ESCUELA TÉCNICA SUPERIOR DE NÁUTICA

UNIVERSIDAD DE CANTABRIA

*Trabajo Fin de Máster*

# CUADERNO DE FAMILIARIZACIÓN PARA OFICIALES DE PUENTE EN BUQUES DE PASAJE TIPO CRUCEROS

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## Cruise Ships Familiarization Booklet for Bridge Officers

Para acceder al Título de Máster Universitario en

**INGENIERÍA NÁUTICA Y GESTIÓN MARÍTIMA**

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Julio – 2023

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## RESUMEN

Estudiar Náutica es casi como estudiar Derecho o Medicina; la especialización es necesaria. Hoy en día es poco común encontrar Oficiales de la Marina Mercante cambiando constantemente de tipo de buque, pues se terminaría siendo *aprendiz de todo y maestro de nada.* La idea es encontrar el ámbito del sector que más se ajusta a nuestros gustos y practicar hasta desarrollar la excelencia.

La preparación y el estudio son fundamentales para la especialización. Los profesionales necesitan adquirir conocimientos específicos y desarrollar habilidades adecuadas para, finalmente, alcanzar las metas propuestas, avanzando así en el ámbito profesional y personal.

Según el Convenio Internacional para la Seguridad de la Vida Humana en el Mar (SOLAS), el personal de a bordo, incluidos los nuevos miembros de la tripulación, deben estar adecuadamente capacitados y familiarizados con los procedimientos y equipos relevantes antes de asumir sus responsabilidades a bordo.

La familiarización generalmente se lleva a cabo a través de un proceso estructurado y planificado por parte de la compañía naviera. Durante este período, los nuevos miembros de la tripulación reciben información sobre las instalaciones del buque, los sistemas de seguridad, los procedimientos de emergencia, las responsabilidades específicas de sus puestos y cualquier otro aspecto relevante para su función a bordo.

Para este Trabajo de Fin de Máster se han evaluado todos los ámbitos de conocimiento que debe hacer frente un Oficial de nuevo ingreso en un buque de pasaje tipo crucero, desarrollando el que se ha considerado un buen modelo de organización y presentación de la información.



## PALABRAS CLAVE

- Oficial de Marina Mercante
- Crucero
- Tripulación

- Seguridad Marítima
- Preparación formativa

## ABSTRACT

Studying Nautical is almost like studying Law or Medicine; specialization is necessary. Today it is rare to find Merchant Marine Officers constantly changing the type of ship, as they would end up being jack of all trades and master of none. The idea is to find the area of the sector that best suits our needs and practice until we develop excellence.

Preparation and study are essential for specialization. Professionals need to acquire specific knowledge and develop appropriate skills to finally achieve the proposed goals, thus advancing professionally and personally.

Under the International Convention for the Safety of Life at Sea (SOLAS), shipboard personnel, including new crew members, must be adequately trained and familiar with relevant procedures and equipment before assuming their responsibilities.

Familiarization is usually carried out through a structured and planned process by the shipping company. During this period, new crew members receive information on the ship's facilities, safety systems, emergency procedures, the specific responsibilities of their positions and any other aspect relevant to their role on board.

For this Master's Thesis, all the areas of knowledge that a new Officer must face on a cruise-type passenger ship have been evaluated, developing what has been considered a good model of organization and presentation of information.

## KEY WORDS

- Merchant Marine Officer
- Cruise Ship
- Crew
- Maritime Safety
- Training

# INDEX

## OBJECT

This Final Project has as a main priority to find an effective organization of the information in order to help the lectors, assumed as bridge officers, to understand easily the cruise ship's policies and equipment. The following Familiarization Booklet is trying to serve as a guidance for bridge officers into the path of getting ready to safely handle a navigational watch onboard a cruise ship.

# 1 INTRODUCTION

The safety of the persons and the ship is everyone's responsibility. The whole ship's crew must be well trained and highly involved with safety and seamanship's practices. However, the bridge officers are the leaders of the safety onboard, and indeed the best way to guarantee that lifeboats will not be needed is to navigate safely.

The following project has considered the ship Celebrity Silhouette has reference for all the pictures and drawings. However, the provided information is represented and explained in general terms so that the lector can have an overview of the Cruise Ship industry regarding the procedures, equipment, and systems.

For the lector reference, Celebrity Silhouette belongs to Celebrity Cruises, which is a brand of Royal Caribbean Group. The ship's keel was laid on January 29th, 2010, and the delivery date was July 18th, 2011. This ship is sailing under Maltese flag with port of register Valletta. Her IMO number is 9451094 and call sign 9HA2583.

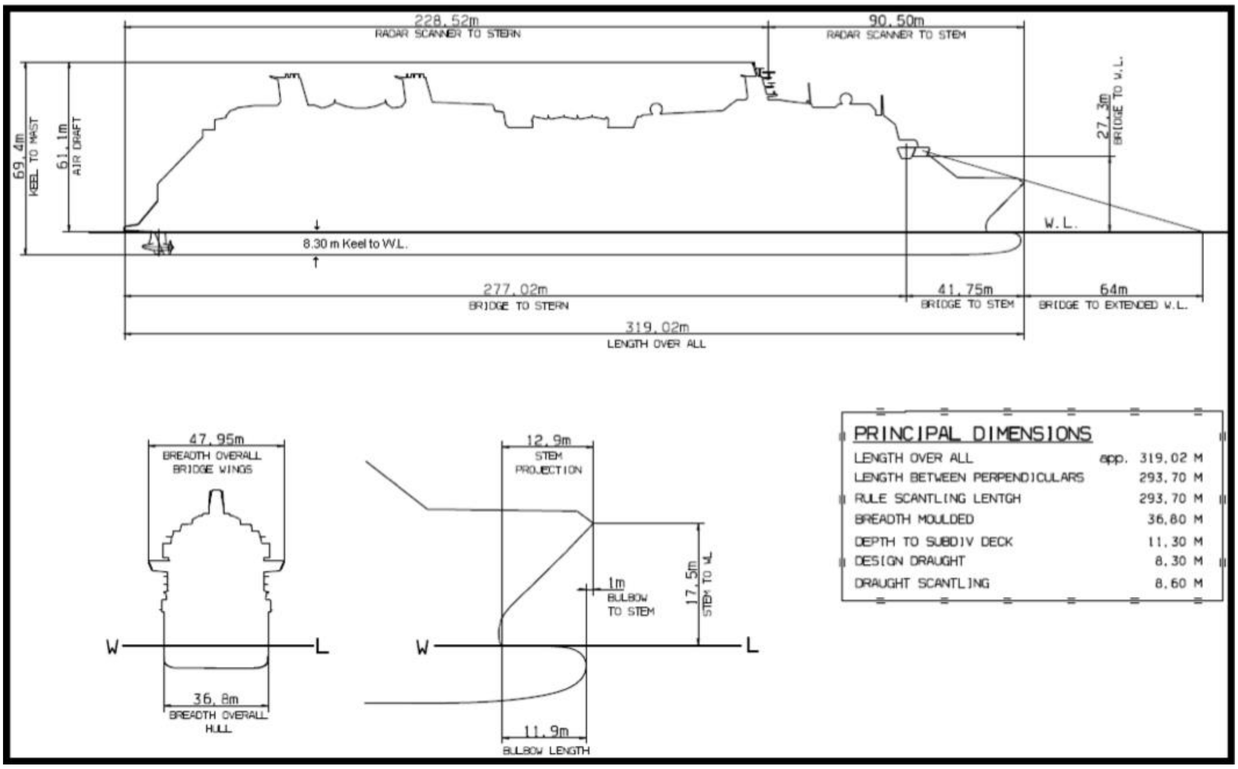



FIGURE 1-1: CELEBRITY SILHOUETTE SHIPS PARTICULARS (SOURCE: GENERAL ARRANGEMENT PLAN)

# 2 POLICIES, PROCEDURES AND PLANS

## 2.1 International Regulation and Conventions

Marine Licensed Officers have passed through courses and exams that certify their level to perform important duties in the maritime industry. However, learning process never ends and being always up to date is a *must.* Bridge Officers should be well familiar with the following publications in their latest versions:

- SOLAS (International Convention for the Safe of Life at Sea)
- STCW (International Convention on Standards of Training, Certification and Watchkeeping for Seafarers)
- MARPOL 73/78 (International Convention for the Prevention of Pollution from Ships)
- COLREG (International Regulations for Preventing Collisions at Sea)

- Ships‘ Routing
- LL (International Convention on Load Lines)
- SAR (International Convention on Search and Rescue)
- International Code of Signals
- IAMSAR Manual (International Aeronautical and Maritime Search and Rescue Manual)
- GMDSS Manual (Global Maritime Distress and Safety Systems Manual)
- BWM (International Convention for the Control and Management of Ships’ Ballast Water and Sediments)
- PSSA (Particularly Sensitive Sea Areas)
- LSA Code (Life-Saving Appliances Code)
- FSS Code (International Code for Fire Safety Systems)
- FTP Code (International Code for Application of Fire Test Procedures)
- ISM Code (International Code for Safety Management)
- Polar Code (International Code for Ships Operating in Polar Waters)
- Cold Water Survival and Recovery Techniques
- ISPS Code (International Code for Ship and Port Facility Security)
- PSC (Port State Control)

Additionally, concerning IMO Circulars mainly coming from Maritime Safety Committee (MSC) and Marine Environment Protection Committee (MEPC), all applicable ship’s flag regulation and local regulation from the sailed area, must be followed at all the times.

## 2.2 Company's Policy

As requested by the International Safety Management (ISM) Code, shipping companies are bound to develop their own Company Management System which contains the overall policies, procedures and applicable daily shipboard operations and the supporting shore side departments. Audits of the Company's Management System are conducted periodically by internal and external parties to verify the effective implementation of the Management System. The following step for a Bridge Officer after has gotten familiar with the international and local regulation, is to being familiar with the Company's policy.

Specifically for the Marine Department of this cruise line, *Navigational Policy and Procedures (NPP)* Manual has been created. All the Bridge Officers should be familiar with the operation of the bridge equipment and the Standard and Emergency Operational Procedures (SOP and EOP). For that reason, all Bridge Officers must go through a familiarization process and pass a test that must be renewed periodically.

## 2.3 Watch Risk Conditions

Before getting deeper into the bridge equipment familiarization, the Bridge Officers must understand in detailed the watch condition company's policy. When the vessel is under way, at anchor, moored or positioned with Dynamic Positioning system, the Master will ensure that the Bridge Team establishes the proper Watch Condition and manning level for the current and expected risk and workload.

When the Watch Condition is set or changed, the associated checklist should be consulted to determine the proper equipment checks and settings, notifications, and log entries.

In normal Watch Condition, the Officer of the Watch (OOW) will have the Navigational Command, which means to have the overall responsibility for the safe navigation and maneuvering of the ship. However, either OOW or Assistant Officer of the Watch

(AOW) can be the Conning Officer, which means to have the actual control of the ship's motion, giving course, helm and engine orders. Logbook entry shall be made for any change of Navigational Command and/or Conn during the watch.

When the Pilot is onboard assisting to the Captain, he/she may take the Conn of the ship, but never the Navigational Command. Only in specific places of the world like Panama Canal, the Master of the ship could lose the Nav Command over the Pilot.

The following tables are a guide to assist the Master in determining the criteria for changes in the Watch Condition:

TABLE 2.3-1: WATCH RISK ASSESSMENT (SOURCE: OWN ELABORATION)

| | **Risk factors** | | |
|---|---|---|---|
| | **Low** | **Medium** | **High** |
| **Waters** | Open | Restricted | Enclosed |
| **Traffic** | Light | Moderate | Heavy |
| **Visibility** | Unlimited | Limited | Restricted |

| | | **Risk analysis** | | |
|---|---|---|---|---|
| **Waters** | **Traffic** | **Visibility** | | |
| | | Unlimited | Limited | Restricted |
| Open | Light | | | |
| | Moderate | | | |
| | Heavy | | | |
| **Waters** | **Traffic** | **Visibility** | | |
| | | Unlimited | Limited | Restricted |
| Restricted | Light | | | |
| | Moderate | | | |
| | Heavy | | | |
| **Waters** | **Traffic** | **Visibility** | | |
| | | Unlimited | Limited | Restricted |
| Enclosed | Light | | | |
| | Moderate | | | |
| | Heavy | | | |

## 2.4 Master's Standing Orders

The standing orders are a set of guidelines to ensure safe ship navigation and operations whether at sea, at anchor or at port. These set of guidelines by the Master encompass a very wide number of aspects of navigation and rules of conduct for the officers. Each Master shall ensure that Bridge Officers fully understand the expectations regarding the Voyage or Passage Plan, watchkeeping, navigation, collision avoidance and Company´s Policy.

These orders are posted and available in paper format for all the bridge watch-keeping officers. The Master Standing Order's acknowledgement shall be done before the Officer is taking over the watch. As a good *"rule of the thumb*", the bridge officer should call Master when find him or herself thinking: *"should I call the Master?"*

## 2.5 Master's Night Orders

The night orders are a supplement to the standing orders that come into force as the Master proceeds to take rest during the night. The standing orders are always in force whereas the night orders add specific points to the withstanding standing orders. The Master writes the night orders every night, with specific regard pertaining to the existing state of the weather, sea and traffic. As happened with the standing orders, the night orders acknowledging must be done in the daily basis by the watch standers.

## 2.6 Watch Handover Procedures

Dual watches are standardized among the cruise ship industry due to the high workload level. Therefore, the navigational watch duties are performed by two qualified licensed officers and one lookout in normal operations. Apprentice Officer can be also included to any shift.

A watch handover is conducted by all relieving and relieved Officers and lookouts before taking the watch. The Lookout handover is conducted in the presence of an Officer. The relieving officers shall be on the bridge 10 minutes prior start the watch to guarantee a proper familiarization.

See below an example of bridge walk-around prior taking over navigational watch, being the number one the starting point:

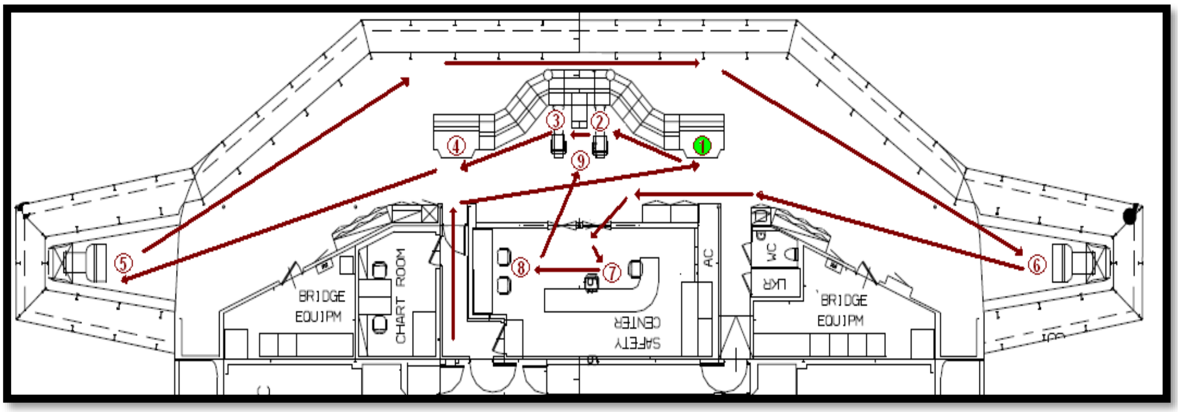



FIGURE 2-1: BRIDGE WALK-AROUND EXAMPLE (SOURCE: OWN ELABORATION)

During the handover, the OOW ensures that members of the relieving watch are fully capable of performing their duties, that all standing orders are understood, and that the relief has been given all critical information required to take the watch.

