



Gabinete de Prevenção e de
Investigação de Acidentes Marítimos

Investigation Report 54 - 2013



“Douro Queen”

April 25, 2013

Report nº: 54/2013

Title: “Douro Queen”

Ratification: June 05, 2014

Classification: Less serious

Name of vessel: Douro Queen

IMO nr:

Registry nr: P-180-AC

State substantially interested:

This report was prepared by the Maritime Accidents Prevention and Investigation Cabinet (GPIAM), which is the office of the central administration of the State that has the mission to investigate the sea accidents and events as accurate and as soon as possible, having in mind the identification of eventual causes and to disclose the related reports, to promote studies, recommendations in sea safety matters in order to minimize the sea disasters and to take part in commissions, organizations of national or foreign activities.

The current report was prepared under the norms of the International Marine Organization (IMO) and following the common procedure of the European Community.

The GPIAM investigations are independent from regulators entities, operators or other outsiders. It is not the object of an investigation to find out guilt or responsibility, therefore this report should not be used for legal actions neither can be used in court as evidence.

The safety recommendations that might result from this report cannot, under any circumstance, create a presupposition of responsibility or guilt.

The hours referred to in this report are local time and the coordinates are in datum WGS84.

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Description:

At 0700 of April 25 2013, the passenger vessel “Douro Queen” left the Gaia port with destination to the Régua river port, situated on the water way of the Douro River. By 0815 she entered the lockage of the dam of Crestuma.

Then, she sailed under a normal rhythm between 7 to 8 knots when around Km 48 and after passing by the Sardoura dock downstream of Entre-os-Rios and after performing a curve of the river and when the change of course was being compensated with the steering gear, the latter blocks and the alarms start giving malfunction signals.

The master, following the instructions of the steering system manufacturer (“Veth Z Drive” – Fig. 1), tries to restart the system. However he could not do it.

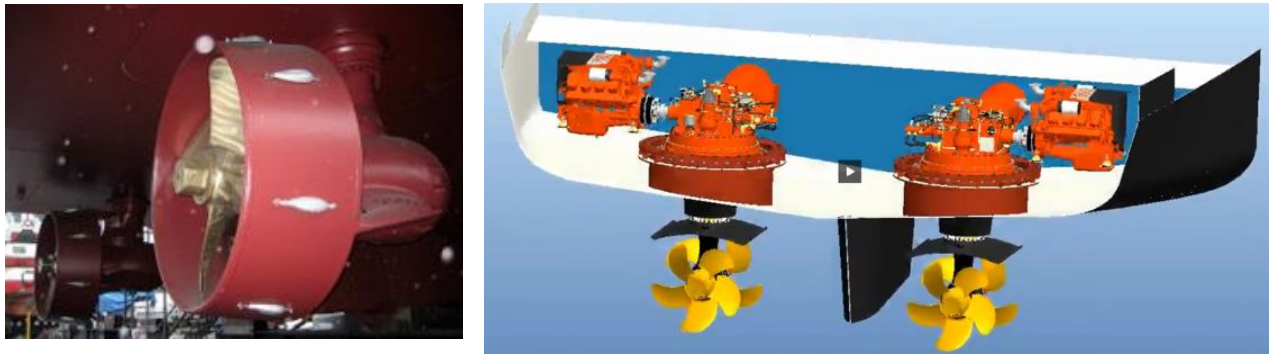


Fig 1 – Type of steering and maneuver “Veth Z Drive”

The ship was sailing headway at a speed of around 7,7/7,8 knots and the “rudder” at portside. The master drops the stern anchors (bridge control system) and orders the bow anchors to be dropped while trying to restart the system once more.

Due to the reduced width of the river in the area, the available space to immobilize the ship is not enough, consequently the “Douro Queen” crashed into the stern of two vessels “Cláudia” and “Maia” that were moored side by side on the north margin of the river, at a local pier, which caused the braking of the mooring of the vessels. The vessel “Cláudia” was moored on the outside of “Maia”.



Fig. 2 – Damage on “Cláudia” and on “Maia”

The collision and the effect of the two dropped anchors altogether immobilized the ship. The two loose vessels are dragged by the local current to the middle of the river.

The collision still caused some damage to the bridge (fig. 3).



Fig. 3 – Damage on the bridge

The master, after checking that no one was injured on board of “Douro Queen” and that the ship was not in danger, ordered to launch a craft in order to proceed to the necessary maneuvers to collect and anchor the vessels which, because they did not have any watchmen on board, were adrift and without control.

