



A Guide To

Master Dry Dock Operations

For Engine Room Department

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Master Dry Dock Operations
for Engine Room Department

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TABLE OF CONTENT

Planning the Dry Dock	(1 - 7)
Preparation for the Dry Dock	(8 - 20)
Manpower Management	(21 - 25)
Mechanical/Machinery Jobs During Dry Dock	(26 - 50)
Electrical Jobs During Dry Dock	(51 - 58)
Checks During Dry Dock	(59 - 71)
Regulations, Surveys and Checks	(71 - 81)
Sea Trials	(82 - 89)

Chapter 1

PLANNING

What is Dry Docking ?

When to Start Planning for the Dry Dock ?

How Ship's Crew Should Plan the Dry Dock ?

How Office Personnel Should Plan the Dry Dock ?

What is Dry Docking?

Dry docking of ships is done to carry out major repairs, surveys, conversions, and modifications by taking the ship out of water.

Seafarers, at some point of time in their careers, have to go through this professionally enriching yet tedious task, willingly or unwillingly.



In one survey carried out by Marine Insight, more than 50% of seafarers considered ship dry docking operation a physically and mentally taxing job, which they would surely avoid if given a choice.

On digging a bit deeper, we came to know about myriad of problems which seafarers face while carrying out the dry docking operations.

This guide is an attempt to provide answers to all these questions.

What are the main reasons seafarers don't like dry docks?

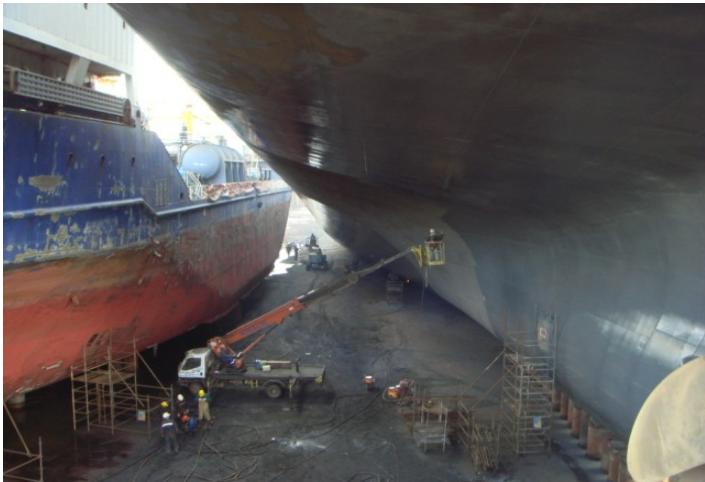
- Physically and mentally stressing task
- Numerous maintenance and repairing jobs
- Limited rest/recreational hours
- Loads of time and efforts required for planning and arranging pre-docking, docking, and post-docking operations
- Have to deal with a variety of surveys and inspections
- High risk of accidents

Needless to say, a successful dry docking of a ship requires immaculate planning and execution, with no room for errors. If not planned adequately, dry

docking operation can easily turn into a nightmare for seafarers.

Why Dry-Docking is Necessary?

As per IMO regulation under SOLAS, it is mandatory for a cargo ship to undergo two inspections of the ship's bottom during any 5 year period.



Ship in Dry dock- Hull Survey

The 5 year tenure is the validity-period of the ship's "Safety Construction Certificate", on the basis of which, the frequency of bottom inspections carried out.

Dry docking of merchant ships is thus held once

every 3 years in order to undergo bottom surveys and other required inspections.



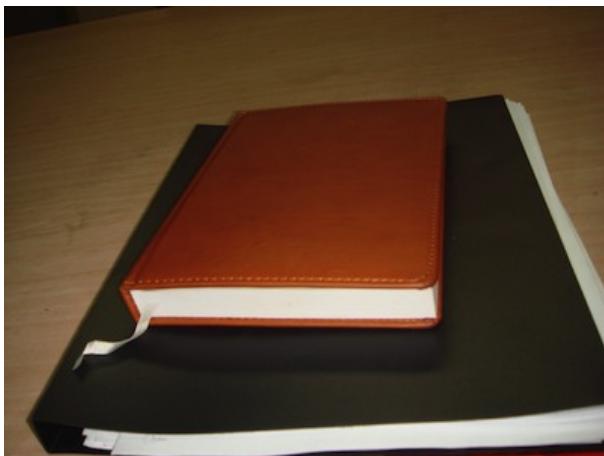
Hull Survey

Dry docking is an operation wherein the vessel goes off-hire i.e. it does not contribute to the business of the company until it is certified fit after sea trials, ship owners / operators want to complete each and every possible pending or upcoming surveys, maintenance jobs, and checks during the docking period in order to save as much time and resources as possible.

Therefore, it's the duty of the ship's crew to assist in the dry docking procedures and ensure that all the tasks involved with the operations are carried out with utmost planning and safety.

When to Start Planning?

The planning for the ship's dry dock starts as soon as the ship comes out of sea trials of the previous dry dock. Each department i.e. engine and deck will have its own dry dock specification files, which will include all major and minor defects that cannot be repaired while the ship is sailing at sea.



Dry Dock Files

Every time a ship comes out of dry dock, a new dry dock specification file is made. Most of the shipping companies use different software tools, which include details on defect lists, expiry dates of certificates, and other major maintenance/repair jobs that are due or require support which can be provided only when the ship is in dry dock (for

e.g. stern tube bearing inspection, overboard valves and hull survey, anode renewal, major d'carb of main engine etc.).

Planning for dry dock includes listing of jobs that need to be carried out in the scheduled dry-docking period. The selection of the dry docking place is done by a company representative, followed by visiting the dry dock and arranging for the necessary manpower and repairing workshops.



Dry Dock Visit

All these jobs are identified before-hand and analyzed for the requirement of spares, tools and expertise. Pre-planning of the dry dock is extremely important, as accordingly, arrangements for the planned jobs are made by the company's superintendent and technical department.

How Ship's Crew Should Plan a Dry Dock?

Dry docking operation of a ship starts with the ship's crew and ends with the ship's crew. Right from pre-planning to post-sea trials, the ship's crew will ensure the smooth operation of all the dry docking processes.

The ship's crew will start planning by making a list of all the jobs that are supposed to be carried out in the dry dock. A general plan of the ship's crew would involve:

- All major defects listed in the dry dock specification file
- All scheduled maintenance tasks of the main engine and related systems, which cannot be performed at sea are noted in the dry dock specifications file
- All scheduled maintenance and repairs for auxiliary machinery (Diesel Generator, Boiler, Compressors, Fresh Water Generator etc.) and related parts which cannot be

performed during voyage are noted in the specifications file

- All rusted pipe fittings, including temporarily repaired sea water and fresh water pipes, which cannot be repaired by the ship's staff are listed in the specifications file
- Repair and maintenance jobs on condensers and heat exchangers are noted
- Repair and renewal jobs of valves (especially overboard valves) are noted
- Maintenance, overhauling and repairs jobs of all engine room pumps are noted
- Maintenance and overhauling jobs of deck machinery systems are included in the file
- Maintenance and overhauling of electrical systems, including alternators, main switchboard, emergency switchboard, ICCP, MGPS etc. is noted
- A requisition is raised for the required spares of all machinery systems

- After consulting with the superintendent, it is decided which jobs will be performed by the ship's staff and how much additional man power will be required in the dry dock

All the above mentioned points are noted in the dry dock specifications file and it is then sent to the company.

Quick Note for First Timers: If this is your first dry dock, make sure you check all previous work records and last dry dock report details of your machinery. Make a file and attach all the reports, readings and special maintenance carried out for ready reference. Plan the requirement for work and spares accordingly.

Quick Note for 2nd Engineer: Do carry a thorough inspection of the whole engine room to ensure no defects are missed out in the dry dock specification file. Also, plan out job allocations for the engine room crew well in advance, with the consent of the chief engineer, as you will be required to carry out inspections of multiple jobs onboard during dry dock.

Quick Note for Chief Engineer: Safety should be the prime concern. It is important to brief the engine room crew on aspects of safety in dry dock. Also, planning of various machinery surveys to be done and discussed with the office and preparation of jobs is to be carried out accordingly.

How Office Representative Should Plan a Dry dock?

Dry docking of a ship is a complicated task, which is handled by both - the ship's crew and the company's office staff.

Both the departments work in collaboration for planning a successful dry dock. A general plan of the company office would require the representative to:

- Ensure dry dock specification file is updated regularly by the ship's staff
- Check the expiry dates of all the ship certificates and plans for surveys in the dry dock
- Check ship's Continuous Machinery Survey (CMS) program and arrange for surveyors. Try to complete as many machinery surveys under CMS as possible in the dry dock itself
- Visit the ship once before planning a dry

dock to discuss and check the repairs to be performed with the chief engineer (C/E)

- Produce a repair specification list generated from the dry dock specifications file
- Prepare technical specifications for ship modifications, dry docking, and refit work
- Monitor work with respect to dry dock schedule and budget, and manage warranty claims when required
- Once the repair specification is done, check the tentative budget allotted for the dry dock
- Decide the shipyard to be used for the dry docking of the ship
- Plan the number of days for dry docking and the number of days for lay-up before and after the dry dock
- As per the allotted budget, do the tendering of jobs to various service providers for receiving quotes
- Ensure that enough spares and additional

manpower is provided to the ship's crew for the dry dock

- Assemble and manage a team of engineers/specialists according to the scope of the work to be carried out
- Send all the collected quotes, jobs to be done, and days of off-hire/ service to the owner or operator

After reviewing the specifications sent by the ship's staff and superintendent, the owner with consultation of the company's technical department, decides the best option to carry out the dry docking of the ship.

Quick Note for Office Representatives: Once the dry dock schedule, budget and place is approved-Liaise with the classification societies and flag state authorities to complete and obtain approvals for specifications and drawings.

Also avail knowledge of Health, Safety & Environment (HSE) issues in full respect of the Corporate & Legislative safety requirements.

Chapter 2

PREPARATION

Engine Crew Preparation

Preparation of Tools and Spares

Preparation of Paints, Chemicals and Gas

Preparation for Oil, Water and Bilges

Preparation for Paper Work

Safety Preparation

Electrical Preparation

General Preparation Before Entering the Dock

Engine Crew Preparation

Once the planning of dry dock is completed, a ship would be given a tentative date for arrival at the dry docking yard. Preparations for the dry dock start several days or even weeks before the ship arrives at the dry dock.

Preparing a ship for the dry dock is as important as the planning process. The first step towards preparing for dry dock is to establish an interface between the company/ ship to be docked and the shore facilities that will perform repair and maintenance jobs is the ship's engine room.