The OOW shall not handover the watch if there is reason to believe that the relieving officer is not capable of carrying out the watch-keeping duties effectively, in which case the Master should be notified immediately or if a maneuver is in progress or a maneuver is about to happen.

When the relieving OOW declares his/her happiness with the information received during the handover, shall be announced clearly who is the new officer with the Navigational Command and the Conn.

## 2.7 Official Logbooks

The following logbooks must be always kept up to date, besides that, only accurate and real information can be recorded:

1) Ship's Official Flag Logbook

2) GMDSS Logbook

3) Ballast Water Logbook

4) Compass Error book

5) Deck Logbook

6) Environmental operations

7) Voyage Reporting

8) Stability Record Book

9) Night Order Book

New technology has arrived to replace the traditional and, well-known, paper logbook. The Electronic logbook presents a new tool for the bridge officer to use during their watch. This new type of logbook is not only an electronic recordkeeping equipment, but also a tool to show the status and on-going operations of the ship.

Since it is still an official document, every officer will have its username and password, which is encrypt in a personal card to make login automatically through the card reading. In case of emergency, the officer in charge of GMDSS operation as per SOLAS, will take the USB drive which will contain the whole logbook data.

### 2.8 Environmental policies

Protecting the oceans and the rich marine life they support is a way of life and a way of doing business for most of the cruise ships lines. Many shipping companies develop specific programs to be followed by their brands to ensure that environmental policies and procedures are well understood by the crew and correctly implemented onboard.

Before continuing to further information that usually cruise ships will be following to perform environmental operations, the following must be understood:

TABLE 2.8-1: SULPHUR ALLOWANCE (SOURCE: OWN ELABORATION)

| | **Inside ECA** | **Outside ECA** |
|---|---|---|
| Sulphur limit (SOX) | 0.10% m/m (mass by mass) | 0.50% m/m (mass by mass) |
| | ECAs established under MARPOL Annex VI for SOx limit are the Baltic Sea area; the North Sea area; the North American area (covering designated coastal areas off the United States and Canada); and the United States Caribbean Sea area (waters around Puerto Rico and the United States Virgin Islands). [1] | Lately cruise ship industry is fitted with Advanced Emission Purification (AEP) or Scrubber systems that are provided at the engine compartments to reduce Sulphur and particulate matter emissions. This allows the engines to burn higher Sulphur fuels (such HFO) because they have an exhaust gas cleaning system fitted. |
| ECA: Emission Control Area | | |

The cruise ship industry uses to work with the concept *Sea and Port Condition* to designate when is allowed to perform discharges into the sea water. It is considered to be at Sea Condition, when the followed is met:

- ✓ Navigating outside 12 nm from the nearest land
- ✓ Navigating outside territorial waters as per UNCLOS
- ✓ Navigating with speed through the water above 6 knots
- ✓ Navigating outside an area with environmental restrictions like MPA (Marine Protected Areas), PSSA (Particular Sensitive Sea Areas) or NMS (National Marine Sanctuaries), with restrictions related to environmental operations, or a no discharge zone.

If these requirements are not met, means that the ship is at Port condition and no environmental operations can be executed. Every change of condition must be logged at the Environmental Log.

The ship may ask for an exemption from company's policy in case of emergency, inadequate holding capacity due to voyage plan restrictions (for instance long port conditions) and/or energy and financial benefits. In all the cases, the exemption from Company's policy cannot be against any MARPOL 73/78 or National and local regulations.

### 2.9 Shipboard Oil Pollution Emergency Plan (SOPEP)

In accordance with the requirements of MARPOL Annex I Regulation 37, SOPEP Manual is written to provide guidance to the Master and officers onboard the ship with respect to the steps to be taken when a pollution incident has occurred. The Plan is available on hard copy on the bridge as well as online in the company's policy platform.

The procedure to be followed by the Master or other persons having charge of the ship to report an oil pollution incident, as required in article 8 and Protocol I of MARPOL;

- the list of authorities or persons to be contacted in the event of an oil pollution incident;
- a detailed description of the action to be taken immediately by persons on board to reduce or control the discharge of oil following the incident; and
- the procedures and point of contact on the ship for coordinating shipboard action with national and local authorities in combating the pollution.[2]

Cruise ship industry normally have a SOPEP locker located on the main deck with all the equipped needed as per the Manual. One specific officer will be the one having the responsibility over this material, requesting needed spare parts and keeping it in order.

## 2.10 Ballast Water Management Plan (BWMP)

Sea water has been used as ballast to stabilize vessels at sea since the beginning of the maritime trade, which is very helpful for the ship's stability and forces. However, ballasting in one region and and deballasting in another, can lead to a potential transportation of marine organisms from one ecosystem to another. It is already recognized by IMO that the spread of invasive species is one of the greatest threats to the ecological and the economic well-being of the planet. Therefore, the International Convention for the Control and Management of Ship´s Ballast Water and Sediments (BWM Convention) has been created.

The purpose of the Convention is to regulate discharges of ballast water and to reduce the risk of introducing non-native species that could harm sensitive ecosystems. In order to show compliance with the requirements of the Convention each vessel shall have on board a valid certificate, a Ballast Water Management Plan (BWMP) and a Ballast Water Record Book that must be kept up to date by the Bridge Officers. [9]

As per this Convention, ships must comply with one of the following regulations:

Regulation D1: Ballast Water Exchange. The ship must conduct a full exchange of ballast water when changing geographic areas of operation. This process is based on a total empty and refill of the ballast spaces three times when ship is more than 200 NM from nearest land and minimum depth of 200 meters.

Regulation D2: Ballast Water Treatment System. Most of the cruise ships are having an approved BWTS that must be used always when ballasting or deballasting. BWTS should not be used for internal transfers.

In another hand, every cruise ship will have a precise BWMP as strategy and set of procedures to minimize the transfer of aquatic species through ballast water. Bridge Officers must be familiar and sign this Plan as acknowledgment.

When a ballast tank is used for wastewater, it must be properly flushed prior to being considered ballast tank again. All ships are required to create a ship specific “Flushing of the Ballast System and Lines” SOP to properly restore tanks to ballast condition.

### 2.11 Ship Security Plan (SSP)

The Ship Security Plan (SSP) is based on the guidelines issued by the International Ship and Port Facility Security Code (ISPS Code) and SOLAS. Because the content and nature of the SSP is classified as a Company Security Sensitive publication, the SSP's are only available to those Senior Officers required to utilize the information to fulfill their duties and responsibilities regarding the security of all Company vessels. Each SSP is vessel specific.

The threat levels are defined as follows:

*Maritime Security - Level 1* (yellow label): means the maritime security normalcy. This is the risk level for which security measures must be maintained for an indefinite period. These are the normal, everyday security measures.

*Maritime Security - Level 2* (orange label): means there is a heightened threat level of an unlawful act against a port, facility or vessel and intelligence indicates that terrorists are likely to be active within a specific area, or against a class of target.

*Maritime Security - Level 3* (red label): means the threat of an unlawful act against a port; facility or terminal is very probable or imminent.

The Master may choose to adopt and implement higher security measures based on intelligence or warning received locally. Any formal changes in MARSEC (Maritime Security) levels are determined by the Flag State and will be communicated to the Master via the CSO (Company Security Officer). The appropriate label (yellow, orange or red) will be posted for the crew member’s understanding. [5]

# 3 SHIP HANDLING EQUIPMENT

## 3.1 Machinery Particulars

The Engine Control Room (ECR) is usually located on the main deck of the ship. At all times, ECR will be manned and ready with an EOW (Engineer of the Watch) on duty, usually an 2nd Engineer. Communication through telephone, talk back system or magnetic phones is provided.

A general overview of the engine configuration system will be always provided for the Bridge Team through an engine monitoring interface. For the purpose of this familiarization, the lector can see the below example of power management:

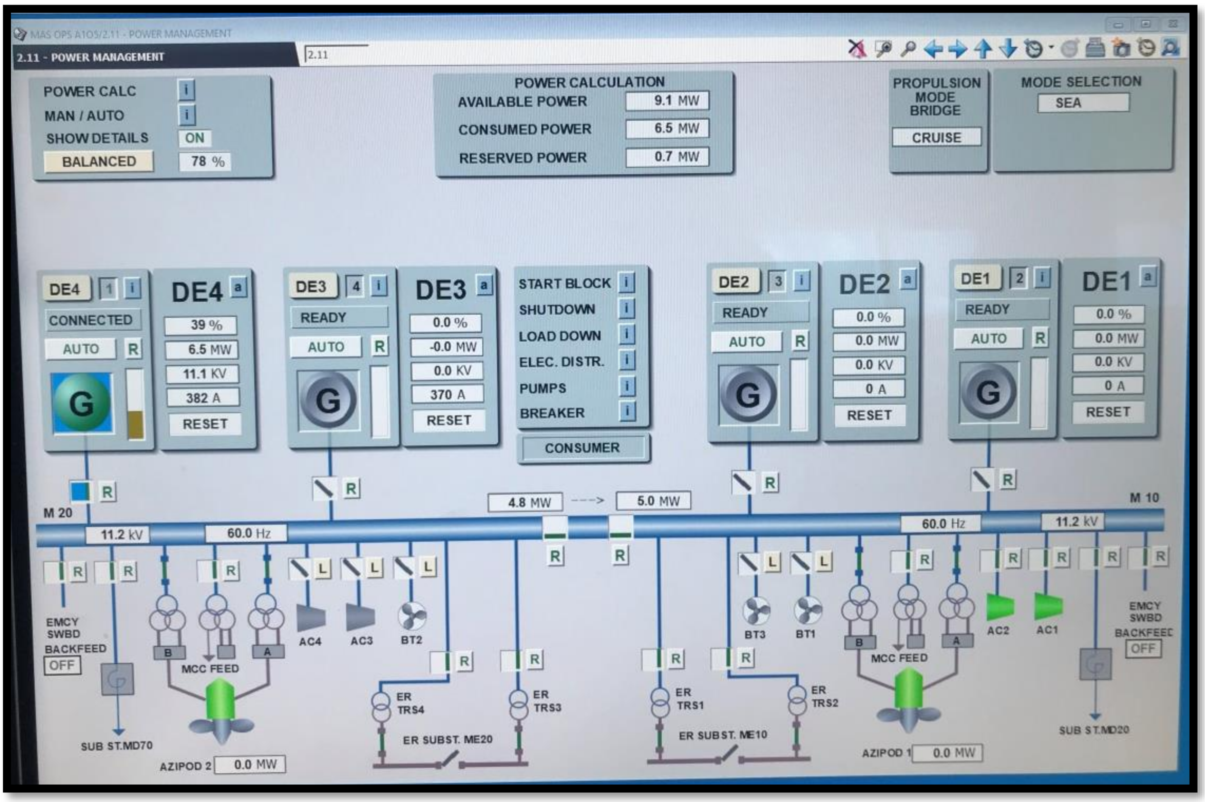



FIGURE 3-1: SHIP POWER MANAGEMENT (SOURCE: OWN ELABORATION)

Bridge Officers must also be familiar with the power limit of their engine and required configuration for each desired speed. As a guidance, below is provided a reference table of Celebrity Silhouette which has 4 Diesel Engines with some basic data:

TABLE 3.1-1: ENGINE OPERATIONAL LIMITS (SOURCE: OWN ELABORATION)

| **Engine Operational Limits** | | | | |
|---|---|---|---|---|
| Engines Online | Max RPM | Engine Load | Power of each Pod | Max Speed |
| **1** | 56 | 81% | 1.4 MW | 10 kts |
| **2** | 102 | 85% | 8.7 MW | 18 Kts |
| **3** | 122 | 85% | 13.8 MW | 21.7 Kts |
| **4** | 128 | 73% | 17.9 MW | 23.4 Kts |

Main Diesel Engines (DEs)

The Main Engine Plant consists usually of diesel engines (DEs) with total output 60.000-65.000 kW that can be operated on HFO (Heavy Fuel Oil) and MGO (Marine Gas Oil). The remote start and stop of DEs can be done from IAMCS (see next page). In case of emergency, the main engines can be stopped by an emergency shutdown. This function can be released either automatically or manually by the operator. Emergency stops for the main engines and fuel pumps are fitted on the Bridge, ECR and by the entrance on the Engine Room.

Due to the quantity and dimensions of the Main Engine Plant, cruise ships use to have Forward Engine Room and Aft Engine Room, so that engines are installed in different compartments for safety reasons. At the same time, DEs are located below main deck.

Main Generators

As there are Main Engines, there are Main Generators with a rated output power as well. The generators are designed to operate together with the DEs in order to produce electricity. Some generators are installed in the Forward Engine Room and the generators are installed in the Aft Engine Room.

Main Switchboards (MSB)

The main switchboards are fed by the main generators. The distribution system can be divided into Feeder side and the Load side. The feeders are the generators, and the loads are various shipboard auxiliary machineries. The Load side is further divided into Essential and Non-Essential services. Essential services are very critical auxiliaries which are directly affecting the safety of personnel, ship in terms of navigation and propulsion. Non-essential services are those that do not affect the safety of ship and personnel.

Integrated Alarm, Monitoring and Control System (IAMCS)

Ships have an IAMCS for the engine system related plants and the air condition plant. Diesel engines and generators, and the related machinery systems will mainly be controlled from the ECR, but part of the systems can also be controlled from the Wheelhouse.

There are usually couple operator stations in the wheelhouse, normally at the forward console and at the safety center. The wheelhouse is defined as the secondary control room for machinery and related plants. The bridge stations have limited rights to operating, but by emergency full operation can be possible. Operator stations in the wheelhouse have only operated rights of systems with password protection. [6]

## 3.2 Blackout

Losing electrical power is devasting for the ship. Main engines and generators require electricity. Pumps that are driven electrically take cold ocean water to cool the engines and electrical pumps get fuel from fuel tanks to supply the engine. In summary, the diesel engines drive the generators and then, the electricity created drives the electric motors (propulsion motors) that are connected to the propellers (azipods or azimuth thrusters, see the following pages).

Large equipment (propulsion motors and bow thrusters) requires electricity of high voltage. As for smaller machinery (lighting, galleys ‘equipment, etc.) the electricity goes to the transformer to step down into lower voltage. Cables distribute power electrical from generators to switchboards.