After this maneuver and having received instructions from the owner whom he had contacted via cellphone, the master sailed “Douro Queen” to the Inersel – Construções, S.A pier that was near them, in order to proceed to the disembark of and assistance to the passengers that were on board and to proceed to the assessment of damages, surveys and repairs that would become necessary.



Fig. 4 – Damage on “Douro Queen”

Data

I. Ship/Vessel

Name:	Douro Queen
Radio Call:	CSXU6
IMO nr:	
MMSI:	263751340
Registry nr:	P-180-AC
Flag:	Portugal
Registry Port:	Douro
Type:	Auxiliary-commerce (Maritime-Touristic)
Sub-Type:	Passengers
Classification:	Bureau Veritas (France)
Gross gauging:	1587
Displacement:	
Gross capacity (tdw):	
Length overall:	78.11m
Length between perpendiculars:	73.84m
Length:	11.4m
Depth:	
Draft:	1.5m
Year of Construction:	2004
Shipyard:	Estaleiros Navais de Viana do Castelo
Construction site:	Viana do Castelo
Hull material:	Steel
Type of hull:	Single-hull
Main machine:	2 x Schottel – Deutz
Power installation:	1220 kW
Nr of generators:	4 (four) – 2 at stern of the machine house, 1 at bow for the electric “Bowthruster” feeding and 1 emergency at bow
Owner:	DouroAzul – Sociedade Marítimo-Turística, SA
Shipowner/Operator:	DouroAzul – Sociedade Marítimo-Turística, SA
Safety capacity/maxim:	5/160
Authorized cargo:	Passengers

II. Weather Conditions

Sea Conditions :	Smooth
Direction of surge:	
Height of surge:	
Height of wave:	
Wind speed:	Calm
Wind direction:	
Visibility:	Good (>5 and <=25 nm)
Natural Light:	

Tide:
Period of tide:
Current:
Water temperature:
Air temperature:

III. Journey

Port of origin: Gaia (Douro River)
Ports of call:
Destination Port: Régua (Douro Inland Waterway)
Type: Inland waterway
Segment: Transit
Nr of days since departure:
Commercial journey: Maritime-Touristic (cruiser)

Number of crew: 27
Number of passengers: 99
Official language on board: Portuguese
Number of nationalities: One

Cargo: Passengers

IV. Accident

Type: Less Serious
Date: April 25, 2013
Time: 1035
Location: Km 48 – Douro inland waterway
Latitude: 40°04'.9N
Longitude: 008°17'.5W
Location on board: Bow
Fatalities: 0

Analysis

The ship “Douro Queen” has an azimuthal propelling system consisting of two machines equipped with “Veth Z Drive” directional propellers, one at SS and another one at PS that can work either independently or in pair mode, i.e., their speed or direction can be operated independently of one another or can be controlled simultaneously by a unique command wherein one of the machines works on a “slave” mode from the other.

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Fig. 5 – Command and steering console on the bridge

The independent function way is normally chosen when the ship starts the maneuvers and the pair-mode is used during transit along the river because the independent control of each propellers in addition to be very tiring when exposed to a long operation period, may be a risk in this type of navigation, i.e., may not keep the desirable stability, both for deflections as for straight direction sailing.



Fig. 6 – Steering and maneuvering command of each of the propellers



Fig. 7 – Operator's position during independent function mode

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At that moment, once the ship was in transit between locks, the machine at SS was working as “master” and the one at PS as “slave”.

When the machines are in pair-mode functioning (master/slave) they do not allow astern commands. That means, in order to be able to steer any speed astern, it is necessary to have the machines working independently. Therefore, the propeller shaft direction needs to rotate 180° to reverse the direction of speed.

The ship is equipped with two anchors at the bow, operable from the bow area and one at stern, at amidships, operable from the bridge.

The propellant shaft, theoretically, takes about 20 seconds to rotate 360°.

To operate the alternative steering of the vessel (direction) it is necessary to operate the electric valves situated at the stern of the propellant head “Z-Drive” (fig. 8).

The steering gear system that connects the drive shaft to the propeller transmitter shaft is located afore of the propeller’s head. In this type of propeller, when there is a power failure, the steering gear automatically engages the drive shaft to the transmitter.

