JOURNAL OF MARITIME RESEARCH

Vol XVI. No. II (2019) pp 37–43

ISSN: 1697-4040, www.jmr.unican.es

Safety management of engine room operations - Roro/Pax ships

A. Dionis Melián[1,2,*], R. Quesada Morón[1,3]

ARTICLE INFO

Article history:
Received 22 September 2017;
in revised form 19 January 2012;
accepted 20 August 2012.

Keywords:
Marine engineering, safety, IMO, Engine Room.

ABSTRACT

The industry in the maritime sector of our time should focus, between other issues, in improving the safety conditions of ships to be able to reduce the number of accidents and increase reliability and safety in the navigation, loading and unloading, intenance operations, repair, etc.
Despite the progress that these improvements have made throughout the history of the maritime transport, events such as fires, oil spills, stranded and even collisions continue to occur in the seas of the world. No doubt that merchant shipping is one of the most dangerous professions, but despite how can we justify that these events continue to occur as often: What do they do with it? While it is true that the cause of all accidents does not fall on the "Human error", the high accident rate due to the human factor is the main reason for making a study of Safety Management with greater depth. The selection of the appropriate personnel according to the national legislation and international, prepared to fill positions of responsibility, ensuring the continuity of the operation of the ship and the safety and protection of the environment environment is a clear and concise objective that every shipping company must follow to ensure efficient and safe operation of your vessels.

1. Introduction.

From the fundamental objective of safety, the need arises to create a documentary base in which shipping companies can keep a record of their activity, preventing possible accidents caused by personnel errors and ensuring the correct maintenance of the entire vessel and equipment. All of the above is included in the Safety Management (hereinafter SM) of each shipping company.

Throughout this article we will study the scope of the SM applied on the basis of three Ro-Ro and Ro-Pax model ships, both operating in Spanish national ports. We will check the importance of following the stipulations of the different chapters that make up the SM, focusing on the engineering department.

There is no single Safety Management Manual that all shipping companies follow, due to the wide variety of ships and the exploitation that they decide to do. The main objective of the SM is to be able to analyze the safety and maintenance procedures, in the case of this article, of the engine department, checking their effectiveness.

For this, the **SM** must examine and determine...:

1. the development of procedures based on the risk they represent to the ship, the environment, personnel and safety.
2. the importance that these procedures describe emergency situations on board for which the crew must be prepared and know how to cope.
3. the importance of Safety applied to the machinery department, and the responsibility acquired by its personnel.

2. Previous Definitions.

In this section, we will compile a series of definitions used in the SM Manuals, important both for the implementation of the SM and for its monitoring.

[1]Universidad de La Laguna. C/ Padre Herrera s/n. - 38200 - Apartado Postal 456 - San Cristóbal de La Laguna - Spain - (+34) 922 31 90 00 - Grupo I+D CONSEMAR (Contaminación y Seguridad Marítima).

[2]Profesor del Área de Conocimientos de Construcciones Navales, UD de Ingeniería Marítima, Departamento de Ingeniería Agraria, Náutica, Civil y Marítima. Tel. (+034) 922316241. E-mail Address: adionis@ull.edu.es

[3]Alumno del Área Grado en Tecnologías Marinas de la ULL, UD de Ingeniería Marítima, Departamento de Ingeniería Agraria, Náutica, Civil y Marítima. Tel. (+034) 922316241. E-mail Address: raquelqm7@gmail.com

[*]Corresponding author: Alexis Dionis Melián Tel. (+034) 922313241. E-mail Address: adionis@ull.edu.es.

- *Document of Compliance (DOC)*: Defined as a document issued to a company that complies with the provisions of the International Safety Management Code (ISM).
- *Safety Management Certificate (SMC)*: Document issued as testimony that the company and its management on board comply with the approved SM system.
- *Designated person*: This is the person on the ground directly linked to the Company's management, whose responsibility and authority allows them to supervise the SM.
- *Internal audit*: Investigation that aims to establish whether the activities related to safety and environmental protection satisfy the requirements of the SM.

3. Safety Management.

The most relevant part of the International Safety Management on board is the section, which reflects both rules and operational procedures that ships must follow to guarantee the safety of the environment, personnel on board and the ship.