Team meeting in Engine room

As mentioned earlier, it is important to prepare the engine room crew well in advance for the dry dock. It is the responsibility of the chief and 2nd engineer of the ship to ensure that their staff is ready for the big task. The following points are to be considered during dry dock preparation:

- Have a meeting with the engine room staff to notify the schedule of lay-up and dry dock
- Put forward all the jobs to be performed by the ship's staff in the meeting
- Allot various jobs to the engineers, ensuring the required manpower for the jobs by giving them assisting hands
- Divide the staff into groups to oversee the work carried out by the shore staff

Quick Note: Company provides additional crew to the ship as extra hands for the dry dock. Since these people will be new to the ship, arrange an introductory 'get-to-know-each-other' meeting for better team management. It is also the responsibility of 2nd engineer to arrange a safety tour of the ship for the newcomers who are onboard for a short period of time.

Preparation of Tools and Spares

During dry dock, almost all machinery systems will be opened up for some kind of inspection, routine maintenance, or repairs. Most of the machinery require a variety of special tools and spares, which must be made available to avoid any kind of delay in the process. The engine room staff must make a note of the following points:

- Engineers must take inventory of the spare parts for their allotted machinery
- Engineers must ensure that all the special tools provided for their allotted machinery are available to them
- Ensure that the chemicals required for the cleaning purpose, in and after the dry dock, are available onboard. If needed raise a requisition for the same
- Check if enough number of lifting tools such as strong belts, wire slings, shackles, and i-bolts are available and in good condition

- Check if lifting devices such as chain blocks and cranes are in good working condition, and equipment of different rated capacities are available onboard
- Check if lip-seal material is available onboard as it is normally kept separate from other spares
- All workshop tools and engine room lifting devices (chain blocks, i-bolts etc.) must be marked by stamping or painting with selected colors to differentiate them from the tools which shore assistance will bring along with them to the dry dock. This is necessary to avoid any loss of ship's tools



Engine room Workshop for Various Tools

- Notify the company for any missing special tools so that they can be supplied before the dry dock. The shore workshop must also be informed to bring their tools along for overhauling engine room machinery

Real Life Incident



After completing dry docking and ship trials in China, a cargo ship was prepared for its scheduled voyage. While at sea, the ship staff found most of the spanners and other workshop tools missing.

The heavy duty chain blocks and i-bolts were also found missing. It was concluded that the shore workshop has mistakenly taken most of the E/R tools. As it's the responsibility of 2nd engineer to look after the engine room tools, the office made him responsible for the loss of property. Eventually, additional stores had to be ordered by the ship's staff to compensate for the missing tools onboard.

Quick Note: Engineers must check and calibrate all precision tools for zero error as they will be used for measurement when the shore or ship staff will perform overhauling of different machinery. The result of measurements will highly depend on the accuracy of these measuring tools.

Preparation of Paints, Chemicals and Gas

Hot work and cutting jobs followed by cleaning and painting of the ship are the most common procedures performed during dry dock operation.

It is the responsibility of the ship's staff to ensure that the ship is presentable and sea worthy after the dry dock is over. For this-

- Ensure that paint for the engine room is available onboard, as immediately after the dry dock, the ship staff's will have to work hard to enhance the look of the engine room in order to avoid any trouble from the Port State Control. (They definitely take the matter of engine room appearance and housekeeping very seriously)
- If needed raise a requisition for paints
- Raise requisition for dosing chemicals of boiler water and fresh water systems as both these systems will be drained to carry out maintenance work



Paint Drums arriving in Dry dock

- Check if enough oxygen / acetylene gas bottles are available onboard. If not, raise a requisition



Gas Cylinders Kept Outside on Deck

- All gas cylinders to be properly secured and kept outside the engine room
- Check if enough welding and brazing rods are available. If any special welding is required (e.g. if boiler shell needs to be repaired), inform the office before hand

Quick Note : Check the paint details of various machinery and systems before raising the requisition. In engine room, different composition of paints are used for floor platings, motors, high temperature areas, anti-corrosive coatings, food coatings etc. Don't forget to refer the paint manual which is available in ship's library for ready reference.

Real Life Incident



- It was decided by the company that the ship staff will be doing the repairing of the cracked boiler shell. During dry dock, the repairing work got delayed and same was allotted to the shore workshop at a higher bid as no special welding electrodes were ordered for the job.

- After completion of dry dock, the ship's staff started the house keeping and painting jobs. The motor man painted all the exhaust pipes of the main engine with silver paint. Within few hours, the paint got peeled off as it was not a high temperature silver paint.

Preparation for Oil, Water & Bilges

Before dry dock, it is required that the ships carry minimum weight of oil, water and bilges in their tanks. This makes it easier to manage the ships during repair and maintenance in dry dock. Consider the following points:

- Calculate the quantity of lube oil present onboard before dry dock to ensure that the amount is enough to do the complete oil renewal of systems such as - Bow thruster system, Stern tube system, Main engine system, Auxiliary engine system etc.
- Consume the bunker oil according to the docking plan and ensure that minimum bunker and water is carried on the ship



Tank Drain for emptying

- Chief engineer should ensure that all the tanks which are required to be cleaned and inspected are stripped off water/oil and no more filling in the tanks is instructed to the crew
- Before lay up or dry dock, start ventilating fuel oil tanks so that gas levels are below the entry limit
- Clean and prepare empty drums (200 liters) to collect all the dirty soot, sludge or bilge water that will be collected during dry dock



Drums filled with sludge

- Clean and dry the bilge wells to prevent any kind of fire or accident as plenty of “hot work” jobs will be performed in the dry dock



Cleaned Engine Room Bilge well

- All engine room and related tanks for fuel oil, bilges, sludge, and water to be sounded and recorded thoroughly before docking

Real Life Incident

During dry dock, the shore technician working on bow thruster demanded to empty the oil from the complete system. As it was not planned earlier, the ship's staff took almost an entire day to carry out this job including empty drums arrangement, shifting of drums to forward part of the ship and pumping out the lube oil from the system. The technician charged the whole day as a "man-day" even when no work was performed by him.

Quick Note: Systems with lube oil sump that require inspection and maintenance in dry dock must be emptied well before entering the dock as it will save ample time and avoid chances of oil spill in the dock. For e.g. the BT system oil must be removed before dry dock. In case the oil is not removed and the drain is opened, there are chances of oil spill in the dock.

Preparation for Paper Work

With regards to the implementation of ISM code on board ships, it is very important for engineers, officers and surveyors on ships to log down all the events and prepare reports of each and every work carried out in the engine room. This would require to:

- Prepare a separate file for blank landing report, which will be filled and signed by the chief engineer (C/E) and the shore in-charge when any machinery or part from the ship is landed ashore for repairs or checks

- Make a separate file to collect all the invoices of spares received during dry dock
- Make a separate log file to note down valve operations in the engine room. Whenever anybody in the engine room operates a valve (opens or closes), he/she should record it in this log file along with the date, time and current position of the valve (open / close)
- Prepare a separate “Isolation log file” to include the date, time and the machinery isolated, so as to ensure that it is brought back to normal when the dry dock is completed
- A “work-done” file to be arranged for the dry dock, which is to be filled with type of work and date of completion of each job
- Keep all manuals readily available for important machinery and systems which will be required by the ship's staff and shore people for reference
- Make a separate set of photocopies of layouts, line diagrams, and systems of all machinery as they will be required by the shore staff. This would avoid losing or misplacing of the the original diagrams
- Previous dry dock reports to be kept ready for reference
- Records of all the clearances of different machinery last measured (in last dry dock or during repairs) to be kept available in separate files for ready reference
- A separate file with all kinds of work permit forms (blank) to be arranged and kept ready



Paperwork

Safety Preparation

Real Life Incident

 During dry dock, no landing reports were signed for the items that were taken to shore workshop. The superintendents were made aware that low quality items were brought back instead of the original ones which were given to the shore. When the superintendent complained, the shore workshop asked for the landing reports, which were not available. Due to lack of documented proof, no action was taken against the shore party.

Quick Note to 2nd Engineer: Encourage ship's crew to record all the duties performed by them in the dry dock including near misses and accidents. These records will be useful for future investigation and record keeping for the ISM code documentation.

Quick Note to chief Engineer: A separate file for all the engine room machinery under maintenance is to be made and all records, jobs performed, and calibration done to be kept ready for presenting to the surveyor when he/ she asks for the same.

Ship becomes an extremely hazardous area during the dry dock period. The chances of accidents and personal injury are extremely high as a result of slips/ falls, fire hazards, open machinery systems etc.

It is important for the ship's crew to ensure that safety is never compromised at any level. However, accidents still occur mainly because of negligence and errors. Consider the following points for utmost level of safety during dry dock:

- Ensure each crew member is issued with required personal protective equipment (PPE)
- Check that PPEs such as hand gloves, overalls, disposable overalls etc. which will be consumed in dry dock are available in plenty
- Prepare good number of ply cards , for both mechanical and electrical jobs, explaining

danger signs such as “MEN AT WORK- DO NOT START/ OPERATE/ SWITCH ON”. Several of such signs will be required during the dry dock operation

- Arrange pad locks for all spare rooms and stores to avoid any unauthorized access
- Firefighting plans and safety measures must be discussed with all the engine crew members before the dry dock
- Firefighting equipment on board should be checked and kept ready for use including fire detector and alarm systems (Check each and every alarm and call point). Any shortcomings or requirements must be informed to the office



Isolating CO₂ Flooding System

- Ensure CO₂ total flooding system or any other fixed fire fighting system is locked to prevent accidental release
- Check all the escape route markings and lightings
- Check there are no hurdles or obstructions in any of the escape routes

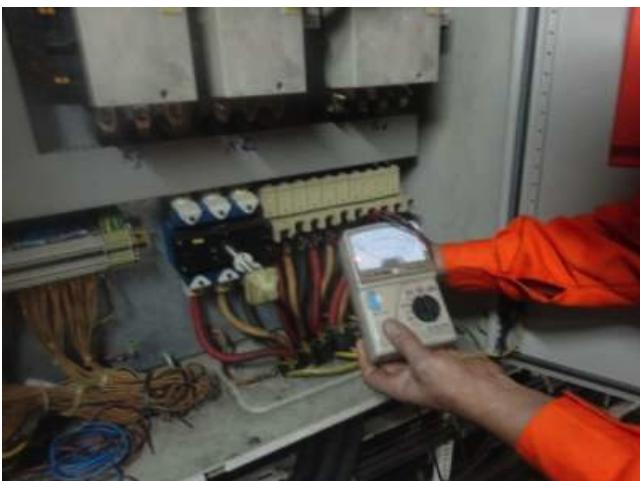
Real Life incidence

Chief engineer and electrical engineer decided to test the CO₂ system during dry dock. They started blowing lines with air, but C/E forgot to disconnect the connection to the CO₂ bottles prior to opening the high pressure air valve. Shortly after starting the test, CO₂ bottles started discharging into the E/R. The chief engineer was unable to stop the discharge. He activated the CO₂ alarm and the electrician made an emergency announcement using the internal radio system. The master announced emergency stations on the ship's public address system and ordered an evacuation of the engine room. About 10 minutes after the accident, rescue operations were started with the help of the shipyard rescue team. Several crew members and yard personnel were sent to the local hospital for medical treatment. Three crew member were later declared dead.