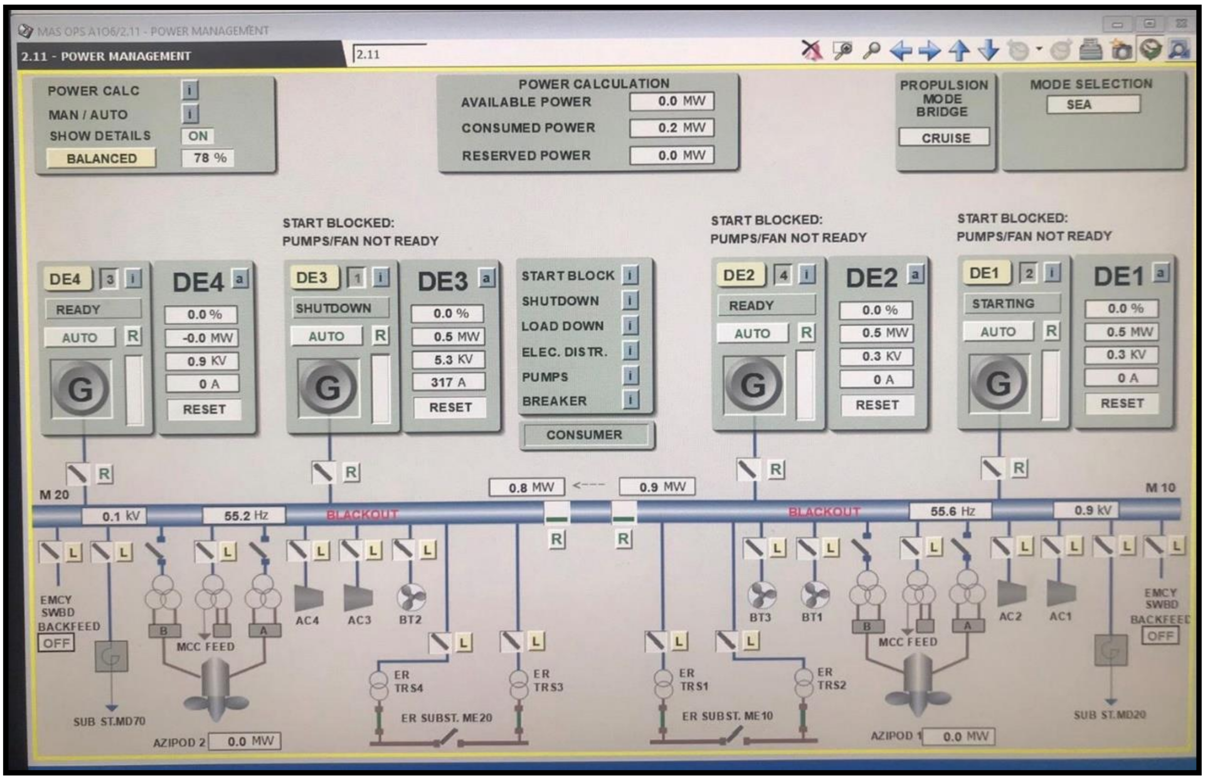



FIGURE 3-2: REAL CASE OF BLACK OUT (SOURCE: OWN ELABORATION)

In case of blackout condition, which is a scenario on a ship, wherein the main propulsion plant and associate machinery stop operating due to failure of power generation system, engine interface will show the following situation in the power management page. However, in compliance with SOLAS requirements, ships have emergency equipment:

Emergency Diesel Generator (EDG)

The EDG set consisting of the Emergency Diesel Engine and the Emergency Diesel Generator is arranged in dedicated EDG rooms above the main deck of the ship, usually port and starboard side. The EDG is designed to supply power to the emergency switchboard in case of failure of the normal power supply form the main switchboard.

Emergency Switchboard (ESB)

The EBS ensures supply to the equipment and installation essential for the proper and safety operation of the ship. This switchboard is arranged in the ESB room between both EDG rooms.

Uninterruptible power supplies (USP)

- Fire zone UPS: each fire zone is equipped with its own UPS, which are used for the loads requiring a transitional source of power.
- Machinery UPS: the two-power production and propulsion plants are each equipped with its own UPS, which are used for control equipment of the main switchboard, propulsion drives, main engines, and the automation equipment for the PMS.
- Bridge UPS: two UPS are used for the control equipment of the navigation system, propulsion plants, safety systems and communication plants.
- Hotel Computer UPS: two UPS are used for the hotel computer system. [6]

## 3.3 Bridge Consoles

The bridge has center, port and starboard wing consoles, from where the Captain and the bridge team can have actual control of the ship's movement and propulsion under normal circumstances. The layout of each console will be different from ship to ship. Below the lector have some references:


FIGURE 3-3: BRIDGE CONSOLE (SOURCE: OWN ELABORATION)

1. Typhon and whistle
2. Thrusters control
3. Thrusters NFU
4. Thrusters angle
5. Thrusters lever
6. DP
7. Steering mode control
8. Propulsion NFU
9. Steering gear control
10. Azipod angle
11. Azipod control panel
12. Azipod levers
13. Miniwheel
14. Gyro compass
15. Magnetic compass
16. Analogue ROU
17. Helm
18. NFU control
19. NFU tiller

1. Echo sounder
2. Speed logs
3. Navtex
4. DGPS units

FIGURE 3-4: BRIDGE CONSOLE (SOURCE: OWN ELABORATION)


1. DSC VHF unit
2. Remote VHF
3. Search light
4. Wind wipers
5. Control heeling system

FIGURE 3-5: BRIDGE CONSOLE (SOURCE: OWN ELABORATION)


FIGURE 3-6: BRIDGE CONSOLE (SOURCE: OWN ELABORATION)

1. Air band VHF
2. DSC VHF unit
3. Remote VHF
4. Search light
5. BNWAS


FIGURE 3-7: BRIDGE CONSOLE (SOURCE: OWN ELABORATION)

1. Sound signaling unit
2. GMDSS multi alarm panel
3. Remote VHF
4. Elephant ear speaker
5. Compass panel

FIGURE 3-8: BRIDGE CONSOLE (SOURCE: OWN ELABORATION)

1. Stabilizers panel
2. Anchors panel
3. Emergency engine order telegraph
4. BNWAS reset button

### 3.4 Ship’s Propulsion

The propulsion system of cruise ships is usually two Twin Azipod is an azimuthing propulsion unit where the motor is in a submerged pod. The propeller is of fixed pitch type and is press fitted on the cone and secured by a nut. The propeller has 4 blades that can be exchanged under water.

The steering gear of the Azipod can be hydraulic pumps or electrical driven motors. The steering unit is in the Azipod Room. The rotor of the steering gear system is attached to the propeller shaft. [19]

Normally two modes are available for the movement of the azipods, reachable regarding the number of pumps or motors running at a time:

| | | |
|---|---|---|
| Normal mode | 2.5°/second | Used when ship is navigating at sea |
| Fast mode | 5°/second | Used in maneuvering mode or hand steering |

Standard characteristics:

- Maximum power 20500 kW
- Maximum propeller speed 130 rpm
- Propeller diameter 5-6 m
- Operational area 55 m2

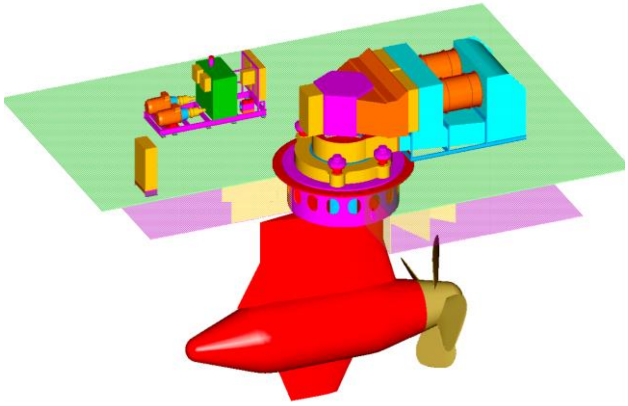


FIGURE 3-9: AZIPOD DIAGRAM (SOURCE: ABB COMPANY)

As per the manufacture, in braking/slowing down conditions, reverse power shall be avoided or at least should not been used above 4 knots. Also, unless in case of emergency, propeller washes over another azipod should not be done. [7]

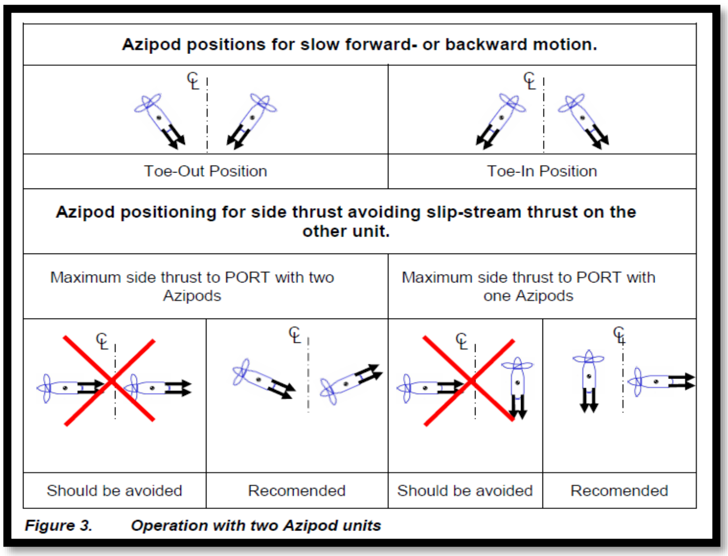



*Figure 3. Operation with two Azipod units*

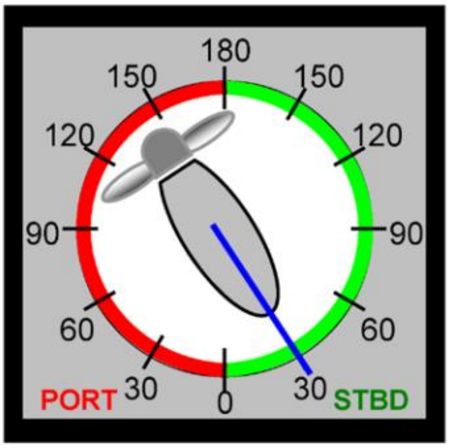
FIGURE 3-10: OPERATION WITH TWO AZIPODS (SOURCE: ABB MANUAL)

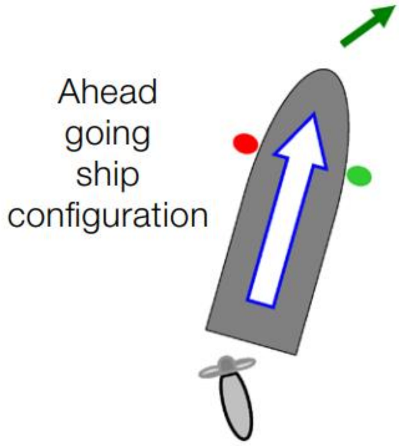
## Basic Azipod Theory

TABLE 3.4-1: BASIC AZIPOD THEORY (SOURCE: ABB MANUAL)

ACTION: By turning the azipod to the lelf

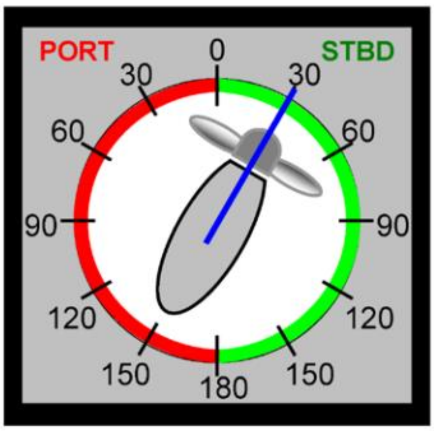
REACTION: the ship's bow will alter course to starboard

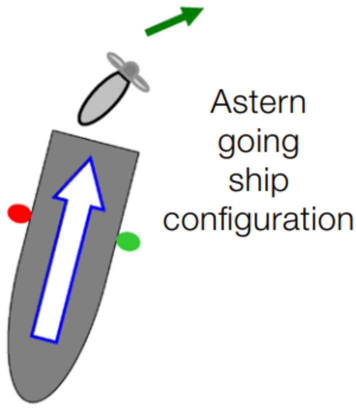



ACTION: By turning the azipod to the right

REACTION: the ship's bow will alter course to port



The effectiveness of the Azipod thrust can be seen in the below diagram. The area in-between the two Azipods is called skeg. This is a ballast tank that blocks the thrust of the two azipods and reduce the effectiveness of specific angles as shown below:

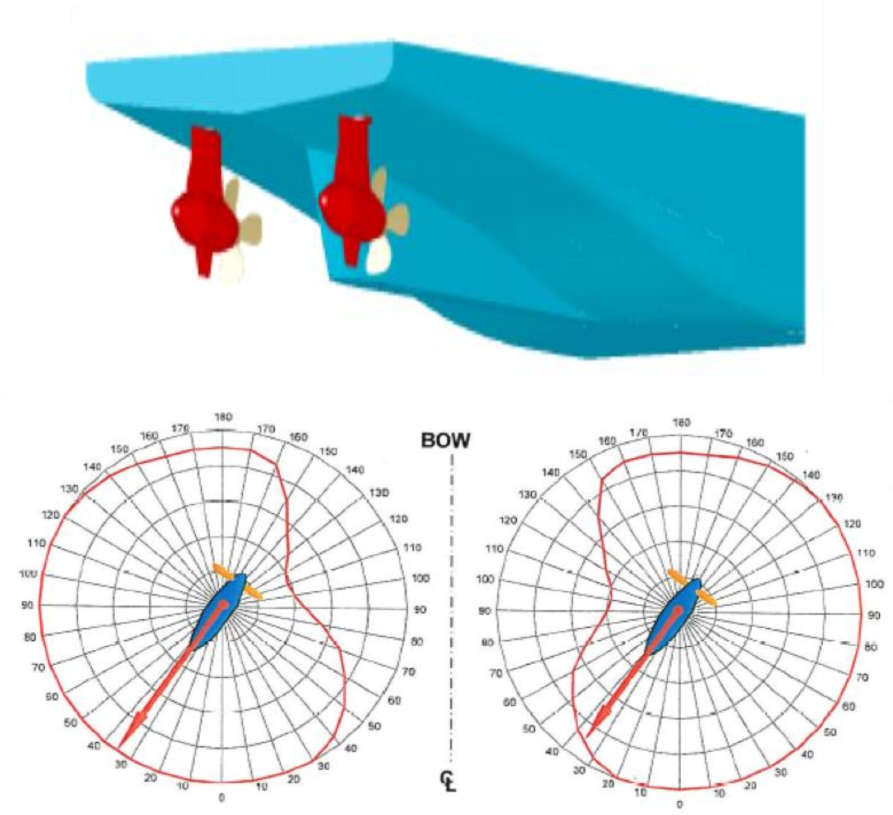



FIGURE 3-11: AZIPODS ANGLES EFFECTIVENESS (SOURCE: ABB MANUAL)

## 3.5 Bow Thrusters

Three or four transverse thrusters in the bow are used to increase maneuverability of the ship by creating a thrust force in the starboard or port direction. The thrusters are driven by electric motors with constant speed. The thrust variations are obtained through controllable pitch propellers of 3 meters diameter and 4 propeller blades each. The pitch of the propellers is controlled by an electro-hydraulic system from the control panels which are arranged in the wheelhouse. The main controls are located on the center console, but they can be started or stopped on the wings as well.