Each shipping company will develop its SM based on the operation of its vessels, but always following the general principles and objectives in terms of safety and environmental protection stipulated by the ISM.

4. Model Ships.

The ship, "Volcán de Taburiente" from the shipping Company "Armas, S.A." and the Ships from the shipping Company "OPDR Canarias, S.A.", "OPDR Andalucia" and "OPDR Canarias", have been used as model ships in this article.

Figure 1: Model Ships.

Source: Authors.

The *"Volcán de Taburiente"* is a ship, whose mission is to transport both ro-ro cargo and passengers. It follows a route between the Canary Islands, with a power plant of 4 x 4500 kW engines and a speed of 22.5 knots).

On the other hand, the twin ships *"OPDR Canarias"* and *"Andalucia"*, belonging to the shipping company OPDR, S.A., are Ro-Ro ships that transport ro-ro cargo and containers. They operate a route between the Canary Islands and the Spanish mainland. They have a single 6000 kW main engine, one shaft line and sail at 16.4 knots.

5. Results.

Safe management is a task for all hierarchical levels of any company, from the highest to the lowest, and is the cornerstone of good management, the outcome of which depends on the level of competence, attitude and motivation of people at all levels.

On the first day of boarding of any crew member, and as stipulated in the SM, an accident risk sheet attached to the post is handed out.

The new crew member will be briefly instructed on basic safety issues, completing the SM's safety decalogue. He/she should understand and apply the following tasks: Location of the professional staff and the crew member's position in it; Signals of emergencies on board; Meeting points of the ship; Obligations during abandonment and fire manoeuvres; Safety buttons for emergency warning; Safety route through the ship: compartmentation, accesses, C.I. elements, rescue and emergency exits; Safety equipment in the cabin; interior communications. PPE.

Table 1: Risk assessment and recommended actions for the Engineer Officer.

JOB HAZARDS	RECOMMENDED ACTIONS
1.- Fall in the engine room	- Always wear safety shoes
2.- Entrapment with pulleys and/or belts	- Always wear overalls - Do not wear rings or chains
3.- Falling suspended weights	- Wear a safety helmet - Cordon off the area - Read the signpost
4.- Noises	- Wear noise-cancelling headphones
5.- Electrocution	- Wear safety shoes - Wear safety gloves - Proceed to switch off power - Switch on/off sign - Wear protective mask
6.- Welding work with fire risk	- Wear special face shields - Wear apron - Wear gloves - Proceed with the cleaning of the area - Make a preliminary study of the area
7.- Entry into tanks	- Degas tank - Self-contained breathing apparatus - Wear guide cord

Source: MGS Naviera ARMAS, S.A.

Once the risk form has been handed in, the familiarisation questionnaire is handed over and the attached test correction form is signed and handed over by the corresponding Officer.

These ships are visited weekly for routine inspection, to check that everything on board is in good order and working order, and to exchange documentation with the Master and Officers concerning the SM, e.g. voyage reports, confined space entry, voyage plans, ship stability, captain/chief engineer officer relief report, etc.

Multiple revisions and updates of the MGS are carried out, checking all the procedures, objectives and annexes of the MGS, either at the request of the Harbour Master's Office or at the company's own request.

5.1. Implementation of the SM Manual.

The SM, administered by the ship, consists of the first thirteen chapters of the ISM Code. In this article we will focus on the study of the procedures that take place in the engine department as stipulated.

It is vital that the Safety Management Manual is seen as an effective aid rather than a burden, in order to facilitate and improve the operation of the ship and the safety of the entire crew.

The objectives of this manual must be carried out by qualified and properly documented personnel to fill positions of responsibility to ensure continuity of ship operation, safety and pollution prevention.

5.2. Development of plans for shipboard operations.

As mentioned above, the analysis of the SM will focus on the engine department. One of the most important chapters in the ISM is Chapter VII: Development of plans for shipboard operations. This chapter is based on the creation of procedures, plans, instructions and checklists, as appropriate, applicable to the most important operations to be carried out on board in relation to safety and environmental protection.

The operational plans and procedures to be complied with by the machinery department are divided into the following: Normal, special and critical operational procedures.