In order to ensure the operability of the ship and prevent “blackout” situations that may jeopardize the steering system, the vessel is equipped with two generators located in the machine house that keep the electric systems of the ship under normal conditions, one generator at the stem ahead of the bridge and a battery pack to feed the feeding system of the steering and maneuvering “Z-Drive” system.

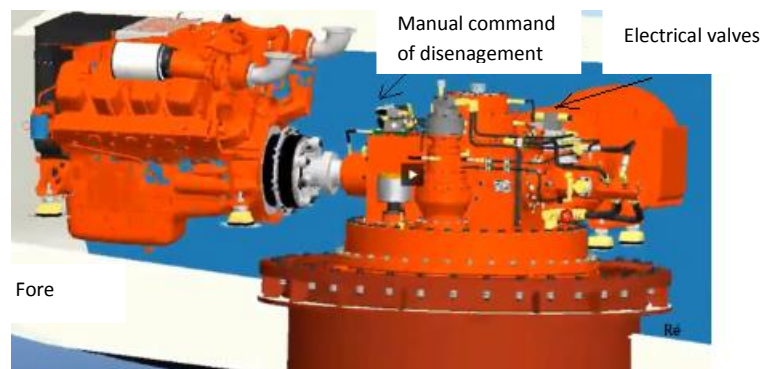
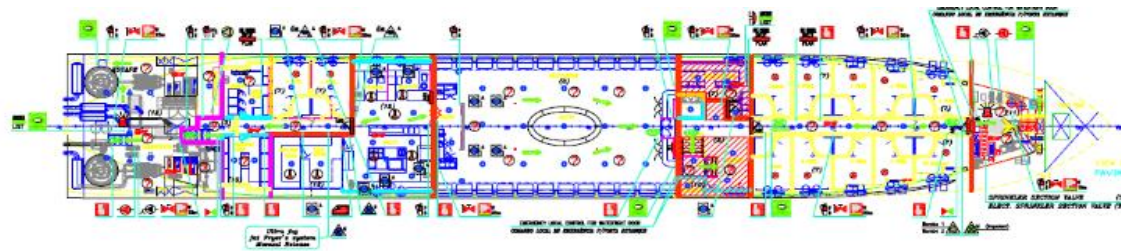


Fig. 8 – Manual commands of the propeller

The Machine House (MH) of “Douro Queen” is located at the stern, with an entry through the maneuver park of the stern and, as it can be seen on Fig 9, it is quite small, thus there is little free space between the several items installed there. The access to the stern part of the “Z-drive” propellers is quite difficult and the available space is quite small which makes the position to operate the electrical valves of the propellers controls quite uncomfortable and requires the operator to be in a squatted position, even a bit twisted.

When the MH is fully operating, i.e. in a normal mode with the two generators and both main machines operating, the noise level inside is very high which makes communication very difficult.

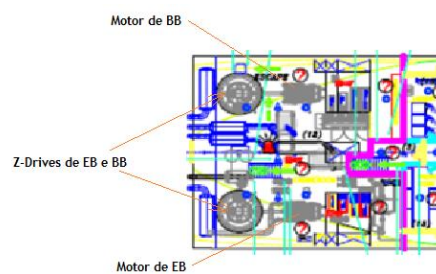
It should be noted that the manual operation of the two propellers must be done under independent functioning, i.e., it is not possible to operate them in a *master/slave* mode and to be able to operate the two propellers in a manual mode simultaneously it is required two operators (one for each propeller).



Machine house covering plant



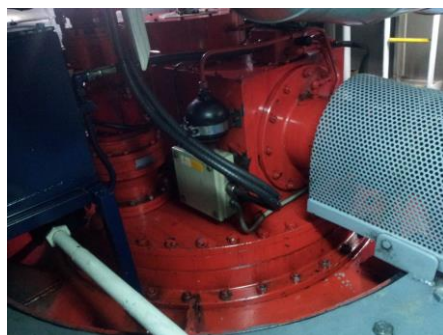
Machine House location and arrangement plant



Central corridor view, PS machine and part of the fore of the Machine House



SS Machine



"Z-drive" SS propeller's head and surrounding area near the rail and at stern



Motor shaft of machine at SS and corridor passage to the rail area towards the stern

Fig.9 - Machine house covering plant of "Douro Queen", details of its arrangement and inside views

As far as the crew is concerned, there is only one driver (1st class practical ship machinist) who is responsible for all the mechanical and electrical installation on board of the ship.