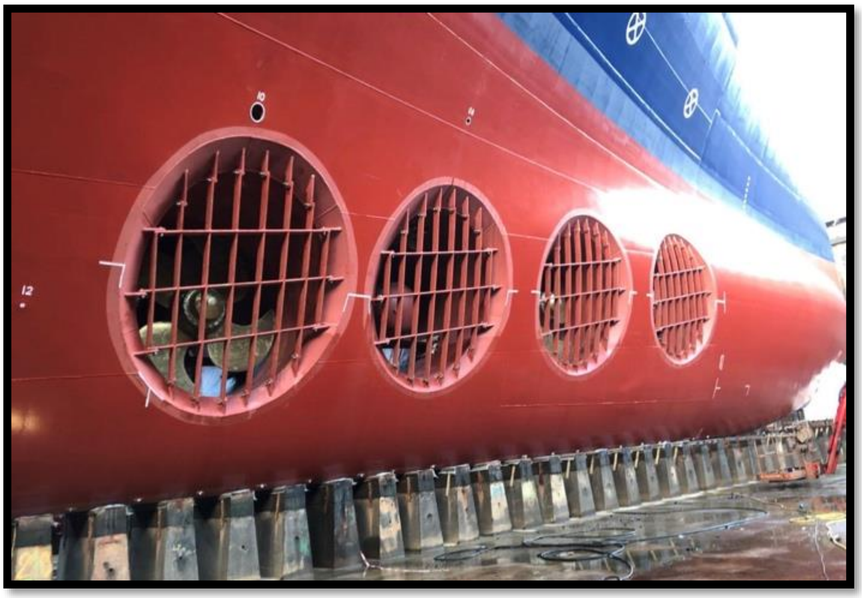


FIGURE 3-12: BOW THRUSTERS SEEING IN DRYDOCK (SOURCE: OWN ELABORATION)

It is very important to keep in mind the bow thruster effectiveness. The 100% effectiveness is reached at 2 knots, 50 % effectiveness at 6 knots and 0 % effectiveness at 9 knots and below. This information can be found in the ship's diagrams.

Normally at least two engines online are needed to start thrusters. First step is to start the hydraulic pumps and then, the electrical motors. When bow thrusters are running, constant monitoring of the MW indicator should take place.

In order to stop the bow thrusters, first is needed to put the pitch to zero, stop the electrical motor and finally the hydraulic pump. Each thruster control panel has an emergency stop button. Each emergency stop button is connected directly to the related medium voltage circuit breaker and causes a trip of the breaker.

It is possible to increase the maximum load of the drive motor temporary to 110%. The running hour counter is reset automatically once a week and creates an alarm if the weekly running hours exceed 3 hours. [6]

## 3.6 Propulsion Modes

Cruise ships usually have several ways to steer the vessel:

1. Lever: manual operation of the Azipods levers to control the revolutions per minute (RPM). Only multiples of 10 are written, from 0 through 100.

2. Speed pilot: optional function of Track Pilot that works as remotely speed controller, which is an alternative to the manual operation of the levers. It's control through the workstation (usually multipilot).
- In Set Lever mode it is possible to set a fixed lever.
- In Set Speed mode it is possible to set a fixed speed.
- In Set RPM mode it is possible to set a fixed RPM.
- In Profile mode the ship can be made to sail with a fixed speed-profile stored for the pre-planned track during the speed/time planning
- In Arrival mode, the Arrival Speed computed by the system can be specified as the set speed which makes the ship reach the desired destination at the planned time of arrival (if permitted by the external conditions).

3. Backup: increasing or decreasing the RPM by clicking the buttons. To activate, flip open the switch cover and turn the switches to "BACKUP". "RPM ON" yellow light will turn on when this mode is engaged. One click means rpm requested, either up (green button) or down (red button). There are 2 controls on the center console, one for each Azipod.


FIGURE 3-13: BACK UP PROPULSION (SOURCE: OWN ELABORATION)

4. AZIPOD ROOMS: there are two local propulsion panels inside each azipod room.


FIGURE 3-14: LOCAL PROPULSION PANEL (SOURCE: OWN ELABORATION)

The is an extra option regarding propulsion called Slow Ramp. This is a ship's load program. When the system is activated, it increases or decreases in a range of 1 to 3 RPM every minute, to make a smooth operation for the engines. It depends on the ship and the type of engine system but mainly works from 40-60 RPM and above. When the operator requires less than the referenced RPM, the system automatically disengages by itself and reduces immediately. It can be activated or deactivated by pressing the specific button in the center console. [6]

## 3.7 Crash Stop

All bridge officers must be well familiar with the stopping procedure of the ship when underway making way. It must be understood the stopping distance, deviation and needed time for the ship when making maximum speed.

Crash stop procedure using full astern (traditional method):

a) Immediately switch the steering to wheel mode (hand steering).

b) Turn off slow ramp if it's activated.

c) Pull levers to full astern, which means from green side to red side.

d) The traditional crash stop is changing the levers to full astern.

This method does work, but the time and distance it takes to stop is almost double that of reversing the azipods.

Crash stop procedure by reversing the Azipods 180°:

a) Immediately switch the steering to maneuvering mode (power will automatically reduce to 50%).

b) Turn the Azipods 35º to 45º outwards/inwards. The actual speed will decrease to 15-16 knots.

c) When speed is 15-16 knots, rotate the Azipods 180º and put the propulsion control lever full ahead.

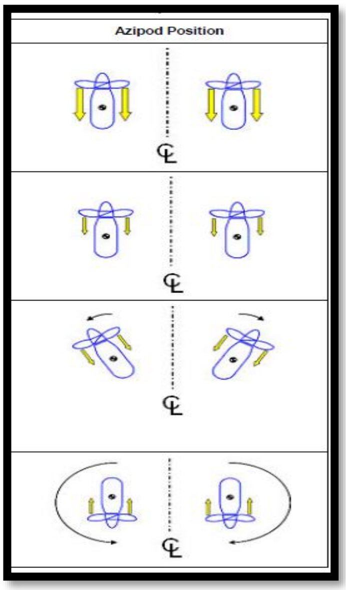



FIGURE 3-15: CRASH STOP DIAGRAM (SOURCE: ABB MANUAL)

## 3.8 Steering Modes

The motion of the ship can be controlled through different methods, they are called steering modes. The Bridge Officers must understand the differences, limitations and benefits of each of them in order to use them efficiently.

Maneuvering (360º) – Makes each azipod independent in azimuth command. The levers are available at the center console and at the bridge wings. Azipods can be syncronized so one azipod will be the Master in propulsion and steering.

Dynamic Positioning - Special system which controls thrusters and azipods together either using a joystick or the DGPS to keep a specific position. It is not usually used due to high fuel consumption.

Autopilot – Track control system which is operated through the Multiplot. Must be engaged to run under its functions (heading, course or track mode) and adjusted in regards of the ship's speed and weather elements.

Wheel – Control of the ship at the center wheel by hand steering with maximum allowance of 35° starboard and 35° port side.

Mini Wheel – it can be used the same as the wheel instead of using a helmsman, the officer can steer the ship by turning it with maximum allowance of 35° starboard and 35° port side. Also available at the bridge wings.

Non-follow up (NFU) – this unit is a backup steering mode. The azipods can be rotated 360°. To activate, flip open the switch cover and turn the switches to BACKUP. This engages the tiller handles beneath. The best way to steer with this mode is to keep one steady and turn with only one. NFU steering is the most elementary form of blind loop steering for independent azipods.

Local control – In case NFU is not working neither, advice ECR to use the local control at the Azipods Rooms.[6]

# 4 NAVIGATIONAL EQUIPMENT

## 4.1 Automatic Pilot

In compliance with SOLAS V/19, all ships greater than 10.000 GT must be fitted with a heading control system. This kind of ships have normally two Auto Pilots o Track Pilots available to be operated through any Multipilot on the bridge. Track Pilot always needs interconnection with a Gyro Compass.

Track control modes

- Heading mode: without automatic drift-correction which controls the heading given using the joystick.
- Course mode: with automatic drift-correction which steers the course over the ground given using the joystick.
- Track mode: execute a pre-planned System Route done by the operator.

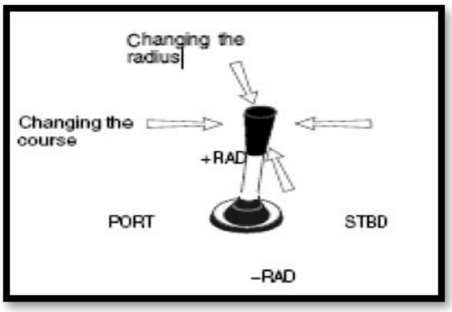



FIGURE 4-1: AUTOPILOT JOYSTICK (SOURCE: AUTOPILOT MANUAL)

Trackpilot parameters

Rudder economy: Optimization between precise track-keeping and frequency of changing of the rudder angle. Select between precise track-keeping in calm sea or very tolerant track keeping in bad weather. Low numerical value corresponds to more frequent movements of rudder. Values are between 1 (calm weather and precise steering) and 10 (very bad weather and very tolerant steering).

Loading: Differing inertia of the ship in different loading conditions. Sets the current load state.

Sailing:  Great Circle or Rhumb Line Navigation. The indication of sailing mode shows whether the To-waypoint, if more than 25 NM distant, will be approached on an approximate GC or RL.

Control: if the ship is not situated on or near to the pre-planned System Route, indicates at first the originally planned route is to be approached and not the next To-Waypoint. To track the original System Route is approached on the shortest way with a maximum course change of 50% of the set course limit.

Trackpilot limits

Rudder Limit (5°-35°): Maximum permitted rudder angle. This limit will allow the ship to turn with a small radius (high ROT) or to be controlled sufficiently at low speed. Under a constant course on open sea, rudder limit should be reduced. In coastal approach, it must be suitably increased.

Course Limit (1°-45°): Corrective steering behavior after deviation of the track. Sets the limit of the course difference monitoring and of the corrective steering angle. The numerical value is the difference between the actual course and the set course. The corrective steering angle, with which the ship is steered back onto the track after deviating from it, is limited to 50% of the course limit value. IMPORTANT NOTE: switchover to Track mode is possible only if the angle between the System Route and the existing course is less than the Course Limit.  Fast return to the track -> a large course limit is necessary.

Track Limit (10m -1000m): Accuracy of track-keeping. Sets the limit of the track deviation monitoring and let’s adjust the track keeping precision. IMPORTANT NOTE: switchover to Track mode is possible only if the deviation of the ship’s deviation from the System Route does not exceed the Track Limit. In order to have precise track-keeping, lower track limit is needed but the rudder movement frequency might possible be higher.

Drift Limit (1°-30°): Maximum compensated drift. Defines the drift angle up to which, in Course Mode and in Track Mode, the drift is considered and compensated automatically.

A common feature of all limits in this group is that when the set value is reached or exceeded, a corresponding alarm appears. [9]

### 4.2 Radio Detecting and Ranging (Radar)

The Radar principal is based on a short burst of electromagnetic energy thrown out, bounces off a target and then returns. As a result, Radar shows the video as well as the Radar targets selected by the operator. AIS targets from a separate AIS transponder unit are processed exactly in the same way as Radar targets. Radar and AIS can be merged.

Depending on the size of the ship, vessels are provided with several radar transceivers. A high placed radar scanner will receive more echoes than lower placed radar scanners. In another hand, two or more workstations can be using the same antenna, but only one will be acting as Master. It is a good practice to be aware about the blind sectors of the radars that are posted on the bridge

Different wavelengths of electromagnetic radiation have different penetrating and reflection properties. The wavelength produced by S-Band radars is 8 to 15 cm (2 to 4 GHz) and the wavelength produced by X-Band radars is 2.5 to 4 cm (8 to 12 GHz). Because of the smaller wavelengths produced by X-Band radar uses small antenna and is more sensitive, so can detects smaller particles. Therefore, monitoring cloud development should be performed by using X-Band radar because it can detect the tiny water particles and used to detect light precipitation such as snow. [8]

Moving on, ARPA stands for Automatic Radar Plotting Aid. It is a radar-based system used in marine navigation to assist with collision avoidance and situation awareness. Getting familiar with ARPA functionalities is basic for a bridge officer in order to perform safely and properly the watch-stander navigational duties. Some of the most important functionalities of ARPA are the following:

- ARPA can automatically track and display the positions, courses, speeds, and other relevant information of targets detected by the ship's radar.

- ARPA can calculate and display information such as closest point of approach (CPA) and time to closest point of approach (TCPA) for tracked targets. This information assists the navigator in making informed decisions for safe maneuvering.

- ARPA can predict the future positions of tracked targets based on their current course and speed, which helps the navigator to make decisions for course alterations or adjust speed to avoid collisions.

- ARPA provides alarms, warnings and indications if there is a risk of collision with other vessels. It considers the vessel's own speed, course, and the movement of nearby targets to determine if a potential collision is imminent.

- ARPA offers both true motion and relative motion displays. True motion shows the movement of targets with respect to fixed objects on the Earth, while relative motion displays the movement of targets relative to the ship's own position and heading. ARPA also provides true or relative vectors, which simplifies collision avoidance decisions.

## 4.3 Electronic Chart Display and Information System (ECDIS)

ECDIS is a geographic information system used for nautical navigation that complies with International Maritime Organization (IMO) regulations as an alternative to paper nautical charts. Nowadays most of the ships are exempted to use paper charts because the following requirements are met; installation of type approved systems, connection to means of emergency power supply, connectivity to the main sensors, which are position sensor, speed sensor and heading sensor, usage of official ENC for the whole intended voyage (Electronic Nautical Charts) and full certified users, which means Bridge Officers holding ECDIS certificates.

The newest ECDIS systems offer Route Planning, Route Monitoring and Voyage Replay. Route Planning is based on sailing routes consisting of WP and straight legs between two adjacent waypoints. These waypoints are defined by their geographical coordinates in WGS-84 format (the standard format of satellite navigation receivers and electronic charts). Voyage Replay is a mandatory ECDIS option that stored information of at least the last 12 hours in the hard drive of the specific workstation. Nothing is downloaded from the VDR. [10]

A new functionality called Radar Overlay must be introduced to the Officers. Radar overlay is a navigation system which superimposes live radar video output over ECDIS. It provides a scan-converted output for display, automatically scaled to suit the displayed chart. The transparency can be adjusted so that the chart can be seen through the radar image. The overlay and its controls conform to ECDIS standard for combining radar with ECDIS chart display.[8]

## 4.4 Navigational Compasses

In compliance with SOLAS V/19, all ships must be fitted with one Magnetic Compass independent of any power supply to determine the ship´s heading. The magnetic compass points to magnetic north which means it must be corrected for variation (the difference between magnetic and true north) and deviation (the difference caused by the ships own magnetic field, created due to the ships steel construction). Magnetic compasses are located usually on the mast deck or monkey island. Its repeater is located on the bridge’s center console.

Besides that, as this kind of ships are greater than 500 GT, they must be fitted as well with a Gyro Compass. The gyro compasses, which use gyroscopic inertia, point to true north and they are, therefore, way more accurate and reliable for day-to-day navigation.