Electrical Preparation

During dry dock, electrical shore supply is provided to the ship as most of the electrical machinery systems are isolated and different types of portable machinery are used for repair and cleaning tasks. The safety and operational aspects of the electrical systems must be ensured to complete the dry dock without any delays or errors. Consider the following points:

- Check the shore connection box provided on the ship and ensure that all connections are functioning properly



Preparing Shore Connection Box

- Provide information to the office about the frequency and voltage supply of the ship taking shore supply
- Check all emergency lightings and emergency generators
- Check and prepare enough number of extension boards as electrical supply connections will be used in plenty
- Ensure that enough number of hand lamps are available and all are in working condition
- Ensure that there are no naked lamps and also prepare for explosion proof hand lamps and lightings
- Arrange enough number of high power rating halogen lamps to ensure a well lit engine room
- Check all portable blowers are in working condition as plenty of them will be used especially for gas freeing and ventilation
- Raise requisition if there is shortage of bulbs, tube lights and wirings

- Ensure that all testing meters onboard ships are in good working condition, including voltmeter, multimeter, clamp-meter etc.
- Additional portable heaters/ fans to be ordered as ship's AC/ heater system will be isolated for maintenance

Quick Note: Electrical officer must thoroughly understand the general electrical diagram/ circuit diagram of important systems (Fire alarm, Main engine, Bow thruster etc.) as he will be assisting the shore technician or helping the ship staff during the maintenance of these systems.

Real Life Incident

When the ship was at Antwerp dry dock in winters, the crew faced difficulties in the accommodation due to very low temperature as the ship's centralized heating system was isolated for maintenance. Since no portable heaters were ordered or asked from shore facility, the ship staff had to continuously send requests for heating arrangements but the company didn't respond to their requests. As the last resort, the ship's crew decided not to work until heating arrangements were made in the crew accommodation area.

General Preparation

Dry dock is an accident-prone area which requires very high level of safety. Apart from the safety measures mentioned earlier, several other precautions that need to be taken into consideration are:

- All heavy weights to be secured prior to the dry dock
- All tanks and cofferdams must be sounded and recorded
- Shore connections for the generator cooling water to be prepared (If ship's power is used in lay-up)
- International Shore Connection (ISC) flange for the fire line to be prepared
- Make sure main engine, generators, and boilers are changed over to diesel oil
- Shore connections for cooling water of provision and reefer compressors to be

prepared (Normally provided by the dock yard)



Fabrication of additional Pipes

- In tanker ships, all cargo tanks are to be gas freed and must be checked twice by gas detectors before making an entry
- All valves and chests to be overhauled must be clearly marked
- Fire plan of the ship must be discussed with the shore facility and copies of them are to be provided to all
- MGPS and ICCP systems are to be switched off and tagged “DO NOT OPERATE”

Real Life Incident

An explosion on board the vessel Seamec II in the Curaçao ship repair company CDM killed five workers. The workers had to make a hole in the hull of the offshore oil platform support vessel to remove a machine that required electronic work. The company's personnel checked for possible gasses or other dangerous substances and gave the green signal for the work to proceed. The gas measuring instrument was not calibrated hence the result shown was not accurate. The first explosion was followed by a second, and then a fire with a lot of smoke erupted.

Quick Note: All gas detectors must be calibrated prior to using them in the dry dock. If there is doubt in the working of such instruments, they should be sent ashore for repair/ calibration. Shore workshop can be requested to use their own detectors for enclosed space or tank entry procedures.

Chapter 3

MAN POWER MANAGEMENT

Fire Watch

Watch keeping

Maintenance of Machinery

Rest Hour Period

Miscellaneous Jobs

The key to a productive and accident-free dry docking is efficient manpower management. Different types of jobs require different number of people to successfully carry them out.

When every task is provided with the right number of people, executing them not only becomes easy but it also prevents time wastage and errors.

Efficient manpower management during dry dock also ensures that there is proper work distribution among crew, allowing them to have sufficient rest hours and preventing excessive workload.

Fire Watch

Whenever there is welding, gas cutting, or any other type of hot-work carried out in the engine room, a responsible crew member from the ship staff must be placed to do the fire watch.

A dry dock safety supervisor (sometimes 2 in nos.) should always be present in the engine room. It's also important to communicate with him/her prior

to starting the hot work for rechecking all the safety aspects related to the job.



Hot work on Ship

Before any hot work is carried out, ensure that proper permit is taken from the dry dock authorities in case the work is performed by the shore staff.

Take and follow ship's hot work permit if the job is to be carried out by the ship's staff.

A fire watch is a must and should include arranging fire hoses and portable extinguishers as per the location and job performed.

Also mark the nearest fire alarm call point and the escape route from the job location.

Quick Note: A responsible engineer officer to be designated for taking frequent engine room rounds to prevent fire/ accidents and to ensure safety. The frequency of the rounds must increase to those areas where hot works i.e. welding, gas cutting etc. are being carried out.

Real Life Incident

The passenger vessel Malaspina was in dry dock in Ketchikan, Alaska, for scheduled repairs when a fire broke out on February 7, 2012, resulting in estimated damage of between \$500,000 and \$750,000. No one was injured. The Malaspina was undergoing duct repair which required "hot work" — cutting, grinding, and welding.

The National Transportation Safety Board determined that the probable cause of the fire on board the passenger vessel Malaspina was the failure of the shoreside working crew and fire watch to ensure that proper cooling has occurred before leaving the area where the repair work was conducted. Contributing to the accident was the work crew's improper use and application of a welding curtain, placed horizontally as opposed to vertically, which allowed molten material to burn through the curtain and fall into the space below.

Watch keeping,

Normally, before and after the dry dock, the ship is berthed in lay-off to do additional maintenance and repair jobs as the cost of dry docking is extremely high.



Engineer in Watch

While the ship is in the lay-up berth, the power is generated by the ship's generator and hence a normal watch keeping routine must be carried out (Depending on UMS or Manned ship) at all times.

Even when the ship is in the dock, machinery such as reefer compressors are always in running condition, and hence a responsible person should be assigned to regularly check the operation of such machinery.

Maintenance of Machinery

A responsible engineer officer will be made in-charge of all major repairs going on in the engine room. He has to ensure that the shore staff gets all the special tools, reference manual, or any other assistance required.

The engineer officer must also check that the desired job is carried out in correct procedure by the shore technicians. If the officer feels that any safety procedure is compromised, he can always take up the issue to the safety officer/ representative of the dry dock.

Every day during the dry dock, the day should start with a tool box meeting held by the chief or 2nd engineer, discussing safety issues and proceedings of that day's job, along with shortcomings/ near misses/ unsafe practices of the previous day's work for improvisation. Risk assessment and personal protective equipment (PPE's) checks should also be included in the tool box meeting. Any shortcoming in the PPE of engine room crew must immediately be followed by issuing the required equipment to the person.



Crew Working in ER

Apart from this, if any maintenance is carried out by the ship's staff, enough number of assisting crew should be present during the operation.

Real Life Incident

While a major overhauling of generator was carried out by the ship's crew, only one extra hand was given to third engineer for overhauling. After removing all the unit pistons from Diahatsu generator, the crankshaft was rotated for removing the bearing shell. Since only two persons were allotted for this job, while rotating the crankshaft, the bearing housing assembly of one of the unit got stuck into the engine frame damaging the same.

This happened as both the the third engineer and the helping hand were not able to keep an eye on all the units.

Since the engine frame got cracked, special technician were called for the repairing work.

Rest hour period

Though during dry dock, the work load is comparatively more on the seafarers, it's imperative that they get adequate time for rest.

It's the responsibility of 2nd engineer, in consultation with the chief engineer, to equally distribute the work to ensure that the crew gets enough rest period as stated in the STCW code.

Excessive fatigue/stress among crew not only reduces the overall productivity but also increases the chances of accidents.

Human error has been one of the prime causes of accidents on ships and it has been scientifically proved that lack of proper sleep/rest leads to increase in human errors.

As physical and mental stresses are comparatively higher during dry dock, it's extremely important that the tasks are evenly distributed among team members and sufficient rest hours are also provided.

Miscellaneous Jobs

To ensure utmost safety, enough crew and responsible officers must be assigned whenever a ship staff is doing any enclosed space entry, heavy weight lifting, working aloft etc.

It is the job of 2nd engineer to do the risk assessment for above listed jobs and provide additional man power if required by the engineer in charge of the job.

The engineer in charge must ensure that all safety equipment such as- SCBA while doing enclosed space entry, gas detectors for atmosphere analysis, Safety harness when working aloft etc. are properly applied and used in the the dry dock.

Quick Note: The SCBA locker must be inspected every day by a responsible ship officer for checking the pressure and condition of all spare gas bottles. If any low pressure bottle is found, it must be immediately charged as plenty of bottles might be required in case of accidents involving fire or enclosed spaces.

Chapter 4

Mechanical/Machinery Jobs in Dry dock

Main Engine

Auxiliary Engine

Auxiliary Boiler

Fresh Water Generator

Bow Thruster

Pumps

Winches and Windlass

Water tight door

Hydraulic system

Valves

Pipings

Sea Chests

MARPOL Equipment

Stern Tube System

A ship's engine room has a number of machinery systems, which are rigorously operated while the ship is sailing. Many of these systems are operated almost continuously as without them a ship cannot make it from point A to B, following all the rules and regulations.

Hence, dry dock is the perfect period to do all the major/minor repairs and maintenance works on these machinery, along with follow up on the surveys.

The engine room machinery jobs which are performed in the dry dock and the duties of the engine staff are as follows:-

Main Engine

The main engine overhauling would usually include several jobs, depending on the survey items under continuous machinery survey and the number of running hours.

If the number of running hours of the main engine components are over, the schedule maintenance

will be performed in the dry dock.

The main engine maintenance in dry dock mainly includes:

Fuel Pump Overhauling: The fuel pumps of the main engine are normally overhauled in the dry dock by the shore workshop staff. For this task, ensure that the main engine is changed over to the diesel oil before the ship gets inside the dock or in the lay-up berth.



ME Fuel Pump Removed

Prepare a landing report for the fuel pumps, indicating the total number of pumps, along with

the reasons for overhauling / repair.

Landing report must be signed by the workshop in-charge and the chief or 2nd engineer.

