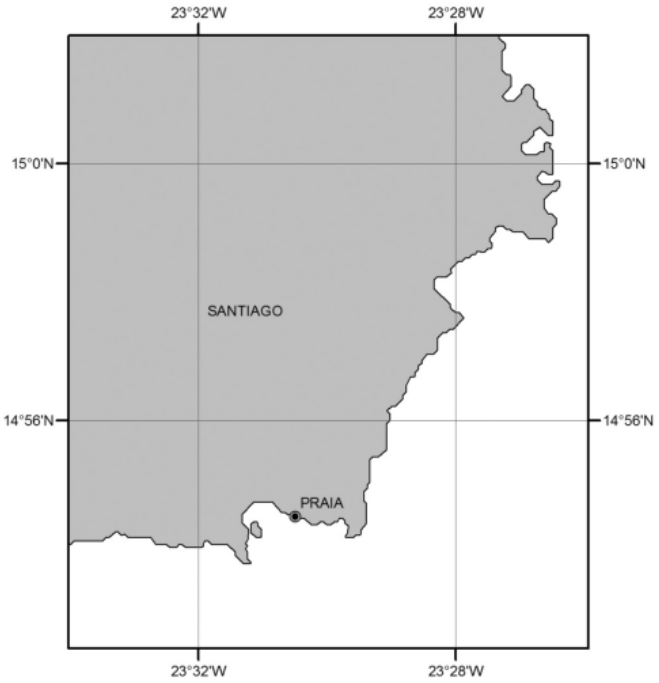
5 – TENDÊNCIA 72 HORAS (15/11/2020 1200 HL – 16/11/2020 1200 HL):

BARLAVENTO OCIDENTAL/ORIENTAL, SOTAVENTO OCIDENTAL/ORIENTAL: Vento NE 4 – 5, localmente 3 à noite/início do dia. Ondas N/NE 1.0 – 2.5m, diminuindo em Zonas Costeiras Sul, 2.0 – 3.0m a Oeste/Norte/Nordeste do Arquipélago e em Sectores Inter-Ilhas em Barlavento Oriental.

ANNEX 5 – PORT OF PRAIA TIDE CHART (2020)

(October to December 2020)

PORTO DA PRAIA (ILHA DE SANTIAGO)



NOTAS

1. Análise harmónica:

   — Efetuada a partir de observações maregráficas de 9 de outubro de 1984 a 10 de outubro de 1985.

2. Localização do marégrafo (atualmente desativado):

   — Latitude 14° 55,0′ N; Longitude 23° 30,0′ W.

3. Alturas de maré:

   — Referidas ao nível do zero hidrográfico.

4. Zero hidrográfico:

   Situado:

   — 0,80 m abaixo do nível médio do mar.
   — 3,177 m abaixo da marca de nivelamento BM0001A situada no extremo do molhe.
   — 3,249 m abaixo da marca de nivelamento BM0001B situada no molhe a N do canto SW de uma vedação que protege duas válvulas.
   (As duas marcas de nivelamento referidas estão associadas a um marégrafo instalado na posição 44° 54,5′ N e 23° 30,5′ W e que funcionou 254 dias em 1995 e 1996.)

PORTO DA PRAIA (ILHA DE SANTIAGO)