FIGURE 4-2: GYRO AND MAGNETIC COMPASS AND RATE OF TURN INDICATOR (SOURCE: OWN ELABORATION)

The system in a multi gyrocompass configuration provides an automatic heading switch over functionality as part of a Grounding Avoidance System (GAS). In this context, GAS refers to all navigation equipment required to keep the heading distribution operating in all steering modes in case of failure of the active heading reference. The substitution is available in auto steering and manual steering mode. As a recommendation, the operator may change to manual steering mode and steer the vessel by hand to gain an overview of the navigational situation during GAS heading situation. [13]

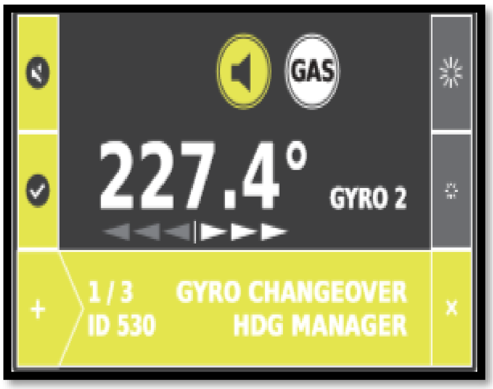



FIGURE 4-3: GROUNDING AVOIDANCE SYSTEM (SOURCE: GYRO COMPASS MANUAL).

Keep in consideration that the courses and bearings laid on a chart are true, but navigators steer courses and take bearings using a compass. The difference between direction as measured by the compass and the true direction as measured on the chart is termed compass error. The Compass Error is a combination (the algebraic sum) of two separate and distinct components, namely variation and deviation.

Every bridge watch duty must calculate the accuracy of the compasses to spot any anomalies or trends and keep a record on the official Compass Error Log. As the ship is navigating at sea without shoreside references, celestial objects like the Sun, the Moon, stars or planets can be used to make this calculation. The officer needs to take an observed bearing looking at the object through the azimuth ring and then use Norie's Nautical Tables and Nautical Almanac to work out its true azimuth (the celestial term for bearing in the sky). The difference is the compass error.

Variation is the difference between True North and Magnetic North, which is located somewhere moving slowly from north of Canada toward Siberia in Russia. The Variation for the local area is found on the paper chart or Electronic Nautical Chart (ENC). It shows a Magnetic North arrow, the local variation, and the annual rate of change. Officers must look at the one nearest the ship's position.

Deviation. The compasses point the Magnetic North but due to ferrous metal such the ship's hull and the engines and electrical equipment such radios or mobile phones, a deviation is created in such a way that deflect the compass from the magnetic north. This deviation changes depending on the ship and on the heading. However, a compass corrector can adjust the steering compass to minimize errors and then produce a Deviation Card showing the remaining deviation for each heading.

### 4.5 Global Navigation Satellite System (GNSS)

GNSS refers to a constellation of satellites providing signals from space that transmit positioning and timing data to GNSS receivers. There are different known positioning systems such as the European Galileo, the Russian Glonass, the American GPS and the Chinese BeiDou.

Many shipping companies use, in general, Global Positioning System (GPS). The system consists of a network of 24 active satellites and 8 spares located nearly 20.000 km above the Earth’s surface. Each satellite orbits the Earth in about 12 hours, and they use 6 different orbits to avoid collisions between them. GPS uses two main mathematical ideas: the first one is trilateration, based on finding the position of a GPS device from 3 or 4 distances. The second one is the relationship between the speed of the signal (the speed of the light c=300.000km/s), the time taken for the signal to travel and the distance.

A Differential Global Positioning System (DGPS) is an enhancement to the GPS which provides improved location accuracy, in the range of operations of each system, from the 15-meter nominal GPS accuracy to about 1–3 cm in case of the best implementations.

The GPS uses the World Geodetic System (WGS84) as its reference coordinate system. The coordinate origin of WGS 84 is meant to be located at the Earth's center of mass; the uncertainty is believed to be less than 2 cm.

### 4.6 Speed Log

A speed log is a marine speed and distance measuring device. Speed logs are crucial for maintaining accurate navigational records, calculating required speed and fuel consumption, and ensuring the safety and efficiency of maritime operations.

There are different types of speed logs used on ships, but a common type is the Doppler speed log. This device utilizes the Doppler effect to measure the speed of the ship. It emits ultrasonic sound waves into the water (like echo sounder), and by analyzing the frequency shift of the reflected waves, it can determine the speed of the ship relative to the water.

Another type of speed log is the electromagnetic speed log, which uses electromagnetic fields to measure the ship's speed. This system includes a sensor mounted on the ship’s hull that interacts with the water to generate speed data. [14]

The speed through the water and speed over the ground are two different measurements used in maritime navigation and the Bridge Officers shall be familiar with the difference:

1. Speed Through the Water: This refers to the speed at which a vessel is moving through the water, also known as its "sailing speed" or "ship's speed." The speed through the water is important for ship handling, maneuvering, and calculating fuel consumption.

2. Speed Over the Ground: This refers to the speed at which a vessel is moving over the Earth's surface. It is determined by combining the speed through the water with the effect of currents, tides, and wind. The speed over the ground is typically measured using a GPS (Global Positioning System) or other satellite navigation systems. This measurement is crucial for navigation, route planning, and determining the estimated time of arrival (ETA) at a destination.

The difference between speed through the water and speed over the ground is primarily caused by external factors such as currents, tides, and wind.

TABLE 4.6-1: NAVIGATIONAL FORMULA (SOURCE: OWN ELABORATION)

$$Hours\ to\ Reach\ the\ required\ speed\ = \frac{DTG - (TTG\ x\ RS)}{Actual\ Speed - RS}$$

Where:

DTG → Distance to go (remaining miles)
TTG → Time to go (remaining time)
RS → Required speed

### 4.7 Echo Sounder

Cruise ship drafts can be even 8-10 meters, and Captains usually request a minimum of under keel clearance (UKC) for safety reasons, which makes very important to have a device for measuring water depth. Vessels are having a navigational echo sounder system that has transceiver units, which is the echo sounder producing the acoustic signals and processing the returns to give the appropriate outputs for depth.

Due to the typical length of the ships, two transducers are installed, the Fore transducer is the primary one (normally 50 kHz) and the Aft transducer is a secondary one (normally 200 kHz). The system includes touchscreens installed on the bridge that can be setup to show different parameters, but it also has an automatic function that takes over the control of range, gain, frequency and power of the system to minimize the required amount of user interaction. Using auto mode, the system will change the range and signal settings automatically, as the depth changes.

The depth can be read off at the echo sounder control panels, or through any of the workstations selecting the option “Depth” because the systems are interconnected. The echo sounder has a mandatory alarm called “shallow water” that must be acknowledged on the display in case of exceeding the set limit. There is also second “deep water” alert. [15]

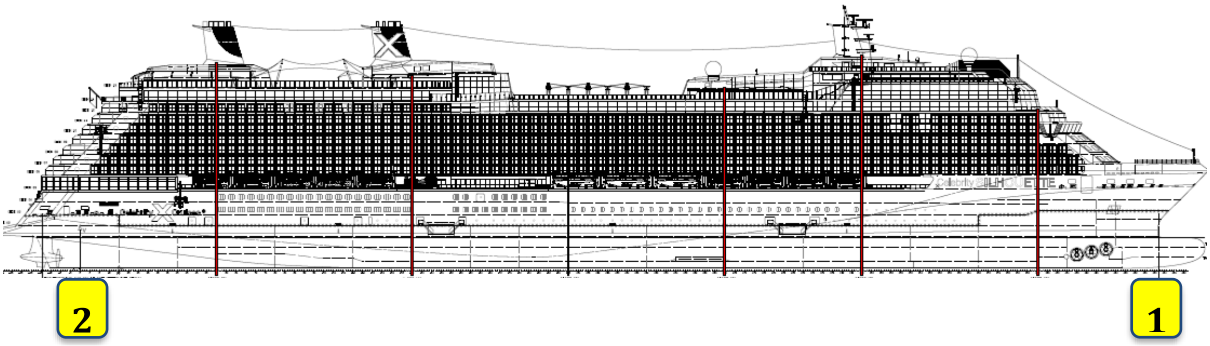



FIGURE 4-4: TRANSDUCERS LOCATION (SOURCE: GENERAL ARRANGEMENT PLAN)

## 4.8 Typhon and Morse light panel

This is an automatic and manual sound and light signals control that release the maneuvering and warning signals according to COLREG Rule 35 and additionally the SOS distress signal. The light signals will be used according to the International Morse Code. The typhon system allows choosing between different signals pre-defined soundings; every 60s, 90s or 120s; and the numbers of whistles to be sounded, always main and secondary to be selected (forward and aft). [16]


COLREG 1972 - Rule 35 Sound Signals in Restricted Visibility

*In or near an area of restricted visibility, whether by day or night, whistle signals shall be used.*

(a) ▬ = vessel making way through water
(b) ▬ ▬ = vessel making no way through water
(c) ▬ ●● = vessel not under command, vessel retricted in her ability to maneuver, vessel engaged in fishing, or towing or pushing another vessel
(e) ▬ ●●● = vessel towed
(g) ● ▬ ● = vessel at anchor

●●● ▬ ▬ ▬ ●●● = SOS distress signal

FIGURE 4-5: TYPHON AND MORSE PANEL (SOURCE: SOUND AND LIGHT PANEL SYSTEM MANUAL)

Remember that these sound signals are specific for restricted visibility condition. Under good visibility they have other meaning.

## 4.9 Bell and Gong Panel

According to COLREG Rule 33(a), a vessel of 20 meters in length or more shall be provided with a bell and a vessel of 100 meters or more shall in addition be provided with a gong. The control system fitted on the bridge works automatic or manually.

To start sounding bell & gong turn the center switch to “I”. It will automatically ring the bell and gong as per regulations for ships at anchor of more than 100m. In order to stop sounding bell & gong turn the center switch back to “0”.

Important reminder: as per COLREG, a vessel is *underway* when is not at anchor, made fast or aground. An underway vessel can have two stages: underway making way or underway not making way, with neutral transmission, no way through the water. [16]


FIGURE 4-6: BELL AND GONG PANEL (SOURCE: OWN ELABORATION)

## 4.10 Bridge Navigation Watch Alarm System (BNWAS)

In compliance with SOLAS V/19 requirement, passenger ships are to be fitted with the BNWAS as a separate monitoring and control system, which is completely independent from the workstations. Its main purpose is to monitor bridge activity and detect operator disability which could lead to marine accidents, that’s why it is also called “*Dead Man System”.* Besides this, it gives an overview of the alarms from the connected navigation and automation system. It must be in operation whenever the ship is underway.


FIGURE 4-7: MONITORING AND CONTROL SYSTEM PANEL (SOURCE: OWN ELABORATION)

It comprises one operator panel at the bridge, located at the forward console of the bridge that can be used to release an assist call addressed to selected crew members. There are some back-up panels which provide indicators for the group alarms and an acknowledgement button. Usually located by Master, Chief Engineer, Bridge and Engine Officers cabins. [6]

If the system is active and bridge team is not pressing the yellow timer reset button within the dormant period (which can be set between 3 to 12 minutes), a visual alarm (flashing light) is raised at the bridge. If no acknowledgment is given from bridge within 15 seconds, the alarm changes into an audible alarm.  If again after 15 seconds no acknowledgment is given from bridge, the alarm is passed to the back-up officer's cabin. If further-on no acknowledgment is given from the back-up officer, the audible alarm is extended to all back-up panels.

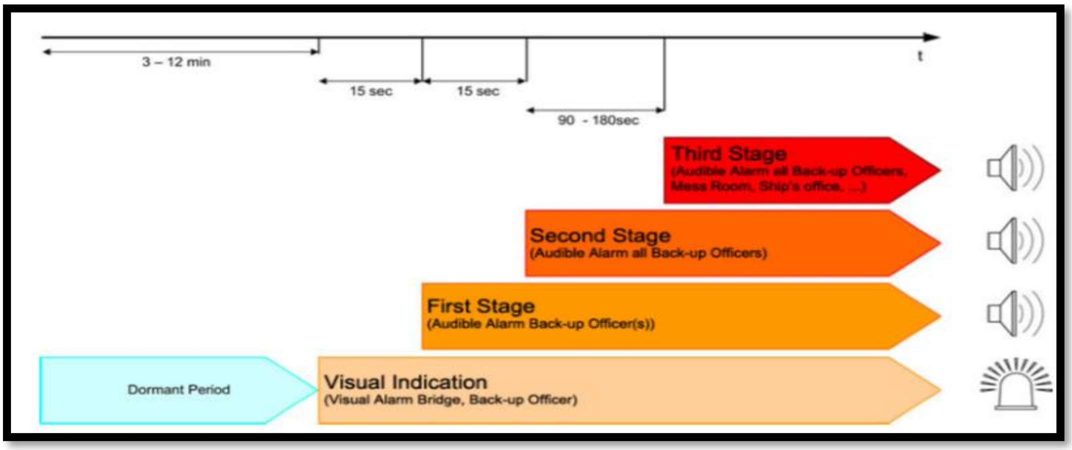



FIGURE 4-8: BNWAS STAGES (SOURCE: BNWAS MANUAL)

## 4.11 Talk Back System and Sounded Powered Telephones

The intercom is an intercommunication system for quick and hand free open conversations between critical locations around the ship. The primary use of the talkback system will be for communication between maneuvering consoles on the bridge. It will also be used for communication between the Bridge and ECR as well as Bridge with Mooring decks.

In another hand, there are many key areas connected by sound powered telephones onboard cruise ships. The purpose of the sound powered phone is to provide communications between critical areas even when there is a failure in the standard communication system. The sound powered phone operates using the magnetic field (energy) generated when cranking the handle on the unit. The system uses three loops defined as the wheelhouse loop, propulsion loop and the safety loop. The units in the machinery rooms have headsets due to the high ambient noise levels. These units have a relay which activates an external bell and beacon.

The operation requires to turn the call generator approximately 5-6 turns until a loud tone is heard, then lift the handset and hold the talk button pressed for the duration of the call. Five to six turns will give approximately 15 - 20 minutes communication. Communication time may be extended if required, by turning the crank again. [6]


FIGURE 4-9: TALK BACK SYSTEM AND SOUNDED POWERED TELEPHONE WITH DIRECTORY (SOURCE: OWN ELABORATION)

## 4.12 GMDSS Equipment

Under SOLAS/IV, all passenger ships and all cargo ships over 300 gross tonnage on international voyages have to carry specified terrestrial and satellite radiocommunications equipment for sending and receiving distress alerts and maritime safety information, as well as for general communications.

GMDSS stands for Global Maritime Distress and Safety System. It is an internationally recognized set of communication protocols and procedures used for ensuring safety of life at sea and distress communication in the maritime industry. GMDSS radiocommunication plays a crucial role in facilitating communication between ships, coastal radio stations, and rescue coordination centers.

GMDSS requires ships to be equipped with specific radio communication equipment depending on their size and area of operation. Mariners who operate GMDSS communication equipment are required to have appropriate certifications too. At the same time, GMDSS set standardized communication procedures and protocols to ensure effective and clear distress communication. These protocols include standard phrases, formats, and priority codes for distress alerts, urgency messages, safety communications, and general radio traffic.