5.2.1. Standard Operating Procedures.

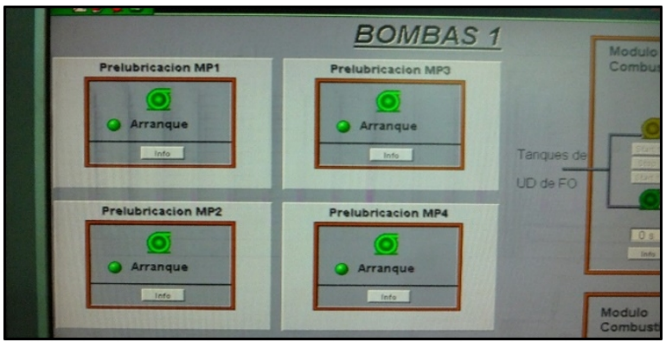
The following are defined as normal operations in the engineering department:

- *P.1N Engine watches and relays*: The main objective of this procedure is that watches and relays are established in such a way that they are carried out without losing continuity and ensuring at all times navigation, surveillance and order of activities on board. In this procedure a Sea Watch and Engine Relief Check is maintained and is to be completed by every Officer of the Watch. The outgoing Officer reports to the incoming Officer what has happened during his watch, work done, entries in the engine log, etc. At the change of watch, the incoming Officer enters his name, professional category, date and time of entry and signature in the logbook.

- *Procedure 2. Preparation before going to sea*: These are operations to be carried out in the engine department before the ship departs. Mainly, the Officer on watch together with the Chief Engineer will make sure that the main engine is working properly, as well as the auxiliary engines. Checking prelubrication pumps, as well as gearbox lubrication pumps and fresh and salt water pumps, starting air pressure, control air and fans. All the reserve pumps will be in automatic mode. Finally, we make a check list of the alarms.

- *Procedure 3N.- Checks prior to arrival in port*: From the bridge, communicate as much information as possible to the engineering department (arrival time, berthing forecast, etc.). It is checked that: Officer of the watch and Chief Engineer Officer do not leave the control room during the manoeuvre; communications with the Bridge are correct; Alarm check in the engine room; auxiliaries running, coupled and with the load distributed; Check list of the engines, as well as the fuel oil temperature; reserve pumps will always be on automatic start.

Figure 2: Pre-lubrication pumps main engines.



Source: Authors.

Figure 3: Auxiliary Engines zone push button.

Source: Authors.

- *Procedure 4N. Lists of repairs carried out weekly on board*: The work carried out in the engineering department, either by the crew or by external workshops, must be reported in order to have a weekly control of such work, sending weekly reports to the Technical Department. We will note down the item to be repaired, the damage suffered or maintenance work carried out, the workshop that has carried out the repair and the date of the repair.

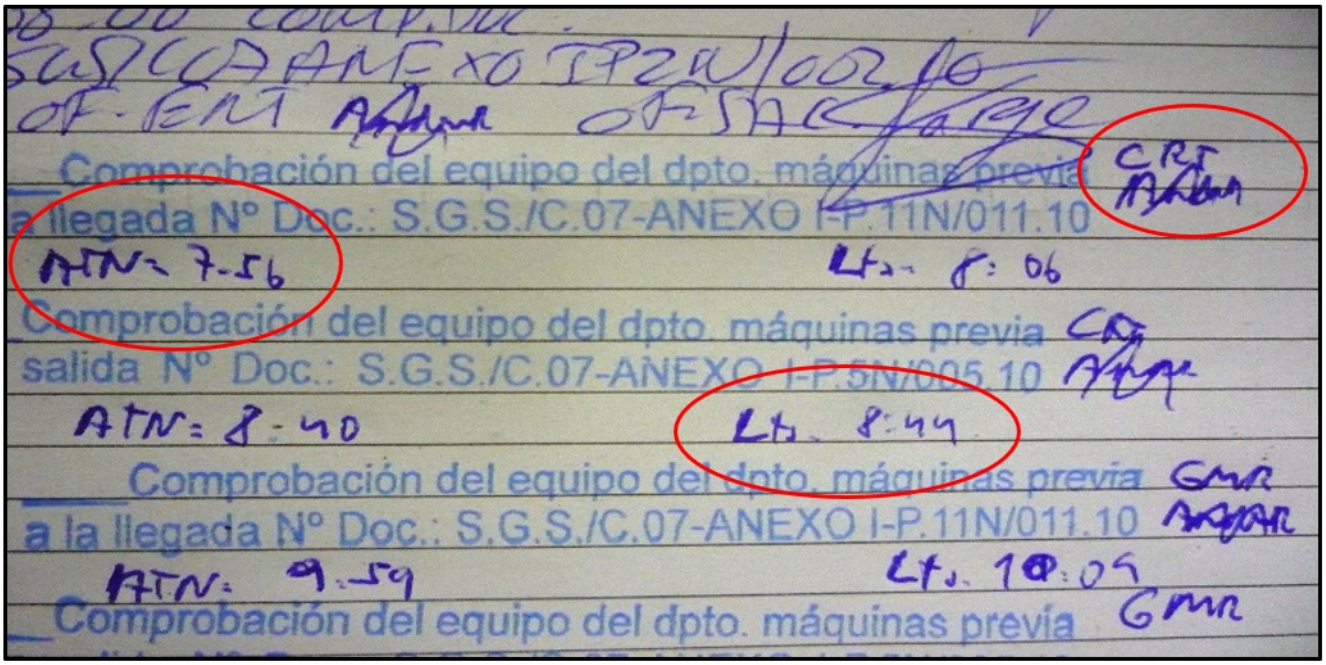
- *Procedure 5N. Checking and maintenance of the local fire - fighting system in the engine room*: Weekly we check that the local push buttons are working properly, that the power indicator is on and we check the log book.