Spares required by the shore technicians must be adequately provided. Also, ensure that all the safety procedures are followed while carrying out the task.

Complete Unit D'carb: Complete unit d'carb may be carried out by the ship or shore staff. The important thing to ensure is that enough man power is available to carry out the job in a safe and efficient manner.



Unit D'carbonization

Also, one must make sure to record the calibrations and take enough photographs of all the parts so as to submit the complete report to the surveyor even if he is not available. Under CMS , the surveyor may check all the components of the combustion chamber.

Turbocharger Overhauling: Turbocharger of the main engine is normally overhauled in the dry dock by maker's representative/ technicians who will take out the rotor to perform the job and may even take it to the shore workshop.

Keep ready all turbocharger tools and spares for a smooth operation.



ME Turbocharger Overhaul

Quick Note: Once the Rotor of the Turbocharger is out of the casing, the chief or 2nd engineer must inspect both the casing and the rotor for their condition. If there is any crack or burn out in the casing, same must be rectified before fitting the rotor.

Air Cooler Cleaning: Air cooler element of the main engine is removed for cleaning and is normally taken to the shore workshop for maintenance.



ME Air Cooler Removal

Ensure to shut all the water valves and drain the cooler before removal.

Quick Note: When the cooler element is out of the engine, clean the frame area of the element and apply primer on the same. This will prevent rust and mud formation in the frame area. The element should also be pressure tested for any tube leaks.



Primer Coating

Pressure Testing

Jacket Water Cooler Cleaning: Cleaning of plate type or shell and tube type cooler is always performed in the dry dock either by the ship or the shore staff.

Ensure enough rubber packings or seals are available to avoid any leakages after assembling. While opening the cooler ensure that all the cooler valves are closed, the vent cock is opened, and the cooler is drained completely.

Lube Oil Cooler Cleaning: The important point to be kept in mind while cleaning the lube oil cooler is to drain all the oil. Shut all the valves,

open the top vent valve, and start draining and collecting the lube oil in a suitable tank or container.



Lube oil Cooler Cleaning

Never open the cooler unless you are absolutely sure that all the oil is drained. If an oil spill occurs in the engine room, it will require additional man hours for cleaning the same.

Such kind of accidents can also lead to other types of mishaps arising from slips, trips, falls, and fire. Whenever any oil spill occurs in the engine room, the crew should immediately attend to the spill for cleanup and treat the situation as an emergency one.

Real Life Incident

The 2nd engineer ordered the engine crew to open and clean the Main Engine Lube Oil Cooler which was of plate type. No risk assessment and job briefing was carried out prior to opening of the cooler. The Fitter and Oiler drained the cooler oil and once the oil flow reduced to minimum, they started loosening the cooler with no oil spill arrangement and containment system. Suddenly the cooler platform was filled with oil spill and the complete work on that platform had to be stopped to prevent hazards such as slipping, fire etc. More crew members were required for cleaning and containment of the oil.

Bearing Checks and Renewal: Connecting rod bearing, crank pin bearing, guide shoe bearing and main bearing checks and renewals are also done in the dry dock.

Under CMS or following the maintenance schedule, all bearings can be opened up for inspection and renewal if required.

While tightening important nuts & studs in the connecting rod, main and crosshead bearings, it is important to check the tightening values provided in the manual.



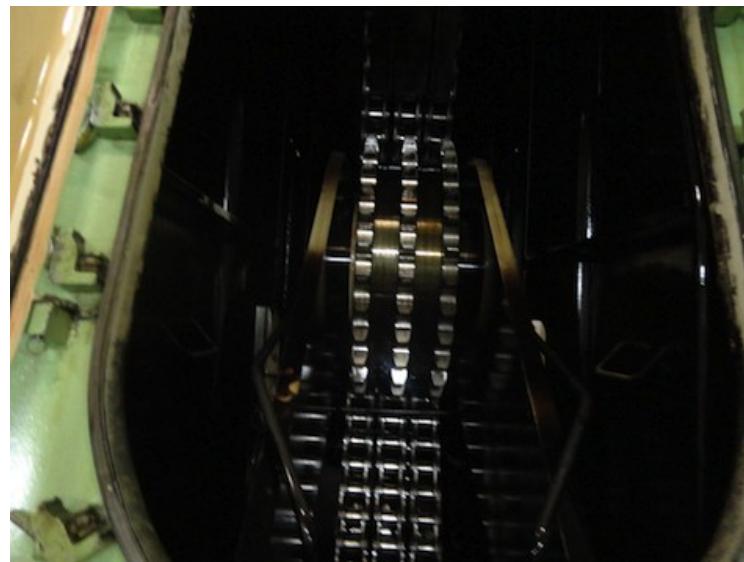
ME Bearing Removal

Care must be taken while performing bearing renewal and all calibrations must be recorded as per the maker's procedure.

Quick Note: When any bearing of main engine is opened up by shore staff, a responsible and experienced engineer officer must check the condition of the bearing shell and crank / crosshead pins of the engine.



Timing Chain Check and Adjustment: The timing chain in MAN B&W engines usually loosen-up after long hours of operation.



Timing Chain Adjustment

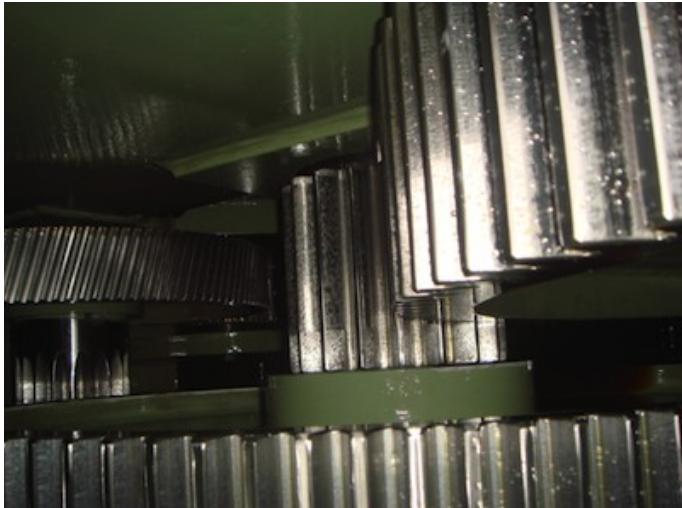
This can be indicated by the pointer provided in the chain system pointing at a number less than the desired value. The chain can be tightened by following the procedures mentioned here.

Tie Rod and Foundation Bolts Check: Tie rods and foundation bolts are one of the neglected parts which are rarely touched while the engine is in operation.

Dry dock is a good chance to check the condition

of the tie bolts, foundation bolts and side bolts for tightness and breakage.

Checks on Gears: The backlash and tooth damages are measured and rectified in dry dock. If any major damage is found, it may be required to remove the gear from the engine for replacement.



Main Engine Gears

Sump Oil Renewal: Oil analysis is done on three monthly basis by a shore lab. If it is decided by the company to renew the oil due to reasons such as contamination, then dry docking is the best time to perform this task.

Any Other Major Repairs: The ship may be due for any other kind of major repairs or the sole

reason to bring the ship in the dry dock is to perform a major type of repair which cannot be done when the ship is in water. Either ways, it is to ensure that all the pending and upcoming maintenance and repair jobs are completed while the ship is in the dry dock.

Real Life Incident

After the shore staff completed the renewal of main and crosshead bearing shells, the shore workshop in-charge requested 2nd engineer to check the job done. The 2nd engineer approved the completed work. During sea trial, when the engine RPM was increased to half ahead, there was heavy vibration and knocking sound. When the engine was stopped for inspection, the connecting rod was found bent and the liner broken inside the crankcase. The reason behind the incident was found out to be wrong tightening values of con-rod bolts.



Bend Connecting Rod of Main Engine

Auxiliary Engine

Auxiliary engines on ships are normally opened up for major overhauling and surveys during dry-dock.

It's important that at least one experienced engineer is always present to assist and check all the readings, clearance values, and tightness values when the job is performed by the shore team.

If the generator d'carb is carried out by the ship staff, enough number of manpower must be provided for smooth and hassle-free overhauling.

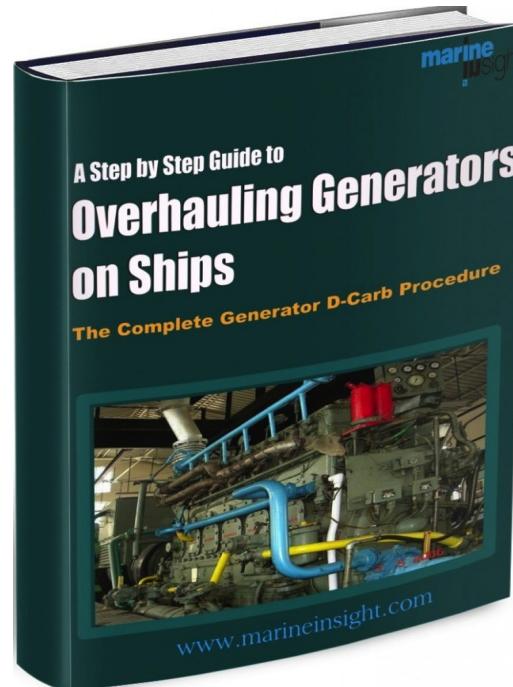


Survey of Generator

To understand the step- by- step procedure of generator major overhauling, check out our ebook:

“A STEP BY STEP GUIDE TO OVERHAULING GENERATORS ON SHIP”

(With Checklists and Gauging sheets)



Download Now

Auxiliary & Main Boiler

Boiler is one of the most important machinery systems on board ships. The main propulsion plant and several other systems highly depend on the steam generated from the boiler, especially if it's running on heavy fuel oil.

When carrying out the maintenance work, it is imperative to drain the boiler water. This has to be done carefully by following proper communication procedure with the dry dock officers. Following are some important maintenance/ repairs to be performed on boiler in the dry dock:

Overhauling of Mountings: Overhauling of boiler mountings which includes all fresh water filling valves, main steam stop valve, auxiliary steam stop valve, vent cock, valves for pressure switch/gauge/alarm systems, blowdown valves, gauge glasses etc. is carried out in the dry dock.

Overhauling of Burner Assembly: The boiler burners (main and pilot) must be overhauled

completely, including the boiler burner motor and forced draft (FD) fan assembly and motor.

Repairing of Refractory Material: It is advisable to check and repair any broken boiler refractory as it leads to decrease in the boiler efficiency and may even bulge or crack the boiler shell due to overheating.



Damaged Refractory

Quick Note: Ensure that the crew working on the refractory knows the properties of the refractory mixture used. After the application of refractory, it is to be set-up by application of heat. Some refractory are fast setting whereas others require water application at regular interval of time.