GMDSS establishes a network of rescue coordination centers (RCCs) around the world. These centers receive distress alerts and coordinate search and rescue operations in their respective areas.

It is important to know the ship's MMSI, which stands for Maritime Mobile Service Identity, a nine-digit Station Identification number assigned to ships and coast stations. On ships, the first three digits which is the MID identifies the Administration that issued the MMSI. For Coast Stations, the MID will follow the two zeros (00MID). Note: this is the same station identity number used for AIS systems. [1,17]

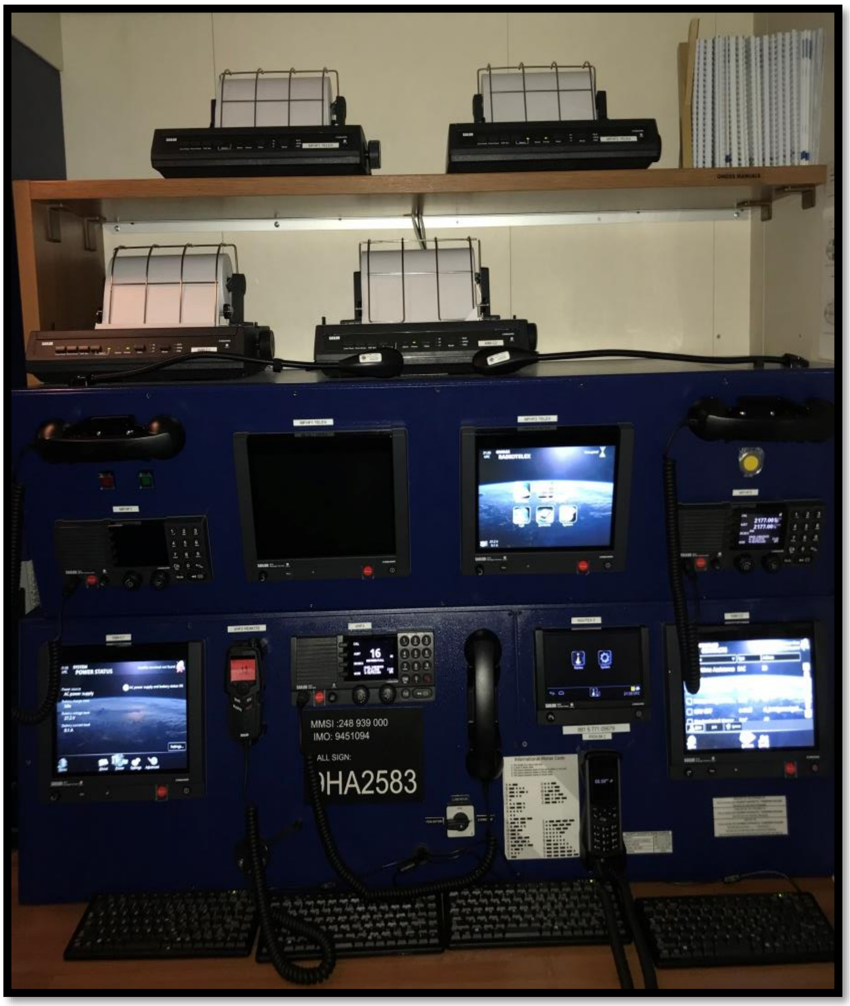



FIGURE 4-10: GMDSS CONSOLE (SOURCE: OWN ELABORATION)

Key words for GMDSS understanding:

Digital Selective Calling: The IMO introduced digital selective calling (DSC) on VHF, MF and HF maritime radios as part of the GMDSS. DSC is primarily intended to initiate ship-to-ship, ship-to-shore, and shore-to-ship radiotelephone communications on VHF, MF/HF and radio-telex communications on MF/HF. DSC calls can also be made to individual ships or groups of ships. DSC distress alerts, which consist of a preformatted distress message, are used initiate emergency communications with ships and rescue coordination centers.

Very High Frequency (VHF): The VHF band ranges from 30 MHz to 300 MHz. The frequency range for marine radios are in the 156-174 MHz band. VHF is utilized to provide short range communication services, generally about 25 miles or more.

Medium Frequency (MF): The MF band ranges from 300 kHz to 3 MHz. The common frequencies used for marine radios are frequencies in the 2 MHz band. MF provides mid-range communication services generally less than 200 miles.

High Frequency (HF): The HF band ranges from 3 MHz to 30 MHz. The frequencies commonly used for marine radios are frequencies in the 4, 6, 8, 12, and 16 MHz band. HF provides long range communication services generally above 200 miles.

INMARSAT Systems: INMARSAT is a private commercial company that utilizes geostationary satellites and Land Earth Stations (LES) globally for marine communication services. Ships fitted with INMARSAT Ship Earth Station (SES) system are capable of distress alerting and for two-way communications using e-mails, fax, data transmission and/or radiotelephone. The system is restricted to approximately 70º North to 70º South.

NAVTEX (Navigational Telex): MF direct-printing service implemented to broadcast Maritime Safety Information (MSI), such navigational and meteorological warnings. It uses 518 kHz for international messages and 490 kHz for local broadcasting.

Cospas-Sarsat Systems: This system utilizes two satellite systems (a polar orbiting and a geo-stationary satellite system) to detect the signal of a 406 EPIRB and transmit the EPIRB's location to the nearest ground station. These ground stations are referred to as Local User Terminals (LUTs).

EPIRB: this is a satellite position indicating radio beacon that transmit a distress alert in the 406 MHz band to polar orbiting satellites in the Cospas-Sarsat System. EPIRB is a transmit only device and cannot receive signals.

SART: A device that transmits a series of response signals after being interrogated by a 9 GHz radar that can be received by any ordinary 9 GHz shipborne radar or suitable airborne radar. The ship's radar does not need to be modified to detect SART signals.

Survival Craft Radiotelephones: Emergency VHF transceivers that operate on VHF CH 16 and one other channel (CH 06 is recommended by IMO) for the purpose of use in survival crafts during an emergency.[17]

### 4.13 Ship Security Alert System

The Ship Security Alert System (SSAS) is a safety measure for strengthening ship's security against acts of piracy and/or terrorism. The ship security alert system is provided to a ship for the purpose of transmitting a security alert to the shore to indicate to a competent authority that the security of the ship is under threat or has been compromised. It comprises a minimum of two activation points, one of which is on the navigation bridge. These initiate the transmission of a ship security alert. The system is intended to allow a covert activation to be made which alerts the competent authority ashore and does not raise an alarm on board ship nor alert other ships.

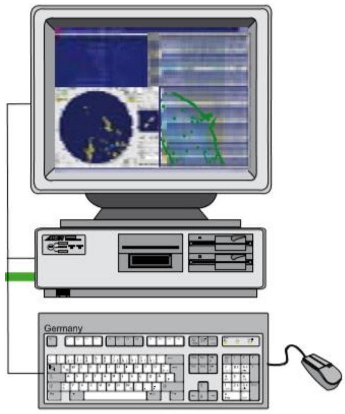
The SSAS is also known as a silent ship security alarm system which, when activated by pressing one of the buttons, does not issue any audio-visual signal on the ship or to nearby vessels or security forces. The alert is first received by the ship's owner, then passed to ship's flag, and these receivers are obliged to inform the national authorities of the coastal states where the ship is sailing. [18]

## 4.14 Voyage Data Recorder

In compliance with SOLAS Chapter V Reg. 20 a VDR must be fitted onboard. Its purpose is to maintain a store, in a secure and retrievable form, of information concerning the position, movement, physical status, command and control of the vessel covering at least the most recent 12 hours of operation. It should be shut down only in case of maintenance by using the ON/OFF key button located inside the cabinet. This key to turn it on/off must be under Master´s surveillance. Annually testing is required. [19]

The system has the following main components:

TABLE 4.14-1: VOYAGE DATA RECORDER DIAGRAM (SOURCE: OWN ELABORATION)

| **VDR Data Concentrator**<br>Bridge Equipment Room | **Final Recording Medium**<br>Mast Deck | **VDR Replay Station**<br>Bridge Office |
|---|---|---|
| <br><br>**Core Module**<br>The Core Module includes all key components necessary for data acquisition and processing.<br>■ Local flash memory 16GB for redundant backup / parallel recording<br>■ USB stick 8 GB for backup / parallel recording incl. fast retrieval functionality<br>■ 2 built-in audio channels for VHF<br>■ 2 built-in serial channels for AIS and NMEA<br>■ Built in 8 port Ethernet switch<br>■ NiMH battery pack | <br>**Final Recording Medium**<br>The Final Recording Medium is a fire resistant and pressure tight storage medium to store recorded data as required by the IMO. The capsule is resistant against shock, penetration, fire, deep sea pressure and immersion. The Final Recording Medium includes:<br>■ Protected memory capsule with 4 GB flash memory for 12 hours recording time<br>■ Mounting unit | <br>**Replay Station**<br>The replay station is an optional PC (software is part of VDR) to download and display the recorded data from the VDR. The replay software is based on ECDIS and visualises the information graphically and alphanumerically in separate windows. |

# 5 DECK EQUIPMENT

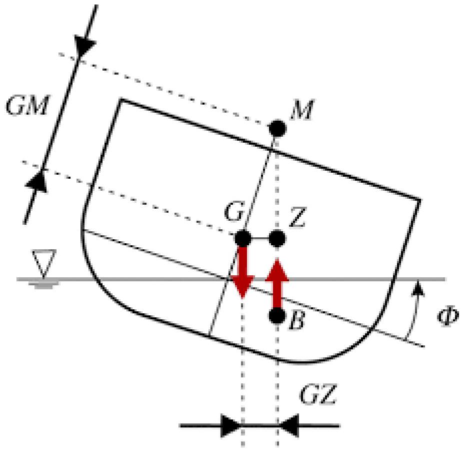
## 5.1 Ship’s Stability

Ship's stability refers to the ability of a vessel to maintain an upright position and resist capsizing or excessive rolling motions when subjected to external forces, such as waves, wind, cargo loading, and other factors. Stability is a crucial aspect of ship design and operation, especially for cruise ships have a considerable wind surface and can be highly affected by the weather elements.

Intact stability refers to the ship's stability in normal operating conditions. Damage stability refers to the ship's ability to remain afloat and stable after sustaining damage, such as hull breaches or flooding. Regulations and design standards specify minimum stability criteria for both intact stability and damage stability. The vessel shall under all circumstances meet or exceed the minimum stability requirements and must not sail if these conditions cannot be met for the planned voyage.

Two different analysis concepts are applied for damage stability calculations: the deterministic concept and the probabilistic concept. For both concepts, the damage stability calculation shall be made according to the method of lost buoyancy. Unfortunately, the collision resistance is not considered when assessing damage stability and vessels with strengthened side structures are treated in the same way as single-hulled ships.

Ship operators are required to have accurate and up-to-date stability documents on board. It is as well common to find on cruise ships a primary stability library on the bridge and a secondary stability library at any other key location on the ship. [1, 7, 8]

| | |
| --- | --- |
| Remembering key concepts to understand stability:<br>○ Center of gravity (G)<br>○ Center of buoyancy (B)<br>○ Metacenter (M)<br>○ Metacenter height (GM)<br>○ Righting arm (GZ) |   FIGURE 5-1: KEY STABILITY CONCEPTS (SOURCE: WIKIPEDIA IMAGES) |

In order to make stability calculations and ensuring the safety and seaworthiness of the vessel, cruise ships are equipped with a certified stability loading computer approved by the Society Class. There are two stations from which the Stability program operates from, and for safety reasons, they are both supplied by different sources of emergency power supply (UPS). Those computers are placed at the Safety Center of the Bridge.

Prior any arrival or departure, the ship's stability calculation must be saved and printed. Besides, when the ship is at port and upright, cross check should be done of the loading computer drafts by getting visual drafts and taking in consideration the density of the water. All conditions are to be made, recorded, printed, signed and filed.

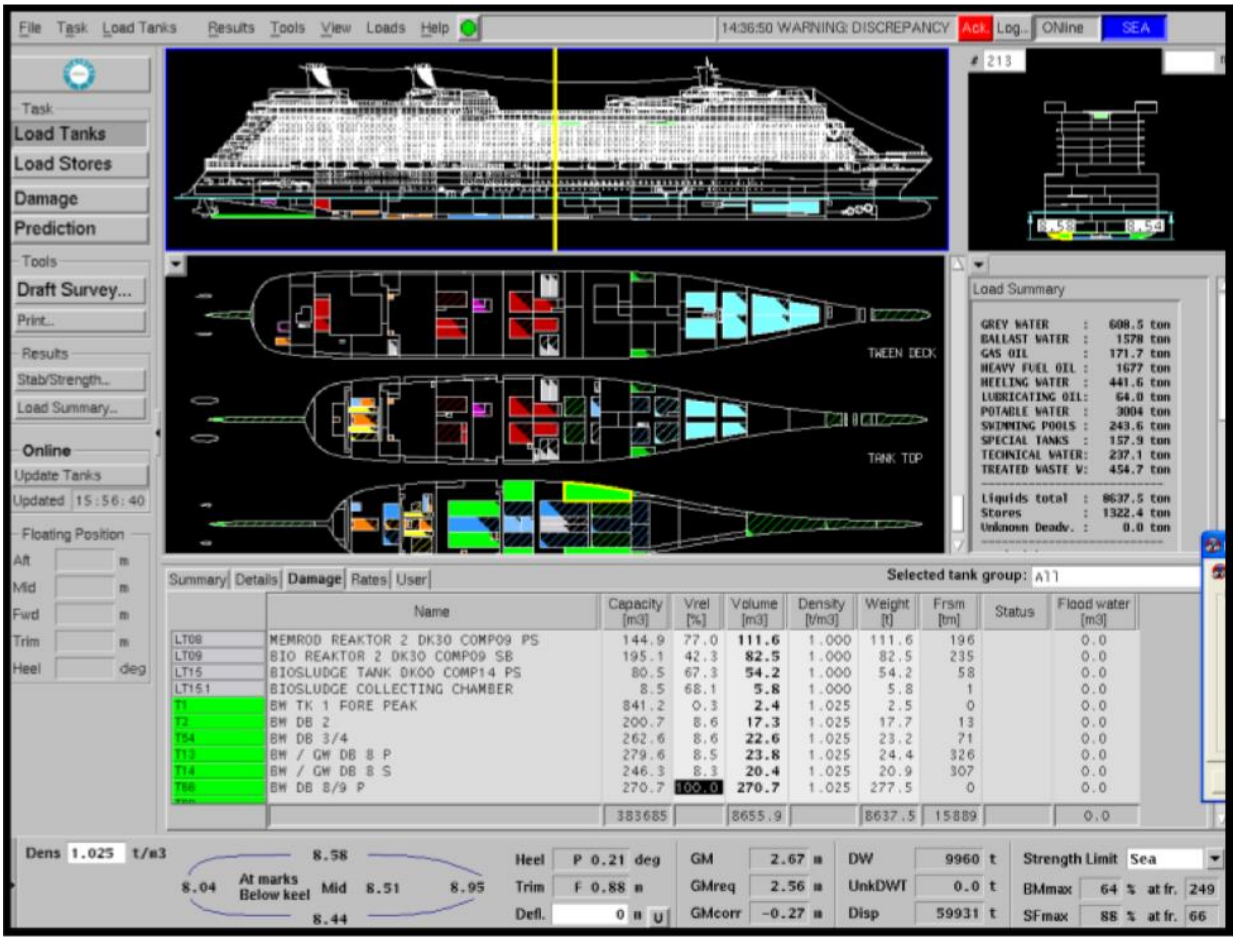
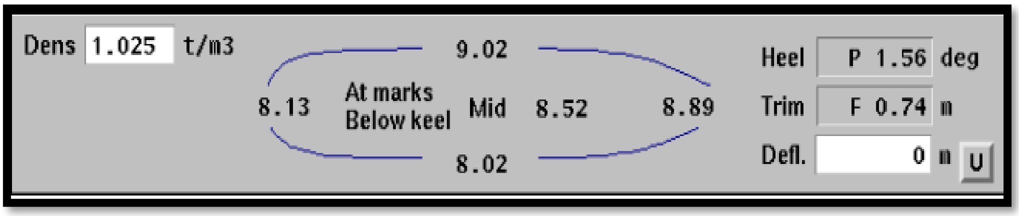
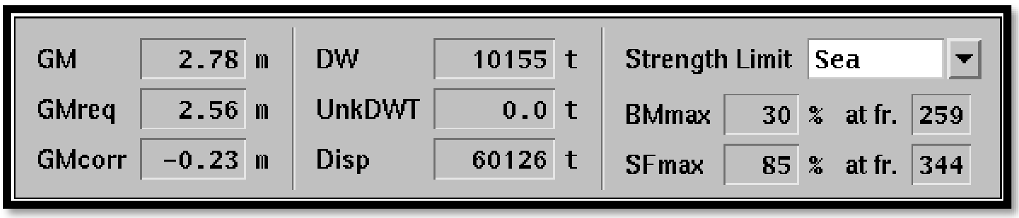