5.2.2. Special operating procedures.

In the Engineering Department we highlight two special operational procedures:

- *P.1E.- Engine room bilges*: Both the bilges in the Engine Room and in the holds must always be kept as clean as possible, checking the state of the bilges and alarms in the control

Figure 4: Check stamp for engineering notebook.



Source: Authors.

Figure 5: Bilge separator.

Source: Authors.

Figure 6: Bunkering in the Port of S/C de Tenerife.

Source: Authors.

room. when bilging, following the stipulations of the International Convention for the Prevention of Oil Pollution at the Sea.

- *P.2E.- Taking on fuel*: We must establish a system so that we can carry it out in the best safety conditions for the personnel, the vessel and the marine environment. Taking on fuel is an operation that is usually delegated to the Chief Engineer, having a control before, during and after taking on fuel. Before we start, we sound the tanks in order to determine the initial fuel content. We then check that all the valves on the tanks into which the fuel is to be discharged are aligned. Using walkie talkies, permanent communication is maintained between the personnel involved. Once the fuel is taken, we probe the tanks and note down the tank probes, we close all the open valves mentioned above. The personnel in the bunker disconnect the hose and check that no fuel is leaking. We then place the gaskets and blind flanges in the right place.

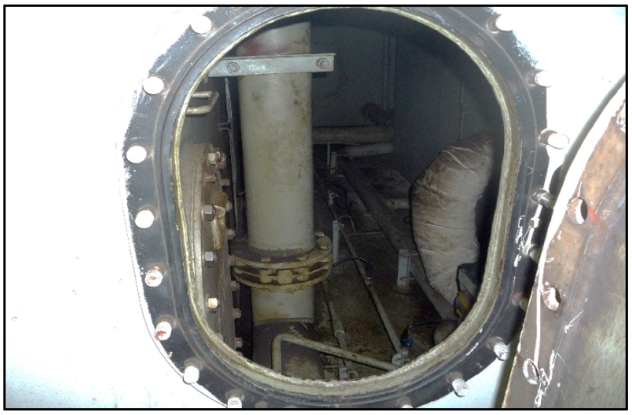
5.2.3. Critical operating procedures.

Any operation in which an error could cause an accident or situation that could threaten personnel, the environment or the ship is considered critical.