Having the necessity to activate the manual steering control system, i.e., to operate on the direction of the propeller(s) manually, the driver in the machine house has to perform the following tasks, assuming that he knows in advance in which propeller to act or whether it is indifferent which one to choose:

- To go to one of the “Z-drive” propellants and to disengage it in order to be able to operate on the other one without interruptions;
- To go across the machine house to the rail on the opposite side and to go to the stern part of the “Z-drive” system of that side;
- Operate on the orientation of electrical valve with a screw driver according to the instructions received from the bridge.

The ship had undergone general inspections before the cruising season began, having accomplished the checking, maintenance and inspection operations and the certification had been renovated at the end of March 2013 (one month previous to the accident).

It was the first time that a problem with the steering and maneuvering system occurred either on this ship or on her twin ship “Douro Cruiser”, both with , at least, 8 to 9 years operating without problems on their propelling system.

As soon as the ship left the Crestuma canal and started her journey towards Carrapatelo, the machines were placed in pair mode.

Upstream and after passing Sardoura dock, the river bends to the right at the Entre-os-Rios area (Fig. 10), therefore the ships have to do a sharp turn to starboard.

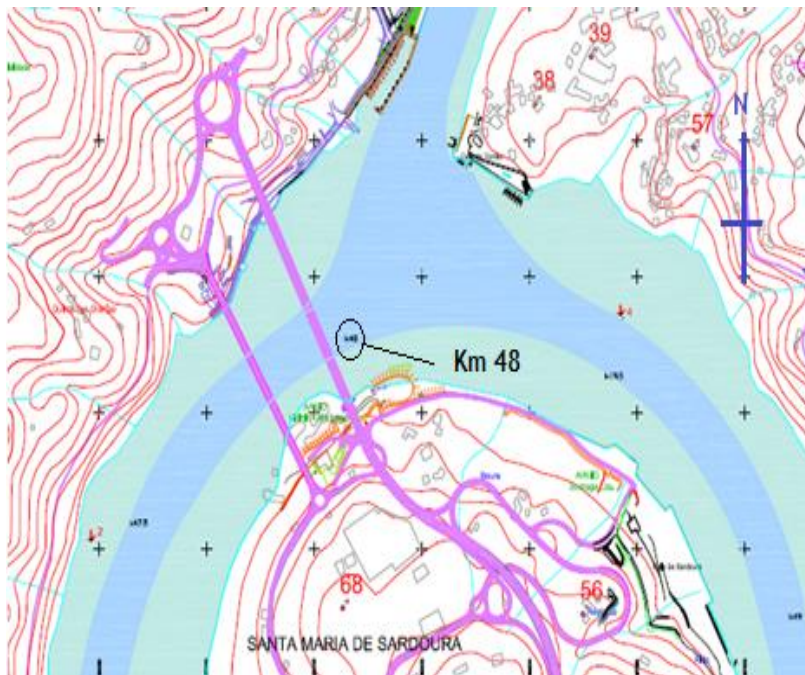


Fig. 10 – Excerpt of chart nr 24 of the inland waterway of river Douro (DGRM)

In this area and in the middle of the canal, the medium depth of the river is 12 meters, the minimum width is 200m and the maximum is 320m and the available distance from the center of the canal to the north bank varies between a minimum of 100 to a maximum of 160/180m.



Fig. 11 – Satellite view of the curve of the river (Google Earth ®)

Considering that the traffic, at this particular section, was little and as a safety manner to prevent eventual changes on the depth occurred on the river bed due to the heavy rains and frequent discharges done on the previous days by the dams upstream of the river, the master decided to sail close to the canal axis, slightly close to starboard (Fig.12).

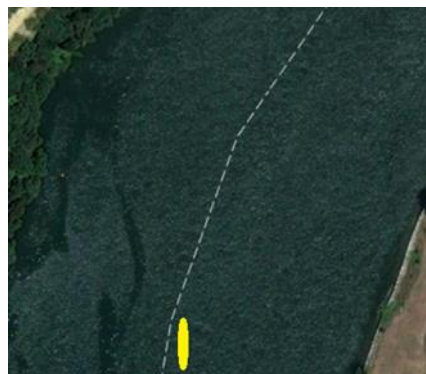


Fig. 12 – Canal axis and position related to “Douro Queen” (modified image. Source: Google Earth ®)

The distance between the canal axis to the north river banks was about 110 meters at the narrowest section, widening to about 160/180 meters at the widest section. I.e., the length of the ship corresponded to, approximately between 70% from the available distance to immobilize the vessel in the first case and about 50% in the second case.