Repairing of Boiler Shell: If the boiler shell is bulged or cracked, dry dock is the right time to do the repair as most of the time, special welding and repairing is required under pressure vessel requirements.



Repaired Boiler Shell

Calibration of Safety Valves: The safety valves (2 in nos.) are pressure tested and reseted at the rated pressure either by the workshop people or by the ship's staff after overhauling.

Follow the regulations to set both the safety valves at the correct pressure. One safety valve will be set

at slight higher pressure than the other one.



Safety Valves

Quick Note: Before opening the safety valve, ensure that the boiler is completely de-pressurised. Note down the opening pressure of both valves (normally stamped or tagged with the valve) and remove the easing gear before opening the safety valve.

Checks on Alarm and Safety Systems: All the important alarms and shut down systems are checked before shutting down the boiler and if any fault is detected, it is rectified before the boiler is brought back into operation.

Cleaning of Water Side: Depending upon the type of the boiler, water tubes, and water drum, cleaning is performed for the water side. The normal process for cleaning includes using a skew jet machine for cleaning the tubes, externally or internally.



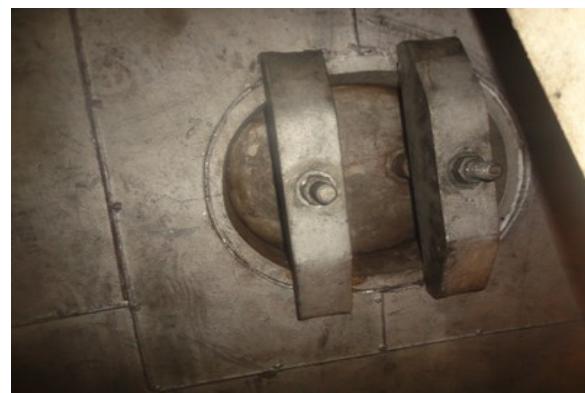
Water side Cleaning

Cleaning of Smoke Side: Smoke side of the boiler is cleaned manually using a brush. Tubes may be cleaned by using a long rod with attached brush of lesser diameter than that of the smoke tubes. Special cleaning equipment such as a rotating flexible rod attached with cooling water connection is also used to dampen the hard soot deposits.



Smoke side tubes

Quick Note: The boiler doors are heavy and elliptical in shape, constructed to secure from inside the shell. Care must be taken while removing them from the shell as they must not be dropped inside the drum damaging the boiler tubes. Renew special joint/ gasket for all boiler doors whenever it is opened.



Boiler Manhole

Fresh Water Generator

Fresh water generator on ship may either be of plate type heat exchanger or shell & tube type. Some passenger or cruise ships may also have reverse osmosis plant for generating fresh water on board. During dry dock following jobs are performed on the fresh water generator:

Cleaning of Heat Exchanger: Whether it's shell type or plate type fresh water generator, the efficiency will reduce if the heat exchanger is dirty.



FWG Evaporator

Cleaning must be done at regular intervals as

specified by the makers. All major repairs must also be done during the dry dock.

Cleaning of Condenser: The condenser is generally cleaned chemically. It can also be taken out of place and sent to the shore workshop for efficient cleaning process.

Inspection of Eductors: The eductors are responsible for creating vacuum and sucking brine out of the FWG. Check the orifice and the flap provided inside the eductors.

Ejector Pump Sea Chest: Cleaning of ejector pump sea check (if provided separately) is a must in the dry dock.

Real Life Incident

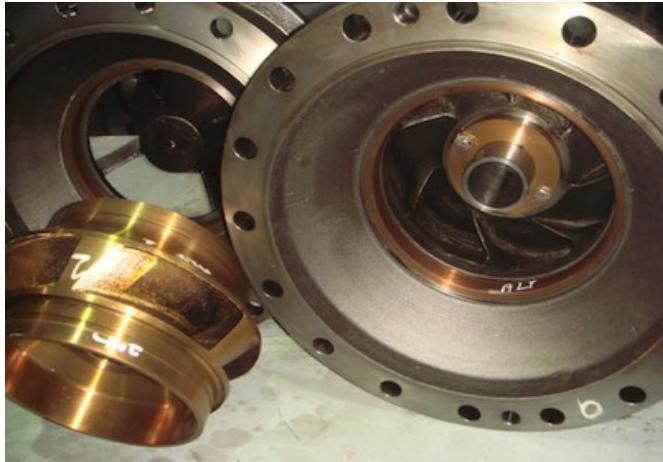
While overhauling the fresh water generator in the dry dock, the ships crew forgot to overhaul the eductor nozzles. Once the FWG was assembled and started, the water production of the system was not improved as expected. While doing the troubleshooting, it was found out that the opening of the eductor nozzle was choked and the whole task had to be repeated.

Pumps

With so many pumps in the engine room, it is important to first overhaul all the major pumps, which are continuously running while the ship is sailing.

The pumps are also covered under the CMS and hence their repair work can be conducted in the dry dock. Following are the pumps which must be overhauled in the the dry dock:

➤ Sea Water Pumps



➤ Jacket Water Pumps

➤ Ballast Water Pumps

➤ Main Lube Oil Pumps



➤ Camshaft Lube Oil Pump



➤ Stern Tube Pump

➤ Boiler Feed Water Pump

Other pumps which may be overhauled depending upon the survey schedules and running hours:

➤ M/E and A/E Fuel Oil Pumps



➤ Purifier Supply Pumps



➤ Fuel Oil and Diesel Oil Transfer Pumps

➤ Fire Pumps



➤ Hydrophore Pump

➤ Cylinder Oil Pump

➤ Other Auxiliary System Pumps

Quick Note: The 2nd engineer must check the maintenance jobs that are being carried out on all the engine room pumps. Once the maintenance work is completed on pumps with mechanical seals, never allow shore or ship staff to test the pump in dry condition as the mechanical seals will break or get damaged even if the pumps run for short period of time.

Bow Thruster

Bow thruster is an essential machinery which must be checked and repaired if required in the dry dock.

A special shore technician generally comes to check the BT system onboard ships during dry dock. Following are the jobs to be performed in the BT system:

Draining of Oil: The complete oil of the BT system is drained before doing any maintenance.



Used BT Oil

Make sure you understand the draining system of the oil. A separate hand pump is generally provided to pump out the oil. The oil should be collected in 200 liters drum easily available on the ships.

Checks: Seal and transmission shaft conditions are checked along with the hydraulic valve which controls the pitch.

The pitch indicator is also checked for any errors. If found, they must be rectified immediately.



Adjustment of BT propeller Pitch

The BT propeller blade is checked for any cracks or breakage. Die penetrant test to be performed on the propeller blades to ensure no damage is

caused.



BT Propeller Blade

Cleaning: Cleaning of all tanks in the BT hydraulic system is done.



BT system Hydraulic tank cleaning

Filling: It is advised to arrange few fresh hydraulic oil drums for the Bow Thruster in the forward stores while preparing for the dry dock. Once the BT work is finished, the oil is again filled up in to the system.

While initially filling the oil, keep an eye for oil leakage through seals, especially when any maintenance work is done in that part.

Quick Note: When filling the lube oil in the BT system, one person must keep checks to ensure no oil is leaking from the seals. The BT propeller protection grills to be inspected for corrosion and damage. In case of defects, they must be repaired by welding or renewal when the ship is in the dry dock.



Welding of BT fan Grill

Winches & Windlass

Winches and windlass are essential machinery used while maneuvering and berthing the ship to a jetty or while anchoring the ship.

Following maintenance must be performed on them:



Mooring Winch

Foundation: Check for any missing or loose foundation bolts. If any sign of rusting or cracks appears in the foundation, repair them.

Cover and Body: Since winches and windlass are exposed to the harsh environment of the sea, checks must be made for rusted or broken bolts on the cover, damaged, or rusted body. If found, required repairs must be performed.



Visual Inspection

Brake: The brake testing must be performed as per the requirements and renewal of the brake liner if the clearance is above required limits.

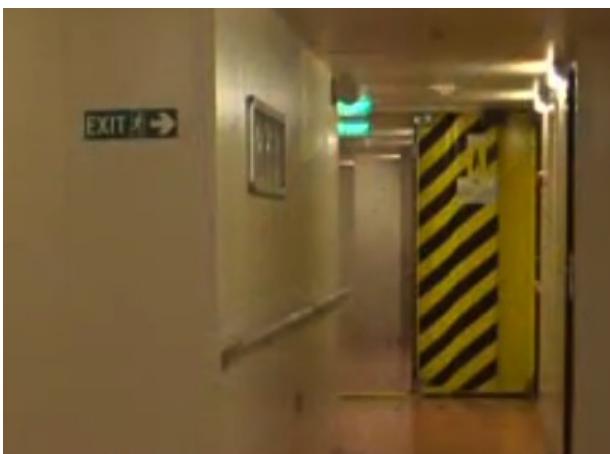
Load Sensor: The load sensors sense the tension on the mooring winches and adjusts the tightening and loosing accordingly. It is important that these load sensors are adjusted properly to get accurate results.

Water Tight Doors

There are several water tight doors on ships, including the pilot doors. Points to remember while carrying out maintenance on these doors:

Check for Rubber Packing: Water tight doors have special rubber packing for water tightness, same to be checked for any damage and repair/renewal to be carried out if required.

Check for Remote Closure: Remote control closing arrangement to be checked for operation. The closing system (hydraulic or air) to be overhauled and maintenance to be carried out using new o-rings.



Water Tight Door

Hydraulic System

The hydraulic system of the ship comprises of various other systems such as ballast water line valves, fuel line valves, bunker line valves etc. Hydraulic system is mostly used to remote control other important systems. Following things are to be checked in the hydraulic system:

Clean and Renew Oil: Clean and renew the hydraulic oil and the hydraulic day tank from where the oil is circulated in to the system.

Check Operation: Check the operation of all the hydraulic valves from the remote control position.

Check Leaks: The valve may not operate or properly function if there is leakage from the seal. Seals must be renewed if leakages are found.

Quick Note: All the hydraulic valves present in the ship should be checked locally (in duct keel or passage) for open/close position when the remote control switch in engine control room or cargo control room are operated. Sometimes, the indication would show open even when the valve is stuck in closed position.

Valves

Dry dock is the time where most of the shipboard valves are opened up for overhauling and renewal. Different types of valves and their maintenance to be done are as follows:

Overboard Valves: There are several overboard valves in the ship which needs attention when the ship is out of water. They are:

➤ **Main Sea Water Overboard Valve**



➤ **Auxiliary Sea Water Overboard Valve**

➤ **FWG Ejector Overboard Valve**

➤ **OWS Overboard Valve**



➤ **Sewage Grey Water Overboard Valve**



➤ **Sewage Black Water Overboard Valve**

- **Compressor SW Overboard Valve**
- **Intermediate Shaft Bearing Cooling Water Overboard Valve**
- **Ballast Overboard Valves**



Normal Valves: All other valves which are listed in the dry dock defect list, along with other planned ones are to be overhauled.