We highlight the following as critical operations affecting the engineering department:

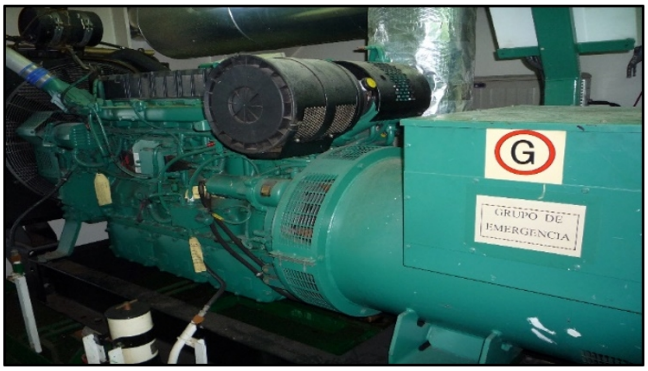
- *P.1C.- Entry into enclosed spaces* : There are places on the vessel (double bottoms, fuel tanks, ballast tanks, empty spaces, etc.) where the atmosphere may be in need of oxygen. **Therefore, under no circumstances shall any person enter**

Figure 7: Entry into enclosed spaces.



Source: Authors.

Figure 8: Emergency engine.



Source: Authors.

an enclosed space without the knowledge and authorisation of their Head of Department.

We must open the enclosed space and allow it to ventilate, and with the oxygen meter, check if the atmosphere contains 21%. The Officer in charge has to complete the checks in the SM Manual before entering the enclosed space, such as: Self-contained breathing apparatus; oxygen resuscitator; hand torches; helmet, gloves, etc.

- *P.2C.- Hot work*: It is essential that under no circumstances shall any person carry out hot work unless they are provided with the corresponding personal safety elements (mask, gloves, apron, footwear, etc.). All areas where hot work is to be carried out must be equipped with portable fire extinguishers and fire pumps and lines must be ready. As in procedure P.1C., we must apply for a hot work permit, corresponding to Annex VII: Hot work permit.

5.3. Emergency preparedness.

It is a fact that a number of emergency situations may occur, for which the crew must be prepared to deal with them. In order to deal with such situations, the ship must be equipped with all the elements required by the Administration, and all safety elements must be maintained.

The drills that are usually carried out on the ship are: Firefighting; Oil pollution; Abandonment of the ship, although the reality is that emergency situations also include: Boarding; Salvage; Propulsion failure; Man overboard, etc. The list of those attending the exercise is noted. Normally *"The Company establishes the need for abandonment equipment to be kept on board in good maintenance condition and for crews to familiarise themselves with the means of abandonment through statutory drills"*.

5.4. Ship and equipment maintenance.

Establishing maintenance procedures, both for the ship and its equipment, is one of the fundamental objectives of any shipping company. It is obvious that the fundamental purpose of maintenance is the correct conservation of the equipment and installations, such as: Maintenance of the ship; Maintenance of the equipment; Repairs; Repairs by personnel from outside the Company; Inspections; Certificates and original reports.

Maintenance scheduling is carried out according to the following criteria:

1. Recommendations of on-board equipment manufacturers.
2. Experience gained during the operation of the vessel
3. The requirements and inspections of the Administration and the Classification Society.
4. Based on the above premises, we define the maintenance and checking intervals.

These procedures are carried out on the basis of:

1. Checklists: Coolers; Pumps; Air Conditioning; Separator; Emergency Engine.
2. Scheduled Maintenance: Main Engine; Auxiliary Engines; Scrubbers; Air Compressors; Fuel Module; Filters; Lubrication.
3. Predictive Maintenance.
4. Corrective Maintenance

On a monthly basis, and with the collaboration of the Chief Engineer Officer, the 1st Officer will be responsible for the control and execution of work on the following equipment in the engineering department: Main engines; Servomotor; Hydraulic installations; Fuel modules; Tank probe; Bilge system; Critical equipment, salvage and safety; Auxiliary engines; Evaporators; Cooling water systems; Boiler and boiler with its pumps; Electricity; Fuel oil systems (filters); Air compressors; Lifeboats.

5.5. Company verification, review and evaluation.

The implementation of the procedures set out in this article is subject to verification by the Company. In order to accredit the effectiveness of the system, as well as its compliance with the provisions of the SM, plans for internal inspections/audits are established. These inspections will be carried out by the company's inspection staff and will not exceed 12 months. The auditor will carry out interviews with the personnel, simulations

Figure 9: Treatment plant room.

Source: Authors.

of concrete dangerous situations, observing the reaction of the personnel.

These audits can be carried out on the basis of different criteria, such as: specific areas or activities of the ship; organisational changes; new personnel; deficiencies found in routine checks and inspections; others that the company may define.