When “Douro Queen” got close to kilometer 48, sailing at a speed of about 7.7 to 7.8 knots, the master, with the ship deflecting to starboard and with the two machines on pair mode, “puts the helm” to port to balance the deflection. At this moment, the steering system blocks, stops responding and the alarm goes off.

The ship, without directional control and going afore, deflected to portside.

No alarm goes off in the machine house indicating that there had been a failure in the command and control system of the propellers or that something was wrong with the steering system of the ship.

The master tries to restart the direction command system of the propellers and stops the machine. The system remains directionally blocked. He stops the machine and drops the stern anchors which is controlled from the bridge and orders that the bow anchor to be dropped (bow castle). He tries to restart the steering system again, but without success.

Considering the depth of the river in the area and the available distance, the anchors do not have enough time to ground and hold the ship.

It should be noted that at the speed of the ship (7.7 knots) it would have taken 25 seconds in the first case and 37/40 seconds in the second case. At that point, even with the machine at a standstill, it would have been very difficult to stop the initial displacement of the ship within the available space without the help of the machine going astern.

As the bow generator was stopped, the available time to throw and be able to operate the “bowthruster” to oppose the deflection of the ship, was not enough.

A manual mode operation on the “Z-drive” system in the machine house would require a very calculated coordination bridge/machine work, even if a number of steps were fulfilled without any interruptions and delays.

To begin with, the master would have to be completely understood when communicating with the Machine House (MH) and the driver would have to understand immediately that he had to take over the emergency steering of the ship. In order for that to happen, either there was a specific alarm that could be operated from the bridge that would indicate without doubt in the HM that the master did not have directional control on the ship propellers on the bridge, or due to the noise in the MH, it would be difficult for the driver, who does not expect a failure of that type (failure of the electronic command of the directional electrical valves), to react to the bridge communication with the required speed.

Then, after the driver’s recognition of the need to take over the emergency steering of the ship, he should go to one of the propellers (placed at on one the sides of the ship) and disengage it assuming that it would not matter which one or that the driver knew immediately and in advance, which one to disengage.

Afterwards, in case he did not have the right screwdriver nearby to operate on the electrical valves, he would have to go to the warehouse, grab it and go to the opposite side so that he could go around the “Z-drive” propellant’s head where he would work, in order to get a position at its stern. For this, he would have to squat to pass over the engine shaft connected to that propeller, go close to the rail, place himself sideways and go behind the propellant’s head, squatting near the electrical valve.

Only in this situation could he work on the electrical valve with the screwdriver, following orders given from the bridge and begin to turn the propeller 180°, which, theoretically, could have been done in 10 seconds considering that its initial position was 180°.

In this situation, we still have to consider the control and regulation of the propeller speed rotation issue, i.e. the speed to give to the ship that would also have been done by the only man on duty in the HM.

Under these circumstances (sailing in restricted waters as of a river) and in order to have some chances of success - emergency steering from the HM – the master would still be required, after realizing the loss of directional control and propellers speed, to contact the HM immediately and not waste time trying to find alternative solutions as he did (such as trying to “reset” the system).

After the accident, when the ship was sent to the Inersel dock with the steering system still inoperable, the shipowner’s experts went through a general survey of the system, the electronic steering circuits and the engine commands. Nothing was found broken, faulty, burned, loose or in any other way incorrectly erected or working.

After being berthed at the Inersel dock for four to five hours, a system launch test was done and the system started and worked correctly.

In order to deepen the analysis of the breakdown and to proceed with the repairs that would be necessary, the company called for the Dutch manufacturer technicians of the propellant system (Veth Propulsion B.V.). They could not reproduce the breakdown and as a safety measure, they replaced the electronic boards of the command of the maneuver and steering system and considered the ship ready to continue her journey, after a survey by the qualified authorities.

Although the Veth Propulsion B.V. technicians could not identify the reason for the breakdown, they pointed out as probable causes: a breakdown on PCB – Veth box ECR (electronic command board) – at starboard which was working as master and caused the loss of control over both the propellants occurred by a bad contact on the potentiometers switches or on the PCB supply.