Steam Valves: The steam system consists of several valves including boiler mountings. All the valves which are listed in the defect list for leakages must be overhauled and their glands must be renewed.



Care must be taken to order same types of valves while replacing the old valves from any of the above systems.

Quick Note: Most of the overboard valves are sent to the shore workshop. Chief engineer or 2nd engineer must visit the yard workshop to test whether air or hydraulic operations of the remote control valves are working fine or not. Also check the special rubber packing and sealing of the valves.



Piping

In dry dock, repair work is carried out for those pipes which are cracked, rusted or temporarily repaired by the ship staff. Sea water system pipelines are vulnerable to rust and cracks, and dry dock is the best time to take extra care of them.



Sea Water Pipe Removal for Repair

If any other piping repair or modifications are performed in the dry dock, care to be taken for checking the material and scheduled number of pipes before replacing them with new ones.



Quick Note: Never use stainless steel pipes in any seawater system without washing them with fresh water as static seawater will cause pitting in the stainless steel. When carrying out hydraulic testing, apply a pressure equal to 1.5 times that of the pipe's working pressure.



Worn out rubber coating

Sea Chests

The cooling medium for various machinery and systems on ships is sea water, which comes from separate sea chest connections in the engine room. In dry dock, as the ship's hull is out of water, it is the best suited time to inspect and clean the sea chests and pipings.

Some of the sea chests that must be cleaned are:

- **High Sea Chest**
- **Low Sea Chest**
- **Separate Sea Chest for FW Ejector pump**
- **Fire Pump Sea Chest**

Following work to be performed:

Cleaning of Strainer: The strainer of the sea chest is removed with the help of a chain block. Clean the strainer by means of pressurized service air and by application of water jet.

Check the complete strainer for any damage and if required renew the strainer element with new spares.



Sea Chest Strainer

Check and Renewal of Sea Chest Inlet Grid:

The inlet grid accessible from outside the hull is checked for corrosion and damage. The complete passage from sea chest to the hull opening is also checked and painted with anti-corrosive paint.



Sea Chest Grid

Checking of Sea Chest Valves: All the sea chest valves (inlet and outlet) are checked for remote closing and water tightness. If there is an issue of leakage or improper closing, it must be rectified when the ship is in dry dock.

Renewal of MGPS Anodes: The Marine Growth Prevention System in the sea chest comprises of anodes which are renewed in every dry dock.

Renewal of Gasket: Whenever the sea chest is opened, it is advisable to renew the complete gasket to avoid any leakage in future.



New Gasket

Overhauling of Sea Chest Mountings: The sea chest mountings comprises of vent cocks and drain valves, which must be overhauled along with the maintenance of sea chests in the dry dock.

Heat Exchangers

The method of maintenance used depends on the type of heat exchanger and the type of deposits, but the general aim of every heat exchanger maintenance procedure remains the same – Cleaning of heat transfer surfaces to prevent any kind of obstruction in the flow process.



Plate type cooler

The main reason for fouling of heat exchanger surface is the increase in temperature difference between the two fluids and change in pressure.

But it is the sea water side of the heat exchanger which suffers the most as a result of corrosion and scale deposits.

The most common type of heat exchangers found on ships are-

1. Shell and tube type

2. Plate type

When doing maintenance of heat exchangers, following points to be remembered:

- If the deposits on the heat exchanger are not very hard, then they can be removed using a wire brush
- If the deposits are stubborn, chemical cleaning should be used by emersion of the part in the chemical solution
- Depending on the type of the heat exchanger, there are tools provided by the manufacturers for the cleaning purpose. For e.g. there are special tools for cleaning shell and tube type heat exchangers
- Once the cleaning is done, the heat exchanger must be flushed with fresh water to remove any remaining chemicals or dirt from the surface

- In sea water cooled heat exchanger, anodes are fitted on the cover to protect the tubes and body from galvanic corrosion. Anodes must be checked and changed if required
- Always renew the cover gasket if it is damaged during opening of heat exchanger
- In oil coolers and heaters, fouling can take place on the outside of the tubes as well. This can be removed by chemical flushing
- In plate type heat exchangers, the stack of plates is removed to expose the surface. The plate surface is then cleaned with a brush or using the methods suggested by the manufacturer. (Sharp tools should be avoided)
- Cleaning should be done in such a way that it does not damage the plate seals. However, if a replacement of the seal is necessary, it must be done before putting the plates back
- While tightening the plates together, care must be taken for even tightening of all the exchanger studs and bolts or else leakage can take place

MARPOL Equipment

MARPOL equipment on ships are those which are used to reduce the outboard quantity of polluting elements to prevent sea water pollution.

Sewage Treatment Plant: General cleaning of sewage chamber is done with flushing water and then scrapping out the hard sediments. The blower function and alarm system is also checked.

Oily Water Separator: Oil water separator maintenance comprises of renewal of filters and cleaning of filter casings (both 1st and 2nd stage).



OWS Maintenance

The oil content monitoring equipment is calibrated by authorized shore technicians.

Incinerator: Burner maintenance, refractory building, checks on alarms and trips etc. are some common maintenance procedures carried out in incinerator.



Incinerator refractory side

Work may be performed on the above equipment as per the running hours or to prepare them for CMS.

Quick Note: Remember not to reuse the filters of oily water separator when opening it for cleaning. Ensure to check the oil probe of the oil chamber for correct working. The calibration of OCM depends upon the expiry date of the certificate last issued.

OCM: Oil Content Monitor

Chapter 5

Electrical Jobs in Dry dock

Motor Overhauling

Crane Maintenance

MGPS and ICCP Renewal

Fire Alarm system

Engine Automation, Alarms and Trips

MSB and ESB Checks

Bow Thruster System

Shore Power and Alternator Maintenance

The ship's electrical engineer is responsible for carrying out all electrical system jobs which are under survey or due for repairs during the dry dock. He works under the supervision of the chief engineer and reports him on the progress and recommendations.

Following are the electrical jobs that are to be performed during the dry dock:

Motor Overhauling: Motor overhauling is an important electrical job carried out in the dry dock.



Motor Overhauling

With different sizes and types of motors on ships, some of them are overhauled in place by the ship or shore staff whereas other big motors such as

lube oil pump motor, sea water pump motor, exhaust fan motor, B.T motor etc. are taken to the shore workshops. Motor overhauling includes insulation test, air gap check, bearing renewal etc.

Crane Maintenance: Mostly all ships are equipped with small or big cranes, including the engine room crane. The best time to do maintenance on such cranes is during the dry dock .



Load test of ER crane

The load testing of engine room and deck cranes are performed during this period. Electrical motors, limit switches and electromagnetic brakes are also checked and repaired if required.

Wire renewal of cranes is also performed if the

working life of the wire is over.

MGPS Renewal: Marine growth prevention system comprises of anode arrangements which needs to be replaced at regular intervals of time.

The wiring, connections and amperage also needs to be checked when the maintenance work is carried out.

ICCP Anode Renewal: Impressed Current Cathodic Protection System is used to avoid corrosion of hull. In this system, several anodes are placed in ships hull and supplied with current.



Hull area for ICCP

Replacement of anodes is to be performed when

the ship is in dry dock. Wirings, connections and amperage are checked during the maintenance.

Quick Note: It is necessary to ensure that when the anode is replaced, they are protected by a covering of paint and other protective measures performed on the hull. Once all the operations on the hull are over, the cover must be taken out before the dry dock is flooded.

Fire Alarm System: Fire alarm on a ship is attended by a shore technician and full cooperation must be given to him/her by the electrical officer for any required assistance.



Alarm on Ship

The shore technician will check each and every alarm inside the engine room i.e. flame and smoke

detectors for proper functioning, and also make checks on the machinery alarms. If he/she finds any abnormality, replacement of the detector might be required. The spares for the maintenance procedure must be provided by the electrical officer.

Engine Automation and Alarm System: The engine automation, alarms, and trips are checked mostly by shore technician i.e maker's representative. Following alarms must be checked by a senior engineer accompanied by the maker's representative:

Main engine slow down alarms, shut down alarms, telegraph bell in all the three maneuvering stations, oil mist detector, emergency stop etc.

Main engine pneumatic system, by which, the remote control operation is performed is also checked by the shore technician.

Quick Note: While the engine alarm is being tested by the shore technician, he must ensure that before making any changes, the chief engineer is notified regarding the same. Any changes in the value is done based on the parameters provided in the machinery manual.

Auxiliary Machinery Alarms and Trips:

Important auxiliary machinery such as generator, boiler, compressor, purifier etc. are also checked for proper functioning of alarms and trips.

Main Switch Board (MSB) and Electrical Switch Board (ESB) Maintenance (ACB overhaul):

Dry dock is the best time to do maintenance and cleaning of MSB and ESB as the complete system can be isolated.



MSB Maintenance

Normally a shore team along with electrical officer and chief engineer performs the maintenance of the MSB which includes:

- Carrying out visual inspection of copper

plate and nut bolts. Marking any missing or burn out areas

- By hand or using a metal/plastic stick (where access for hand is not possible), tap the bus plates gently so as to find out any loose connections. Ensure to wear electrical gloves even when the busbar is not live



Busbar Plates

- The busbars are mechanically supported inside the switchboard by means of insulators, which may be of rubber or ceramic materials (Bad conductors). Check for any damages in the insulator part
- By using an adjustable spanner or particular size spanner, tighten the nuts in the busbar

connection for main and emergency switch boards

- Check the tightness of the wire connections, which are connected to the circuit breakers and clean the busbar and switchboard areas with the help of a vacuum cleaner
- If u find any loose connections or sparks, black-out the particular and adjacent busbars before tightening the nut
- If u find any metal piece or nut bolts missing or lying inside the panel, ensure to remove it as the same can cause short circuit or fire
- Check the door breaker knob is working fine i.e. when the knob is operated for opening the door, the complete unit should get de-energize

Quick Note: If the main switchboard busbars are to be inspected or to be worked on when the emergency generator is running, keep in mind that there will be some portion of the main switchboard which will be fed by the emergency switch board. Hence know the complete system properly and stay away from those areas fed by the ESB.

Level Control and Alarm System Checks and Repair: Various systems such as fuel, water and lube oil comprise of bunker, storage and service tanks with level and alarm sensors. Some of these tanks are equipped with auto start/stop filling pumps which operate as signaled by the level sensor in the tank.