FIGURE 5-2: STABILITY LOADING COMPUTER (SOURCE: OWN ELABORATION)

Elemental stability concepts are to be evaluated before setting sail:




1) Maximum mean draft and ship's trim
2) Actual metacentric height and required metacentric height

3) Deadweight and displacement for the calculated drafts
4) Strength limit; bending moments and shearing forces at each specific frame, setting “sea” for bad weather and “harbor” mode for calm weather conditions.

Before making ballasting/deballasting operations or before discharging overboard any water waste, calculation can be made through the loading computer to pre-evaluate the result and provide decision support to the Bridge Officers.

Summary | Details | Damage | Rates | User — Selected tank group: BALLAST WATER

| | Name | LOAD | Capacity [m3] | Vrel [%] | Volume [m3] | Density [t/m3] | Weight [t] | Frsm [tm] | Frs.max [tm] | Online |
|---|---|---|---|---|---|---|---|---|---|---|
| T1 | BW TK 1 FORE PEAK | BM | 841.2 | 0.3 | **2.6** | 1.025 | 2.6 | 0 | 806 | ON |
| T2 | BW DB 2 | BM | 200.7 | 9.0 | **18.1** | 1.025 | 18.5 | 14 | 161 | ON |
| T54 | BW DB 3/4 | BM | 262.6 | 9.1 | **23.8** | 1.025 | 24.4 | 74 | 1074 | ON |
| T13 | BW / GW DB 8 P | BM | 279.6 | 8.3 | **23.1** | 1.025 | 23.7 | 322 | 403 | ON |
| T14 | BW / GW DB 8 S | BM | 246.3 | 8.2 | **20.1** | 1.025 | 20.7 | 305 | 403 | ON |
| T68 | BW DB 8/9 P | BM | 270.7 | 100.0 | **270.7** | 1.025 | 277.5 | 0 | 675 | ON |
| T69 | BW DB 8/9 S | BM | 237.6 | 100.0 | **237.6** | 1.025 | 243.5 | 0 | 675 | ON |
| T21 | BW TK 9 S | BM | 276.6 | 9.3 | **25.8** | 1.025 | 26.4 | 445 | 445 | ON |
| T18 | BW TK 9 P | BM | 276.6 | 9.6 | **26.6** | 1.025 | 27.3 | 445 | 445 | ON |
| T64 | BW DB 10 S | BM | 182.8 | 100.0 | **182.8** | 1.025 | 187.3 | 0 | 661 | ON |
| T50 | BW DB 10 P | BM | 182.8 | 100.0 | **182.8** | 1.025 | 187.3 | 0 | 661 | ON |
| T66 | BW / GW DB 11/12 P | BM | 260.4 | 92.8 | **241.7** | 1.025 | 247.7 | 524 | 524 | ON |
| T67 | BW / GW DB 11/12 S | BM | 235.2 | 92.9 | **218.5** | 1.025 | 224.0 | 474 | 474 | ON |
| T0 | BW DB 16/17 SKEG | BM | 436.7 | 15.5 | **67.5** | 1.025 | 69.2 | 24 | 33 | ON |
| | | | 4189.7 | | 1541.6 | | 1580.2 | 2626 | | |

FIGURE 5-3: TANK GROUP OVERVIEW (SOURCE: OWN ELABORATION)

## 5.2 Stabilizers

In order to reduce the rolling effects inducted by the waves at cruising speed and to compensate all or a part of heel, most of passenger ships are provided with one pair of active fin stabilizers normally over 200 tons each. The plants are arranged approximately at midships in the lowest decks. When the stabilizers are not in use, the fins are housed in two fin boxes, fully contained within the hull. The stabilizers will take around 120 seconds to be fully extended. For those ships over 300 m, the normal stabilizers extensions are approximately 6-7 meters and surface of 20 m2.

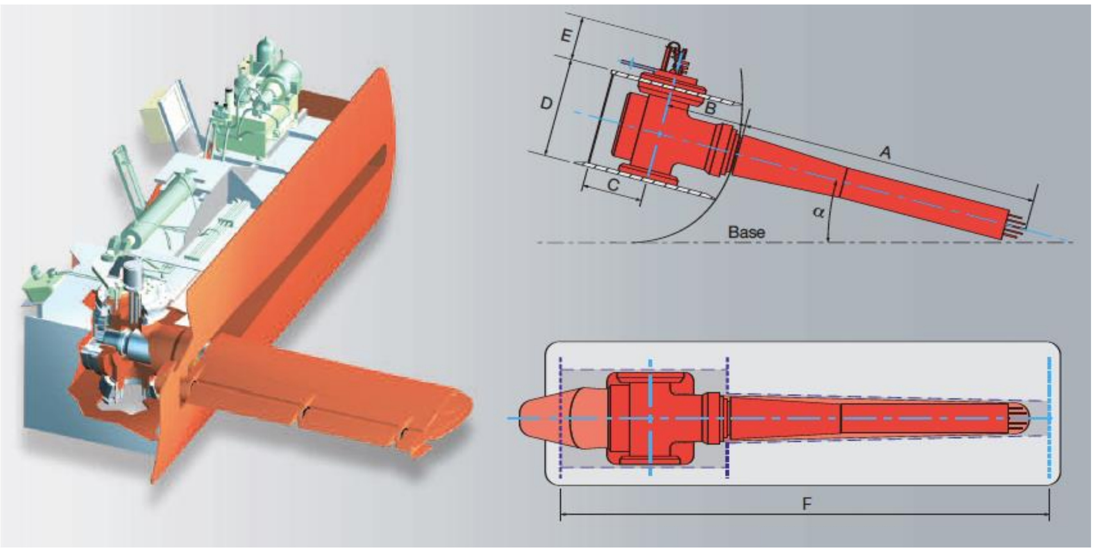



FIGURE 5-4: STABILIZERS (SOURCE: STABILIZERS MANUAL)

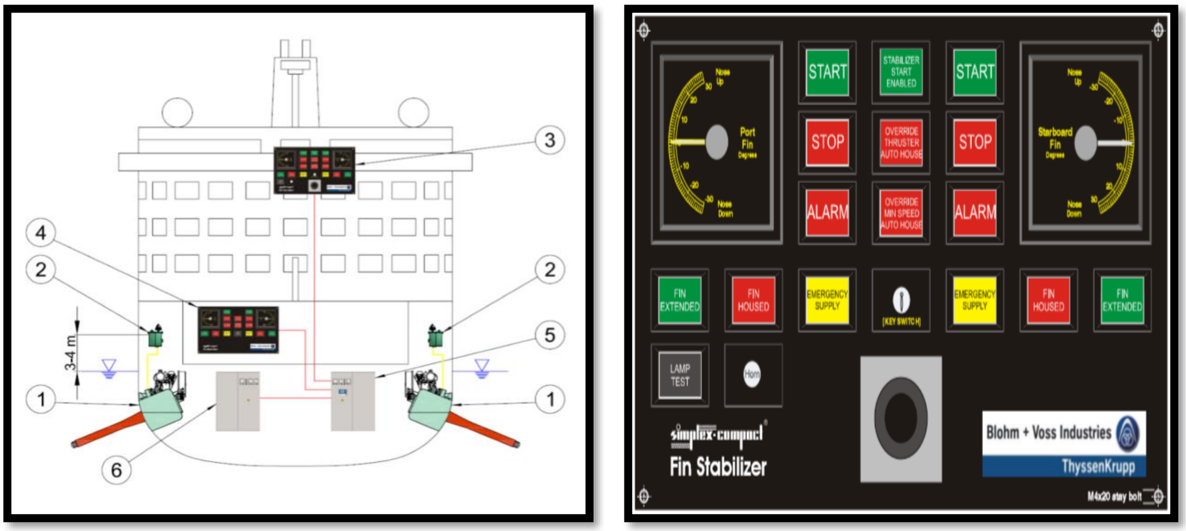



FIGURE 5-5: STABILIZERS PANELS (SOURCE: STABILIZERS MANUAL)

Due to safety reasons, the stabilizers will be auto housed when reducing speed or starting the thrusters because the system understands that the ship is approaching then to the port. However, extra options are available through the bridge panel:

Override thrusters

The control panel bridge is equipped with a button “Override Thruster Auto Housing”, that allows to disable the automatic housing, when the vessels maneuvering some of the thrusters. When override thruster auto housing function is activated, it is indicated by a red light on the panel.

Override minimum speed

The control panel bridge is equipped with a button “Override Min Speed Auto Housing”, that allows to disable the automatic housing, when the vessels speed decrease below minimum fin operation speed (STW 8 knots). There will be an alarm between 8 to 9 knots speed through water. When override minimum speed function is activated, it is indicated by a red light on the panel. [7,20]

## 5.3 Anchors

Cruise ships are having two anchors of approximately 15 Tn each at forward mooring station.

FIGURE 5-6: ANCHOR TYPE (SOURCE: OWN ELABORATION)

At the same time, two anchoring lines are arranged holding each anchor. These heavy chains are used for holding a vessel at anchor. They are marked as follows:

- ✓ the anchor lines are marked every 27.5 m, the links painted white are placed on back and front of kenter shackle (KS), which are painted red.
- ✓ the last 27.5 m chain length at each side is painted white. The length before the last length at each side is painted yellow.

Normally around 14 shackles are available for each anchor, which means a total chain mass of 182.207 kg or 182.2 T with a breaking load of 7960 kN.

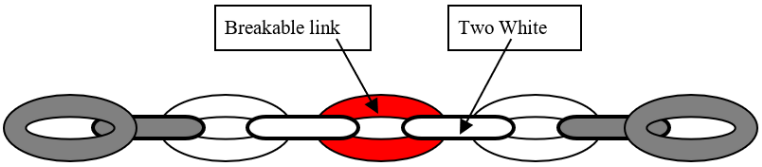



FIGURE 5-7: ANCHOR CHAIN EXPLANATION (SOURCE: OWN ELABORATION)

The ships have 2 anchor windlasses. These machines restrain and manipulate anchor chain and allows the anchor can be raised or lowered by using chain cables. The windlasses are controlled from two single controllers, arranged at forward mooring station. Lifting speed up to 9 m/min. [6]

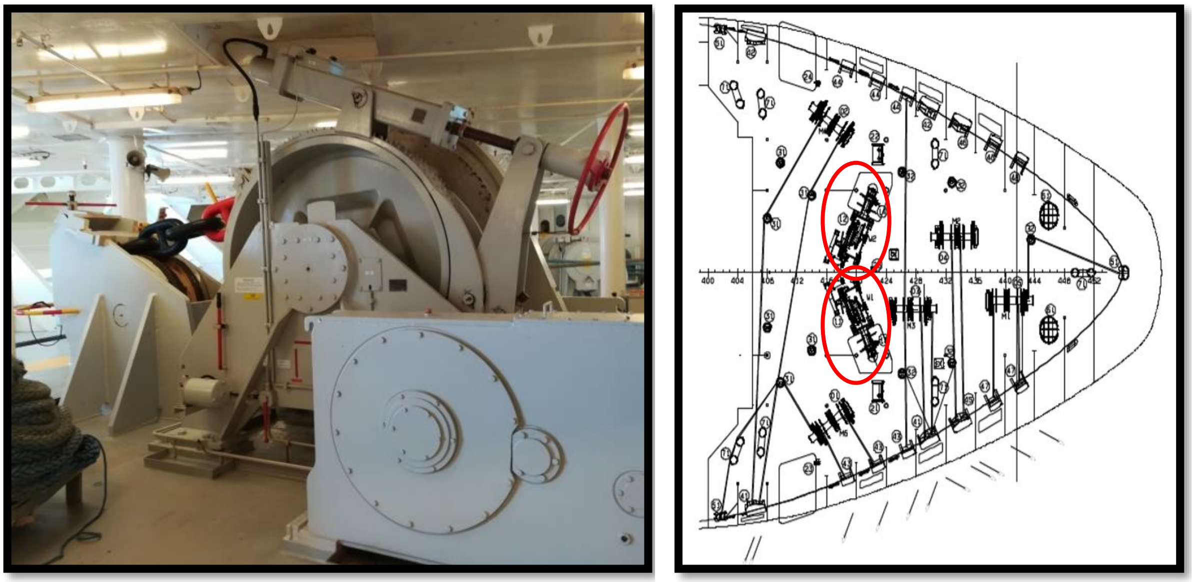


FIGURE 5-8: ANCHOR WINDLASS AND LOCATION IN MOORING STATION (SOURCE: OWN ELABORATION AND GENERAL ARRANGEMENT PLAN)

The anchors can be controlled using different stands located in the forward mooring and in the navigation console on the bridge.

TABLE 5.3-1: ANCHOR OPERATION PANELS (SOURCE: OWN ELABORATION INCLUDING FIGURES)


| | | |
|---|---|---|
| Panels | Three (3) in the forward mooring station | One (1) on the bridge center console |
| Operation | Dropping and heaving up | Only dropping |
| Control | Center line stand controls both anchors; starboard side stand controls starboard side anchor; and port side stand controls port side anchor only | Control over both anchors, port and staboard anchors |

## 5.4 Mooring stations

The primary idea of a cruise ship is being safely moored during the day and navigating during the night. Therefore, to keep the ship properly alongside almost regardless the weather conditions; good quality and quantity of mooring lines must be available.