Conclusions

Of this report we can conclude the following:

- a) The accident was due to an unidentified breakdown of the electronic system of the SS propellant command which was working as “master” and caused a failure on both propellants.
- b) As contributive factors to the accident we may point out:
 - a) The reduced available space for maneuvering in this area of the river, the inability to reverse the ship direction of travel by means of rotation of her propellant(s) and the speed of the ship at the time, made it impossible to stop the ship in the available space;
 - b) The periods of heavy rain on the previous days of the accident at the same time at the discharges from the dams upstream the river caused a certain instability of the river bottom which made it difficult for the anchors to ground quicker;
 - c) The absence of a reliable system that would allow a clear alert to the machine house that the steering system was not working properly and that the master did not have control on the propellants, giving clear instructions to the engine driver to start immediately the emergency steering system protocol in the machine house;
 - d) The absence of an efficient system to perform the manual emergency command of the azimuthal propellants “Z-Drive” in restricted waters sailing conditions , particularly rivers, susceptible to be operated from de machine house;
 - e) The difficult access available to the alternative manual commands to both propellants and their distribution in a way that did not allow their operation from a single point in the machine house;
 - f) The lack of training of the crew, in particular the master’s and the engine driver’s to find a solution to an emergency situation like this and to develop a joint action in order to minimize it.

Safety recommendations

Due to the conclusions reached within this report, the GPIAM recommends:

a) To the “Douro Queen” shipowner:

54-2013.1 To implement a transit timetable procedure on his ships that ensure a safety speed maintenance in all inland water ways of the river Douro, wherein the safety speed means “the one that allows to stop the ship in an appropriate distance to the existing circumstances and conditions”.

54-2013.2 To install in the machine house of his ships an alarm of failure of the “Z-Drive” propellants command control system on the bridge, indicating that the propellant control must be taken over in the machine house immediately.

54-2013.3 To implement on his ships a training procedure aimed to give answers to situations of steering system failure, making sure that a change to the emergency steering from the house machine is made in the shortest time possible. These training procedures should be done as often as necessary to ensure a quick response from the ship machinist and to generate a good coordination/cooperation between him and the master.

B) To the Veth Propulsion B.V. Company

54-2013.4 To install in ships with one or more propellants “Z-Drive” type, especially in the ones intended to sail in restricted areas (rivers) and/or with narrow machine houses a control and a manual system close to the propellants and reserved to a single point of the machine house so that only one operator may intervene in all propellants simultaneously without having to “run” from one place to another in the machine house, either to disengage them or to work on the command electrical valves using improvised tools.

Abbreviations

AMN – Autoridade Marítima Nacional / National Maritime Authority
ACT – Autoridade para as Condições do Trabalho / Work Conditions Authority
BB – Bombordo / Port side (PS)
Cl. – Classe / Degree
DGAM – Direção-Geral da Autoridade Marítima / Maritime Authority General Directorate
DGRM – Direção-Geral de Recursos Naturais, Segurança e Serviços Marítimos / Natural Resources, Safety and Maritime Services General Directorate
EB – Estibordo / Starboard side (SS)
EMSA – Agência Europeia de Segurança Marítima / European Maritime Safety Agency
EPI – Equipamento de Proteção Individual/ (PPE) Personal Protection Equipment
IMO – Organização Marítima Internacional / International Maritime Organization
INEM – Instituto Nacional de Emergência Médica / National Institute of Medical Emergency
IPMA – Instituto Português do Mar e da Atmosfera / Sea and Atmosphere Portuguese Institute
IPTM – Instituto Portuário e dos Transportes Marítimos / Port and Maritime Transport Institute
ISN – Instituto de Socorros a Náufragos / Life-Saving Institute
Km – Quilómetro / Kilometer
Kw – Quilowatt / Kilowatt
Lff – Comprimento fora-a-fora / Length over all
Lpp – Comprimento entre perpendiculares / Length between perpendiculars
LT – Hora local / Local Time
m – metro / meter
Mi – Milha náutica / (nm) Nautical mile
N/A – Não aplicável / Not applicable
SHST – Saúde, Higiene e Segurança no Trabalho / OHS - Safety, Health and Welfare at Work
STCW – Convenção Internacional sobre Normas de Formação, de Certificação e de Serviço de Quartos para os Marítimos / International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
STCW-F - Convenção Internacional sobre Normas de Formação, de Certificação e de Serviço de Quartos para os Marítimos para Tripulantes de Embarcações de Pesca / International convention on training and certification for fishing vessel personnel
Vis – Visibilidade / Visibility