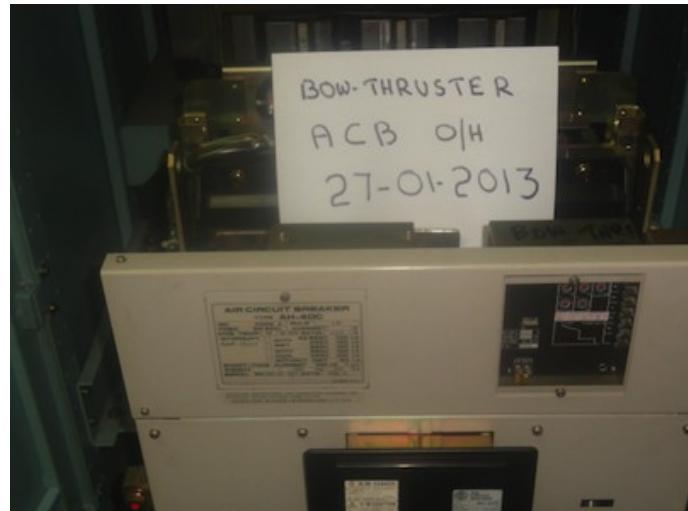
All these sensors are checked for defects and malfunctioning units are repaired or renewed. Some systems comprise of pneumatic level controls, which require cleaning of the air pipes by blowing compressed air.

Bow Thruster System Maintenance: Since the Bow thruster unit is out of water during dry dock, it is required to empty the complete oil from the system before docking the ship in order to carry out the maintenance. A shore technician is normally appointed to perform checks and repairs in the BT system.

The technician will check the functioning of hydraulic valves (2way, 3way etc.) and the condition of the motor. The technician will also check if the pitch angle at local point and the ordered pitch from remote stations are matching or not.

If there is any abnormality in the current/ voltage values at a particular pitch, the error will be identified and rectified.

The BT switch board panel is also opened up to perform maintenance work.



BT motor ACB

After completing all the maintenance, it is the responsibility of chief engineer to ensure that the system is completely cleaned and filled with fresh oil. He should check the system by starting it in front of the technician.

Shore Connection: When the ship is in dry dock, its power source i.e. generators are not used as no cooling water (Sea water cooling) is available.

Hence, shore power is taken for the ship. Working under the chief engineer, the electrical officer is directly responsible to connect the shore power provided by the dry dock. The earth wire from ship to shore must be provided and installed.

Alternator Maintenance: Before starting any maintenance work on the alternator, all safety precautions should be taken and the alternator should be shut and locked down. Also, post notice and ply cards at relevant places. The alternator heater must also be isolated. Also consider the following points

- Clean the alternator ventilation passage and air filter
- Check the insulation resistance of stator and



Alternator Windings

rotor windings

- Air gap between stator and rotor to be checked and maintained between 1.5 to 2 mm
- Slip rings to be checked for even wear down and to be renewed if required
- Carbon brushes to be cleaned and checked for free movement
- The brush contacting pressure to be checked by spring balance
- Automatic Voltage Regulator to be checked and cleaned off oil and dust
- The lube oil level of pedestal bearing to be maintained and renewed as per planned maintenance
- A vacuum cleaner can also be used to remove dust accumulated in the inner parts of the alternator
- The terminal box cover gasket to be checked for proper oil and water tightness

- All the connections in the terminal box to be tightened properly
- Cable gland to be checked for integrity
- Forced ventilation around alternator must be maintained at all the times
- Check heater for proper operation
- The foundation bolts of the alternator to be checked for tightness

Engine Room System Controllers, Actuator, and Positioner Units: Most of the actuators in the engine room are electro-pneumatically controlled to keep the temperature of a particular system within limits. These controllers are checked and repaired if required by the shore technician in the dry dock. Following systems that can be operated using actuator/controller are:

- Low Temperature Cooling Water System
- Main Engine Lube Oil System
- Main Engine High Temperature System

- Steam Dump Systems
- Heavy Fuel Oil Purifiers Heaters
- Main Engine Lube Oil Purifiers
- Deck Steam
- Engine Room General Service Steam
- Calorifier Domestic Fresh Water
- High Temperature System

Ensure to cross check all the repairs and jobs done by the shore technician.

Real Life Incident

During sea trial of a small chemical tanker, the pilot as maneuvering the vessel back to lay-up berth. When the astern movement of the engine was given, the engine did not respond to the same. Realizing the situation, pilot stopped the engine and asked the master to drop the anchors. The ship bow struck the jetty leading to small damage in the fore part. It was later found that there is no transfer of signal to astern system leading to no response for astern command.

Chapter 6

Checks in Dry Dock

Safety Checks

Checks on Tanks & Enclosed Space

Machinery Checks

Instruments & Tools

Valves & Sea Chests

Piping

Electrical Checks

Safety Checks

Ship's dry dock is a hectic operation wherein several jobs are undertaken simultaneously.

It is important for the engine room department, especially for the chief and 2nd engineers, to keep a track of all jobs going on to ensure that the operation is performed safely and efficiently, both by the ship and shore staff.

Safety Checks During Dry Dock:

- ✓ Always keep a fire watch whenever there is hot work performed inside the engine room by ship or shore staff
- ✓ Ensure that before starting any job, all PPEs are properly worn by the crew
- ✓ Everyday risk assessment must be performed by the 2nd engineer for all crew members designated with different jobs
- ✓ Crew must fill, read and sign required work permits before doing the job

- ✓ If the ply cards used by the dry dock personnel are in local language, especially meant for shore personnel, provision must be made so that the ship's crew can also understand the same
- ✓ Engineers must take frequent rounds of the engine room to ensure that all safety and required procedures are followed



Engineer in Safety round

- ✓ If any breach is noticed, one must inform the worker following unsafe practices. If even then safety is overlooked, the shore safety officer must be informed
- ✓ Ensure everyone who could be affected by the surroundings are well protected

- ✓ Ensure no one is smoking inside the engine room
- ✓ At the end of each working day, all waste material to be disposed off from the engine room

Checks and Precautions During Lifting Operation:

- ✓ Ensure that if the load is lifted manually, proper lifting techniques and enough manpower are used
- ✓ Ensure that the layout area is clear from where the load is to be lifted or shifted



Lifting Operation

- ✓ If the crane or chain block is used, ensure it is of rated capacity
- ✓ Ensure that no one is standing or crossing under the load
- ✓ Avoid manual lifting for heavy load if mechanical lifting option is available

Checks and Precautions During Hot Work:

Hot works in dry dock are a major cause of accidents on ships. Following precautions and steps must be taken when carrying out any kind of hot work while the ship is in the dry dock:

- ✓ When performing welding, ensure fire watch is carried out
- ✓ Clean all possible flammable material and substances from the working area
- ✓ Use suitable screens during arc welding so that passers by and others using the area do not suffer a welding flash (arc eye)
- ✓ Make sure there is adequate ventilation to

prevent unnecessary inhalation of fumes or building up of gas



Hot work

- ✓ The equipment to be used must be in good order
- ✓ Ensure that fumes from the work do not accumulate in the working area
- ✓ Ensure fire hoses are ready and fire line is pressurized
- ✓ Keep a check on the areas that can be affected by hot work
- ✓ Keep a portable fire extinguisher near the hot work location

- ✓ Ensure that the fire alarm is not isolated where the hot work is being performed
- ✓ Stop the work if you have any doubt or sense any abnormality when doing gas cutting
- ✓ Remember where flammable vapors exist, isolate electrical equipment in the vicinity as electrical equipment including battery operated tools can ignite the vapors
- ✓ Ensure there are no leaks from pipes regulators, gas, or oxygen cylinders when doing gas cutting
- ✓ Ensure that flashback arresters are fitted to the equipment
- ✓ Ensure that gas bottles are always used upright and regulators are set correctly and turned off when not in use

Quick Note: When welding or hot work is being performed in an enclosed space or tank, the atmospheric content is monitored repeatedly at every 15 minutes interval. Also, ventilation is continuously provided in the enclosed space even when there is no explosive gases detected.

Tank & Enclosed Space

The ship comprises of various enclosed spaces and tanks which are opened up for cleaning in the dry dock.



Tank in ER

It is the responsibility of the ship's engineers to carry out cleaning of such areas with utmost precaution. Following checks are to be performed when doing cleaning of tanks and cofferdams in the engine room:

- ✓ Ensure that the tank chosen for cleaning is completely drained

- ✓ To double check that the tank is empty, take manual soundings even if remote sounding system is available
- ✓ Open bottom drain of the tank to check no oil/ water/ sludge is coming out
- ✓ Open the bottom door first
- ✓ Follow enclosed space entry checklist and enter only after doing proper ventilation
- ✓ Check condition of sounding pipe bell and area
- ✓ Ensure that the drain line of the tank is cleared
- ✓ Check the condition of float and alarm systems inside the tanks
- ✓ Check for sludge accumulation and cleaning of the same to be performed
- ✓ Check condition of steam heating lines in the fuel tanks



Steam Line Inside Tank

- ✓ Pressure test of steam heating line to be done
- ✓ If there is complain of leakage from the tanks, they must be tested by using water jet from outside and checking leakage from inside
- ✓ Pressure test of the tanks can be done by using compressed air at less than 1 bar pressure by making arrangements through sounding pipes while the tank is intact i.e. all doors are fully tightened
- ✓ If the pressure does not drop for at least 1 hour, the tank is “OK” with no leakages

- ✓ When going inside duct keel or cofferdam, ensure that more than two people are available in the team
- ✓ Check all duct keel lightings are in working condition. Check for water accumulation
- ✓ Check for oil/water leakages inside duct keel or cofferdam
- ✓ Check for any steam leakages inside the duct keel

Real Life Incident

A 200 liter drum sealed in engine room had previously contained mineral oil, and had not been cleaned/rinsed out. Later it was filled with up to 70 liters of waste water and carbon residue from boiler. During that time oil/carbon residues separated from the water and floated on top, producing an explosive vapor. One day the oiler tried opening the top cover but was unable to do so because of rust. He then used a portable cutting tool on the outside of the drum. As the drum is an enclosed space, and the application of heat from a cutting tool ignited the air/fuel mixture, it resulted in an explosion which led to death of the oiler.

Checks on Machinery

In dry dock, several machinery are opened up for inspection and repairs. It is the job of the 2nd engineer and other operational level engineers, who are designated to look after the engine room operations, to ensure that all required steps are taken to efficiently complete the job and proper record keeping of them is done.