In another hand, mooring winches to control those ropes are needed as well. For ships so big like cruise ships, normally each mooring station has 5 mooring winches. The winches are double drum electric driven and the maximum pulling speed is 18 meters per min. The mooring lines or hawsers are usually 200m or 220m by 72 mm, with a breaking strength over 900 kN. [6]

Specially attention must be given to the windlass & mooring winch brake pads and replacement must be done in time and manner.

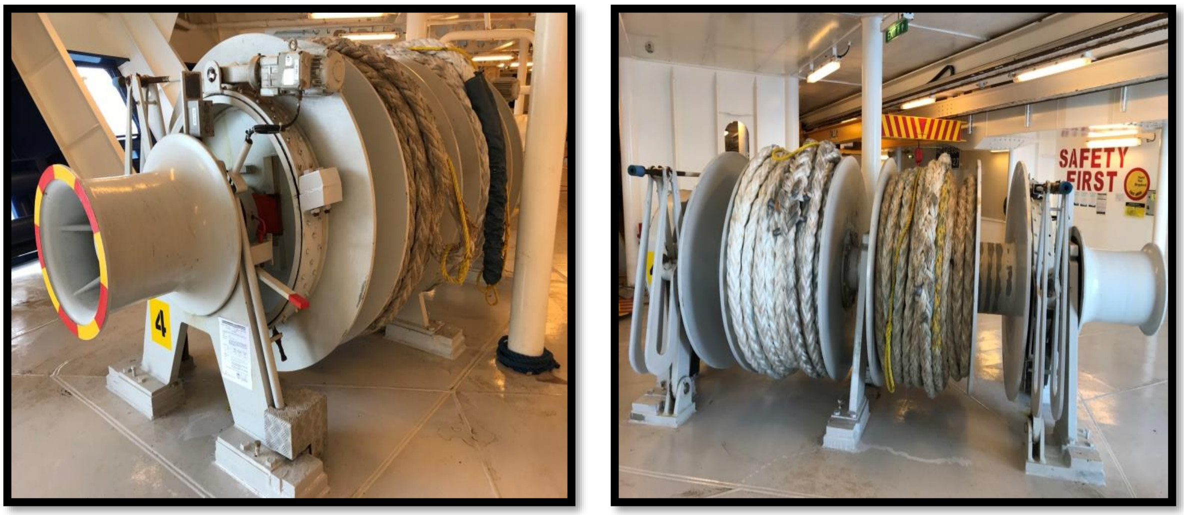



FIGURE 5-9: MOORING WINCHES (SOURCE: OWN ELABORATION)

# 6 SAFETY EQUIPMENT

All passenger ships constructed on or after 1 July 2010 shall have on board a Safety Center as per SOLAS with the full functionality (operation, control, monitoring or any combination thereof, as required) of the safety systems listed below:

- all powered ventilation systems;
- fire doors;
- general emergency alarm system;
- public address system;
- electrically powered evacuation guidance systems;
- watertight and semi-watertight doors;
- indicators for shell doors, loading doors and other closing appliances;
- water leakage of inner/outer bow doors, stern doors and any other shell door;
- television surveillance system;
- fire detection and alarm system;
- fixed fire-fighting local application system(s);
- sprinkler and equivalent systems;
- water-based systems for machinery spaces;
- alarm to muster the crew;
- atrium smoke extraction system;
- flooding detection systems; and
- fire pumps and emergency fire pumps.

Onboard cruise ships, this safety center is usually located on the Bridge. Compliance with the following regulations helps to enhance the safety of personnel and minimize the risk of fire-related and incidents at sea.[1]

In the context of maritime safety, SOLAS regulations specify requirements for the subdivision and arrangement of ships into different Main Vertical Zones (MVZs), also known as Fire Zones (FZ) for the cruise ships industry.

The purpose of dividing the ship into MVZs is to limit the vertical spread of fire, smoke, and flooding within the vessel. Each zone is typically equipped with fire-resistant bulkheads, insulation, and structural elements to provide compartmentalization and containment of potential hazards. This helps to protect critical areas, provide safe refuge spaces, and facilitate the evacuation of the passengers and the crew.

As defined by SOLAS, the maximum distance of a MVZ will be 48 meters. [1] For cruise ships of approximately 300 meters in length, the following calculation will be made:

$$\frac{300\ m}{48\ m} = 6{,}25 \quad \rightarrow \quad \boldsymbol{7\ Main\ Vertical\ Zones}$$

## 6.1 Public Address System

In compliance with SOLAS III/5 requirement, cruise ships as passenger ships have fitted a public address system. It must be clearly listened above the ambient noise in all spaces, and it is provided with an override function controlled from the bridge, so that all emergency messages will be broadcast if any loudspeaker in the spaces concerned has been switched off, its volume has been turned down or the PA system is used for other purposes. It is connected to the emergency source of electrical power.

Cruise ships have, at least, two PA systems on the bridge, one for emergency communications that broadcasts to all areas and one for routine announcements where desired areas can be selected by the user. There are others PA systems for routine announcements located on key points of the ship, such ECR, Guest Relations desk, Shore Excursion desk, Dining Room, Communication Center, Broadcast Room and Conference Center. [6]

The newest systems have pre-defined the alarms sounding:

- ✓ General Alarm: 7 short and 1 long blast
- ✓ Fire Alarm: continuous ringing
- ✓ MOB: 3 long blasts

## 6.2 Fire Detection System

Fire detection systems are an essential component of shipboard safety, and SOLAS provides guidelines and regulations for the installation and operation of these systems.

There are some general principles for all the ships, and some others specific requirements depending on the size and type of the vessel.

As part of the fire detection system, smoke, heat and flame detectors are included, typically used as a primary means of fire detection. SOLAS specifies that smoke detectors should be installed in accommodation spaces, service spaces, control stations, and other appropriate areas. SOLAS mandates the installation of heat detectors in machinery spaces, mooring stations and other areas where the use of smoke detectors may not be suitable.

On cruise ships there is a complete Integrated Safety and Emergency Management System for control and monitoring of alarmed areas and forms an integrated part of the fire detection system.

In the event of alarm, the Bridge Officer must always investigate the alarm location. Someone must be sent to perform a visual check of the area, usually a security guard or a safety team member. Beside this, checking the cameras around the area is important and helpful. If the alarm raised from a guest or crew cabin, call immediately to the cabin’s phone number. Be pro-active to understand what has caused the trigger of the alarm.

As the fire detection system should be interconnected with the ship's general alarm system as part of SOLAS requirement, if the fire alarm is no acknowledged in the first

2 minutes, the General Alarm of the ship will sound continuously in all the crew areas. In order to stop the sound, the fire alarm must be acknowledged.

This automatic system is also complemented with the manual fire alarms provided at strategic locations throughout the ship to enable crew members to raise the alarm in case of a fire. Those are known as Manual Call Points or break glass units.


FIGURE 6-1: MANUAL CALL POINT (SOURCE: OWN ELABORATION)

## 6.3 Ventilation Remote Shutdown

For fire spreading prevention, there is a ventilation remote shutdown panel at the Safety Center with the following options:

- Ventilation in the accommodation spaces can be shut down by main vertical zones. Also, since the evacuation of the persons onboard will take place through the staircases, never by using the elevators, it is important to know the possibility of restart the ventilation in the staircases at the time that the ventilation has been shut down in the accommodation spaces.
- Ventilation in specific fire risk areas such as the galleys, the main laundry can be also shut down.

Once again, according to SOLAS regulations, an atrium is a specific architectural area found in passenger ships. It is a vertical open space that extends over 3 or more decks. This is an area easily found on cruise ships where smoke extraction and handling are necessary. As per SOLAS, the smoke extraction in those areas will start automatically after 2 minutes when 2 or more detectors are activated and left unacknowledged if the switch is on *"Auto"* position. The fire screen doors and dampers will close, the ventilation will stop, and the smoke extraction will start. [1]

Low Location Lighting as an electrically powered evacuation guidance system for the ship, can be switched on from this panel by turning to *"ON"* position.

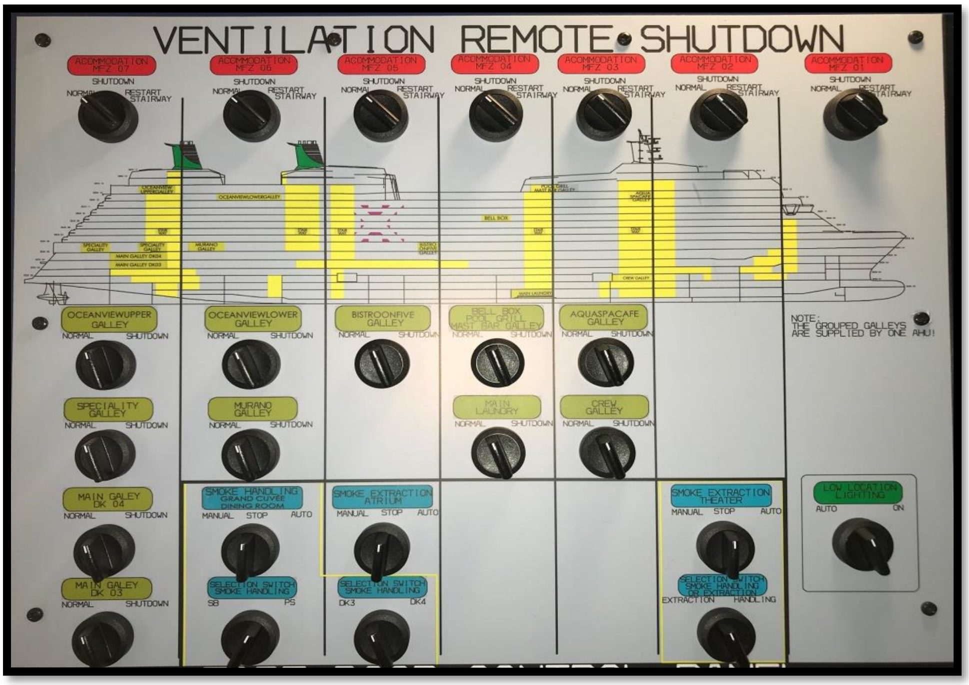



FIGURE 6-2: VENTILATION SHUTDOWN PANEL (SOURCE: OWN ELABORATION)

### 6.4 Fire Screen Door Panel

Regarding SOLAS regulations, Fire Screen Doors (FSD) play a crucial role in ensuring the safety of life at sea and containing the spread of fire on ships. These doors are designed to provide fire resistance and prevent the passage of flames, smoke, and gases between different compartments of the vessel.

Due to the dimension of the cruise ships, an average of more than 800 to 1000 FSD can be found all around the ship. Those FSD can be operated locally or remotely. There is a fire door control panel at the Safety Center with the following options: fire doors can be closed by fire zones or by specific areas such the galleys and the laundry. It is possible as well to close all fire doors of the ship by using the master switch. All fire doors of the ship can be closed automatically by the fire detection system when in auto mode if fire alarm is not acknowledged within 2 minutes.[21]


FIGURE 6-3: FIRE DOOR CONTROL PANEL (SOURCE: OWN ELABORATION)

## 6.5 Watertight doors

WTD is a door located at or below the bulkhead deck and maintains the watertight integrity of the subdivision in which it is located. Cruise ships over 300 meters usually have from 30 to 50 electrically operated WTDs enabling tightness to be ensured between adjacent compartments in case of flooding. The WTD can be named as follows:

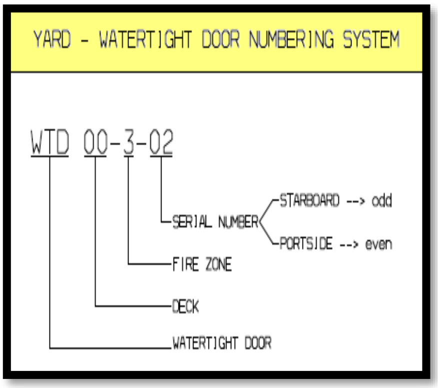



FIGURE 6-4: EXAMPLE OF WATERTIGHT DOOR NAMING (SOURCE: WTD MANUAL)

In case of flooding in any compartment, closing of the WTDs can be controlled from the wheelhouse, emergency stations and locally.

The main way is using the remote-control panel located in the Safety Center. There is a master switch allows simultaneous closing of all watertight doors and splash watertight doors by turning to *"doors closed"*. Besides, a switch provided for each group of watertight doors as per fire zone allows closing of the corresponding group doors only. When the door is put in remote close from the bridge, the alarm will sound 5-10 seconds before the doors closes for the awareness of the people around.


FIGURE 6-5: WATERTIGHT DOOR REMOTE CONTROL PANEL (SOURCE: OWN ELABORATION)

Besides, emergency stations allow several watertight doors to be closed from main deck. Each watertight door can be closed by means of hand generator located in relevant emergency station. In all of them there are a hydraulic accumulator for back-up power, remote control valves with magnetic actuators for closing operation only and hand pumps for remote closing of all doors or of individual door manually. [6]

## 6.6 Shell door panel

Doors in the side shell are used on cruise ships for passengers, pilots, bunker hoses, provisions, etc. For this specific case shown below, they are located from deck 02 to deck 05. The opening mechanism can be top-hinged or side-hinged and the doors are designed to open inwards (such the passenger doors) or outwards (such the platforms).

Security department is the one in charge to operate the shell doors. They should report any movement and, as good practice, the bridge officer should always double check the information given with the indication panel.

The following panel located on the Safety Center, shows shell doors status: green light shows a shell door closed and red light indicates a shell door opened. [6]


FIGURE 6-6: SHELL DOOR INDICATION PANEL (SOURCE: OWN ELABORATION)

# CONCLUSIONS

Cruise ships are a very little part of the world-wide fleet, but through the years they have become a new way of doing vacation for our society. The consequence is a high-level demand of well-trained and prepared officers to drive and manage those ships.

Training is crucial for marine licensed officer's onboard ships for several important reasons, which are the conclusions of this Project:

1. Safety as main priority: Only constant training ensures that all marine licensed officers have the necessary knowledge and skills to carry out their duties safely. This prevents accidents, mitigate potential hazards, and respond effectively to all kind of emergencies onboard.

2. Compliance with regulations: Marine licensed officers need to be familiar and comply with a wide range of international and national regulations, including those related to navigation, safety, environmental protection, and crew welfare.

3. Technical proficiency: Officers receive training in the technical aspects of ship operation, including navigation, propulsion systems, machinery, cargo handling, and communication equipment that enables them to understand and operate the ship's systems effectively, ensuring smooth and efficient operations.

4. Decision-making and leadership: Marine licensed officers must develop their decision-making and leadership skills. They need to learn how to analyze situations, and make fair judgments, which is crucial for maintaining safety and ensuring efficient operations on board.

5. Teamwork and communication: Effective teamwork and communication are vital for the smooth operation of a ship. Training programs emphasize the importance of close loop communication and interpersonal skills among officers and crew.

6. Professional development: Training is not a one-time event but an ongoing process. Marine licensed officers need to continually update their knowledge and skills to keep up with industry advancements, regulatory changes, and best seamanship practices.

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# FIGURES TABLE