HORAS DO FUSO 1 (TU - 1) 2020

OUTUBRO

	Hora	Altura		Hora	Altura
	h m	m		h m	m
1 QUI	01 14	0.3	16 SEX	00 44	0.3
	07 33	1.4		06 59	1.5
	13 42	0.3		13 15	0.2
	19 51	1.3		19 30	1.4
2 SEX	01 47	0.3	17 SÁB	01 27	0.2
	08 05	1.4		07 45	1.5
	14 11	0.3		13 55	0.2
	20 21	1.3		20 11	1.5
3 SÁB	02 18	0.3	18 DOM	02 11	0.2
	08 36	1.3		08 30	1.5
	14 39	0.3		14 35	0.2
	20 49	1.3		20 53	1.5
4 DOM	02 48	0.3	19 SEG	02 56	0.2
	09 06	1.3		09 16	1.5
	15 07	0.3		15 15	0.2
	21 17	1.3		21 36	1.5
5 SEG	03 19	0.3	20 TER	03 43	0.2
	09 36	1.2		10 02	1.4
	15 34	0.4		15 57	0.3
	21 46	1.2		22 21	1.4
5 SEG	03 19	0.3	20 TER	03 43	0.2
	09 36	1.2		10 02	1.4
	15 34	0.4		15 57	0.3
	21 46	1.2		22 21	1.4
6 TER	03 50	0.4	21 QUA	04 33	0.3
	10 06	1.2		10 50	1.2
	16 03	0.4		16 41	0.3
	22 17	1.2		23 11	1.3
7 QUA	04 24	0.4	22 QUI	05 29	0.4
	10 38	1.1		11 44	1.1
	16 34	0.4		17 30	0.4
	22 52	1.2			
8 QUI	05 03	0.5	23 SEX	00 09	1.2
	11 15	1.0		06 35	0.5
	17 11	0.5		12 50	1.0
	23 35	1.1		18 30	0.5
9 SEX	05 51	0.6	24 SÁB	01 24	1.2
	12 02	1.0		07 58	0.5
	17 57	0.6		14 18	1.0
				19 53	0.6
10 SÁB	00 34	1.1	25 DOM	02 50	1.2
	06 55	0.6		09 26	0.5
	13 15	0.9		15 45	1.0
	19 02	0.6		21 28	0.6
11 DOM	01 58	1.1	26 SEG	04 03	1.2
	08 25	0.6		10 35	0.5
	14 57	0.9		16 49	1.0
	20 35	0.6		22 39	0.6
12 SEG	03 24	1.1	27 TER	05 00	1.2
	09 58	0.6		11 25	0.5
	16 20	1.0		17 37	1.1
	22 05	0.6		23 31	0.5
13 TER	04 31	1.2	28 QUA	05 46	1.3
	11 02	0.5		12 04	0.4
	17 18	1.1		18 16	1.2
	23 08	0.5			
14 QUA	05 24	1.3	29 QUI	00 12	0.4
	11 51	0.4		06 26	1.3
	18 05	1.2		12 38	0.4
	23 58	0.4		18 50	1.2
15 QUI	06 13	1.4	30 SEX	00 48	0.4
	12 34	0.3		07 02	1.3
	18 48	1.4		13 09	0.4
				19 21	1.3
			31 SÁB	01 22	0.4
				07 35	1.3
				13 38	0.3
				19 51	1.3

NOVEMBRO

	Hora	Altura		Hora	Altura
	h m	m		h m	m
1 DOM	01 53	0.4	16 SEG	01 55	0.2
	08 07	1.3		08 11	1.4
	14 06	0.3		14 10	0.2
	20 20	1.3		20 33	1.5
2 SEG	02 24	0.3	17 TER	02 42	0.2
	08 38	1.2		08 59	1.4
	14 34	0.3		14 52	0.2
	20 49	1.3		21 17	1.5
3 TER	02 56	0.4	18 QUA	03 31	0.2
	09 09	1.2		09 46	1.3
	15 03	0.3		15 35	0.3
	21 20	1.3		22 03	1.4
4 QUA	03 29	0.4	19 QUI	04 22	0.3
	09 42	1.2		10 34	1.2
	15 34	0.4		16 19	0.3
	21 53	1.3		22 53	1.4
5 QUI	04 06	0.4	20 SEX	05 16	0.4
	10 17	1.1		11 26	1.1
	16 08	0.4		17 08	0.4
	22 30	1.2		23 48	1.3
5 QUI	04 06	0.4	20 SEX	05 16	0.4
	10 17	1.1		11 26	1.1
	16 08	0.4		17 08	0.4
	22 30	1.2		23 48	1.3
6 SEX	04 47	0.5	21 SÁB	06 17	0.4
	10 56	1.0		12 26	1.0
	16 46	0.5		18 04	0.5
	23 14	1.2			
7 SÁB	05 36	0.5	22 DOM	00 54	1.2
	11 46	1.0		07 26	0.5
	17 34	0.6		13 40	1.0
				19 15	0.6
8 DOM	00 10	1.2	23 SEG	02 08	1.2
	06 39	0.6		08 40	0.5
	12 57	1.0		14 59	1.0
	18 39	0.6		20 39	0.6
9 SEG	01 26	1.1	24 TER	03 16	1.2
	07 59	0.6		09 46	0.5
	14 31	1.0		16 04	1.0
	20 05	0.6		21 54	0.6
10 TER	02 48	1.2	25 QUA	04 15	1.2
	09 21	0.5		10 39	0.5
	15 49	1.1		16 56	1.1
	21 31	0.6		22 52	0.6
11 QUA	03 56	1.2	26 QUI	05 04	1.2
	10 26	0.5		11 23	0.5
	16 48	1.2		17 39	1.2
	22 38	0.5		23 39	0.5
12 QUI	04 53	1.3	27 SEX	05 48	1.2
	11 18	0.4		12 00	0.4
	17 37	1.3		18 17	1.2
	23 32	0.4			
13 SEX	05 45	1.4	28 SÁB	00 19	0.5
	12 03	0.3		06 27	1.2
	18 22	1.4		12 34	0.4
				18 51	1.2
14 SÁB	00 21	0.3	29 DOM	00 56	0.4
	06 35	1.4		07 04	1.2
	12 46	0.2		13 06	0.4
	19 06	1.5		19 23	1.3
15 DOM	01 08	0.2	30 SEG	01 30	0.4
	07 23	1.4		07 40	1.2
	13 28	0.2		13 36	0.3
	19 49	1.5		19 55	1.3