Following the audit, it shall determine whether these solutions are amendable in the short term and do not pose a high level of risk to safety or to anticipate contamination. It shall also stipulate whether the non-compliances it may detect are a definite risk and require immediate attention.

Finally, a copy of the findings shall be provided to the master.

Conclusions

1. We have found that the procedures followed by each of the shipping companies' model ships assist in the prevention of accidents, the safety of the marine environment, the safety of the ship itself and the safety of the professional personnel on board.

2. We have examined the operations of the engine department of the model ships, on which we have We have examined the operations of the engine department of model ships, on which we have based the study of the procedures of the Safety Management Manual. Safety Management Manual, verifying the importance of good training and professionalism of the crew. the importance of good preparation and professionalism of the crew (familiarisation tests, checklists, etc.), checklists, etc.), in order to be able to deal with a position of responsibility such as that of Engine Officer. responsibility such as that of an Engineer Officer of the Merchant Navy.

3. Bearing in mind the importance of knowing how to act in the event of any incident, be it a minor or a major one. in the event of any incident, whether minor or emergency, we have found that during the training course that during the training period carried out "in situ" on the model ship, no fire-fighting exercise was carried out on the no fire drills were carried out in the engine room areas.

4. Based on the results of the study of critical operational procedures on board, we can deduce that the lack of checking checklists in operations such as confined space entry or hot work can lead to accidents and even loss of life. It is possible that habit and overconfidence on the job may have led to this lack of checks. Checklists are one way of ensuring safety during the execution of the activity on board, but without the commitment of personnel to carry them out, they are of no use.
5. This work has been carried out from two different points of view, as far as the application of the Safety Management Manual is concerned. The work has been carried out from two different points of view, as far as the application of the Safety Management Manual is concerned: a practical point of view on board the ship Volcán Volcán. a practical point of view on board the vessel Volcán de Taburiente for six months, during which we checked how the where we checked how the procedures of the Safety Management Manual were applied to the engine department "Volcán de Taburiente". the engine department "in situ"; and an external point of view together with the company external point of view with the Inspector of the company Naviera OPDR Canarias during four months, where the four months, where the documentation relating to the machinery department was hand-delivered by the department was hand-delivered by the ship's Chief Engineer during weekly visits. during weekly visits. We conclude that there are notable differences between the two points of view. between the two points of view.

6. Based on the results obtained in the course of the work, we are able to propose several improvements in the way operational and emergency procedures are carried out on board. operational and emergency procedures on board:

- That there should be a greater interest on the part of the crew in safety during the conduct of different exercises. That there should be a greater interest on the part of the crew in safety during the performance of various exercises.
- Establish the need for clearer and more concise checklists. checklists.
- Conduct emergency drills involving the entire crew and the entire ship. crew and the whole ship.
- Practical and realistic verification that the reports that reach the shipping company coincide with reality. Shipowner's Office are in line with reality.

References

Manual de Gestión de la Seguridad. Naviera OPDR Canarias, S.A. (2012)

Manual de Gestión de la Seguridad. Naviera ARMAS, S.A. (2014).

Librería Náutica Cartamar. <http://www.cartamar.com>

Noticias Jurídicas. <http://noticias.juridicas.com/base_datos-/Admin/rd1907-2000.html

Librería Náutica. <http://www.libreria-nautica.com>

Boletín Oficial del Estado. *Reglamento sobre Reconocimientos Obligatorios para Garantizar la Seguridad de la Navegación de Determinados Buques de Pasaje.* <https://www.boe.es/buscar-/doc.php?id=BOE-A-2000-21336>

International Maritime Organization. <http://www.imo.org>

SOLAS. *Capítulo III: Dispositivos y medios de salvamento.* <http://personales.gestion.unican.es/martinji/Archivos/SolasCap-3.pdf>

Organización Internacional del Trabajo. <http://www.ilo.org-/global/about-the-ilo/mission-and-objectives/lang–es/index.htm>

Naviera Armas, S.A. <http://www.navieraarmas.com/horarios>

Hijos de J. Barreras. <http://www.hjbarreras.es/?page=lis-ferries.2&idp=30>

OPDR. <http://www.opdr.com/es/lineas.html>