DEZEMBRO

	Hora	Altura		Hora	Altura
	h m	m		h m	m
1 TER	02 04	0.4	16 QUA	02 33	0.2
	08 14	1.2		08 46	1.3
	14 07	0.3		14 35	0.2
	20 28	1.3		21 04	1.5
2 QUA	02 38	0.4	17 QUI	03 22	0.2
	08 49	1.2		09 32	1.2
	14 40	0.3		15 19	0.3
	21 01	1.3		21 49	1.4
3 QUI	03 15	0.4	18 SEX	04 10	0.3
	09 24	1.1		10 18	1.2
	15 14	0.4		16 03	0.3
	21 37	1.3		22 36	1.4
4 SEX	03 54	0.4	19 SÁB	04 59	0.3
	10 02	1.1		11 03	1.1
	15 51	0.4		16 48	0.4
	22 17	1.3		23 24	1.3
5 SÁB	04 37	0.4	20 DOM	05 48	0.4
	10 44	1.1		11 52	1.0
	16 32	0.4		17 35	0.5
	23 01	1.3			
5 SÁB	04 37	0.4	20 DOM	05 48	0.4
	10 44	1.1		11 52	1.0
	16 32	0.4		17 35	0.5
	23 01	1.3			
6 DOM	05 26	0.5	21 SEG	00 16	1.2
	11 34	1.0		06 40	0.5
	17 21	0.5		12 47	1.0
	23 54	1.2		18 30	0.6
7 SEG	06 22	0.5	22 TER	01 12	1.2
	12 37	1.0		07 36	0.5
	18 21	0.6		13 51	1.0
				19 35	0.6
8 TER	00 59	1.2	23 QUA	02 13	1.1
	07 28	0.5		08 37	0.6
	13 56	1.0		14 59	1.0
	19 35	0.6		20 49	0.6
9 QUA	02 11	1.2	24 QUI	03 14	1.1
	08 39	0.5		09 37	0.6
	15 11	1.1		16 01	1.0
	20 54	0.6		21 59	0.6
10 QUI	03 20	1.2	25 SEX	04 11	1.1
	09 45	0.4		10 31	0.5
	16 14	1.2		16 55	1.1
	22 06	0.5		22 59	0.6
11 SEX	04 22	1.3	26 SÁB	05 04	1.1
	10 43	0.4		11 18	0.5
	17 09	1.3		17 41	1.1
	23 07	0.4		23 49	0.5
12 SÁB	05 20	1.3	27 DOM	05 53	1.1
	11 34	0.3		11 59	0.4
	17 59	1.4		18 21	1.2
13 DOM	00 02	0.3	28 SEG	00 32	0.5
	06 15	1.3		06 37	1.1
	12 22	0.3		12 37	0.4
	18 47	1.4		18 58	1.2
14 SEG	00 54	0.3	29 TER	01 11	0.4
	07 08	1.3		07 17	1.1
	13 08	0.2		13 12	0.3
	19 33	1.5		19 34	1.3
15 TER	01 44	0.2	30 QUA	01 49	0.4
	07 58	1.3		07 56	1.1
	13 52	0.2		13 47	0.3
	20 18	1.5		20 10	1.3
			31 QUI	02 26	0.3
				08 33	1.1
				14 23	0.3
				20 47	1.4

Devido à variação do nível médio do mar, são de esperar alturas de água superiores, em cerca de 0.1 m, aos valores indicados na tabela.