Main Engine:

- ✓ While doing overhauling of the engine, check the condition of removed parts (piston, liner or valves). Calibrate the parts and renew if required with new spares



- ✓ When performing bearing inspection, check the condition and measurement of the bearing. Renew if the limit value is exceeded
- ✓ Check the “K” value when fitting back the turbocharger after overhauling
- ✓ When the piston is removed, it should be pressure tested
- ✓ Fuel pump lead to be checked and compared with the original reading



- ✓ Ensure to reconnect the VIT link at correct distance after the fuel pump is installed

VIT: Variable Injection Timing

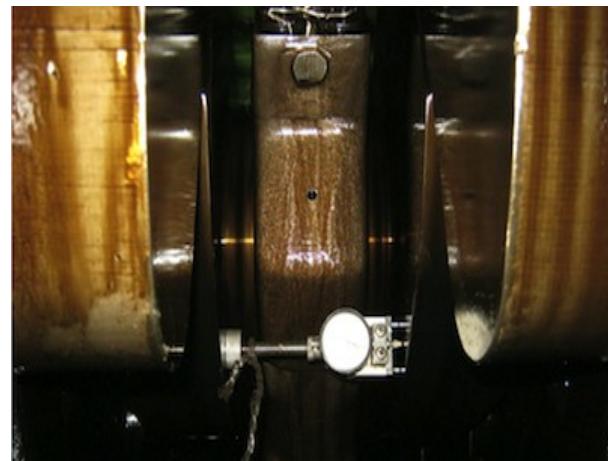
- ✓ After doing major overhauling (renewal of piston liner or bearing) check crankcase for any dropped tools or cleaning rags
- ✓ Ensure all the parts are tightened at their rated torque
- ✓ Once all work on main engine is performed, start the lube oil pump and check for lubrication with crankcase doors open
- ✓ Record every thing which was performed in the main engine and keep enough photo evidence

Auxiliary Engine:

Auxiliary engine overhauling is normally performed in the dry dock, hence following checks are to be performed:

- ✓ Check all alarm and trips are reset once the overhauling is over
- ✓ Do a thorough crank case inspection before taking fresh oil
- ✓ Governor to be sent to shore for overhauling

- ✓ Ensure surveyor has approved for using old or same parts if no new spares are used
- ✓ Record everything which was performed on the auxiliary engine along with enough photo evidence
- ✓ Check crankshaft deflection after d'carb is completed



Measuring Crankshaft Deflection

Quick Note: After completing overhauling of generator, it is to be tested as per the breaking-in and running-in requirements for a given period of time as per maker's instructions. The running-in of the generator engine is carried out using diesel oil and in case of any problem, the shore staff responsible for the overhauling is informed regarding the same.

Boiler:

Boiler is one important machinery which needs to be started first among others when the dry dock work is on the verge of completion.

It is the responsibility of the chief and 2nd engineer to ensure and check that all maintenance and cleaning jobs on the boiler are performed as per correct procedures. Following points are to be considered:

- ✓ When draining boiler for internal cleaning and inspection, ensure that the dry dock area, where boiler blow down overboard emerges, is clear and same is notified to dry dock authority before hand
- ✓ Ensure that the boiler pressure gauge gets calibrated by shore workshop
- ✓ All alarms and trips are calibrated and checked once the boiler job is done
- ✓ Greasing of easing gears to be performed
- ✓ Check condition of the water and smoke tubes
- ✓ Thickness of the tubes can be measured with electromagnetic transducer provided by the shore workshop
- ✓ Boiler gauge glass must be cleaned and fitted back with new gaskets
- ✓ Always renew the gasket when boiler manhole doors are open. Never use old or used gasket
- ✓ When the settings of safety valves is given to the shore workshop, chief or 2nd engineer must visit the workshop to check the pressure settings of both the safety valves



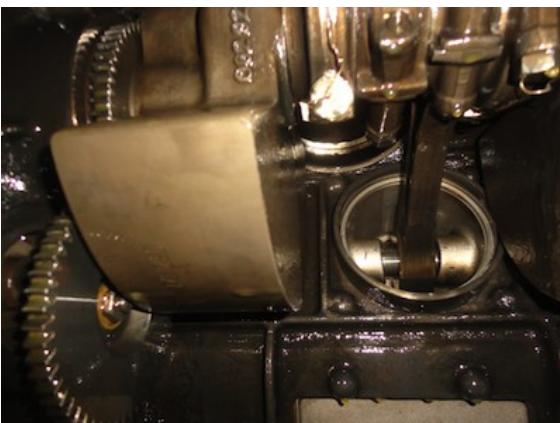
Boiler Tubes



Pressure Setting of Safety Valves

- ✓ When starting a boiler, inform the shore and deck people to ensure that no one is working on the funnel

Apart from the main auxiliary machinery, a ship's engine room has several smaller machinery systems which require equal amount of attention. Do note the following points



Air Compressor Overhauling

- ✓ If any maintenance is done in the air compressor, ensure that it is filling the air bottle in required amount of time
- ✓ Ensure outlet valve of the air compressor is opened once the maintenance is done
- ✓ Check all the trips are in working condition
- ✓ When work on purifier is completed, check the amperage value, vibration and abnormal sound after starting the machine
- ✓ If fresh water generator is opened up for cleaning, check the coating inside for damages and if required, repair it by special epoxy based food coating
- ✓ The salinometer must be calibrated by recommended shore facility
- ✓ After STP cleaning and maintenance is done, ensure that the process for creating anaerobic bacteria is fulfilled by starting the blower
- ✓ Oil content monitor of OWS can be calibrated by a shore technician approved by the maker

STP: Sewage Treatment Plant

OWS:Oily Water Separator

Checks on Instruments and Tools:

- ✓ Torque wrench available on ship must be sent to shore for calibration
- ✓ All special calibration tools like dial gauge etc. to be sent to shore for checking
- ✓ High load chain blocks which are old to be sent to shore for calibration and testing
- ✓ Temperature gauge calibrator on ship to be checked for proper functioning by shore personnel
- ✓ High load capacity i-bolts and special lifting tools to be checked for capacity testing and cracks/ damage by shore experts

Checks Valves and Sea Chests:

- ✓ If vacuum box of fire pump or any other pump is provided, test the same after repair
- ✓ Proper gland packing of rated pressure is to be installed in the steam valves
- ✓ Ensure lagging is placed in steam valves

- ✓ Check prior to assembly the lapping work performed on valves and valve seats



- ✓ Check rubber coating inside the sea-chest
- ✓ Check MGPS work is finished before boxing up the sea-chest



Checking Valve in Shore Workshop

- ✓ In order to check the water tightness of the ship chest valve, water jet is used on the closed valve from inside the ship and any kind of leakage is checked from the outside

Checks on Piping:

- ✓ If any piping section is renewed or repaired, check it by pressure testing
- ✓ Ensure that the pipe renewed is of the same size as that of the previous pipe
- ✓ Ensure the new pipe is of the same schedule i.e. pressure capacity



renewed S.W Pipe section

- ✓ Ensure that rubber coating is provided if it is

a sea water system piping

- ✓ Check if same flange types and bolt holes are provided
- ✓ Ensure lagging are placed in all high temperature and steam pipes

Electrical Checks:

- ✓ Inspection of the recessed zinc reference cells on ICCP system to be carried out
- ✓ Do not apply any dielectric shield around reference anode
- ✓ Ensure that the protection cover is removed from ICCP anodes after hull painting is done
- ✓ When doing maintenance in MSB and ESB, check for hotspots using thermographic or laser camera. Such spots must be rectified during cleaning
- ✓ All meters like Ammeter, KW meter etc. in the switch boards of all generators to be calibrated. Same to be checked during operation

MSB: Main Switch Board

ESB: Emergency Switch Board

- ✓ All alternators including emergency ACB, Over current, Reverse power, Under voltage, Under Frequency trips to be tested and adjusted if required
- ✓ Megger test of all motors prior removing and after completion to be done



Testing of Motor

- ✓ Stator to be dipped in varnish and baked. Blower impeller and casing to be cleaned and checked for cracks
- ✓ Labyrinth packing to be inspected and renewed if required
- ✓ Fan housings to be sand-blasted and coated

with 3 coats of Epoxy paint (Yard supply)

- ✓ Ensure all electrical supply point are in operational condition
- ✓ Auxiliary blower's Impeller to be dynamically balanced by shore technicians



Blower Fan in Yard Workshop

- ✓ Rounds to be taken to ensure lightings inside engine room and tanks are working properly
- ✓ Shore electrical supply meter readings to be taken and recorded on daily basis
- ✓ Echo Sounder Doppler Log to be checked and inspected

Chapter 7

Regulations, Surveys & Checks

Dry Dock Regulations

Dry Dock Surveys

Checks Before Flooding

Dry Dock Regulations

A ship is run by a ship owner, who ensures that all minimum requirements of dozens on maritime codes and conventions are properly implemented, to have an enhanced level of safety and quality.

Following are some of the important regulations pertaining to dry docking of merchant vessels:

- Two inspections of the ship's bottom are required during any 5 year period under the mandatory provisions of SOLAS I/10 where "any" 5-year period applies to all ships except oil tankers and bulk carriers subject to the enhanced survey program under resolution A.744(18) versus the 5-year "period of validity of the safety construction certificate" that resolution A.744(18) applies to determine the frequency of bottom inspections.

The 5-year "period of validity of the safety construction certificate" is the base for measuring the frequency of bottom inspections for all ships.

- Lifeboat on-load release mechanisms not complying with new International Life-Saving Appliances (LSA) Code requirements to be replaced no later than the first scheduled dry-docking of the ship after 1st July 2014 but, in any case, not later than 1st July 2019.



Lifeboat in Dry dock

As criteria for the implementation of the "Extended Dry Dock Interval", at the time of new building, the corrosion prevention system for the bottom shell has to fulfill the following requirements:

- Dry film thickness of coating for 7.5 years has to be an average of 300 µm

- Anodes (Alu./zinc) prepared for 7.5 years alternatively:
 - Impressed current system is to be installed and maintained

As criteria for the implementation of the "Extended dry-dock interval", for ships in service, the corrosion prevention system for the bottom shell has to fulfill the following requirements:

- Dry film thickness of coating for ships in service has to be a minimum of 250 µm
- Anodes (Alu/zinc) prepared for 7.5 years

Alternatively, if installed, an impressed current system is to be maintained and documented in the Planned Maintenance Scheme

Quick Note: Depending upon the condition of ship's hull, the dry dock can be extended as per the regulations. If an extension is allowed, the continuous machinery survey will take place as per the schedule and the arrangements of the same to be done accordingly by the ship and shore staff.

Dry Dock Surveys

Dry docking is mainly done to perform hull survey of the ship. Apart from the surveys, several repairs and maintenance jobs are performed in the engine room which are to be surveyed by the surveyor.



Surveyor in Dry dock

These surveys of machinery systems either fall under Continuous Machinery Survey, Annual survey, Intermediate survey, or After-repair surveys carried out in the dry dock. Below is a list of the surveys which are normally carried out on the engine room machinery when the ship is in dry dock. (Kindly note that this is not an exhaustive list and the number of surveys will depend on the

condition of individual machinery)

Survey of Main Engine:

- Continuous machinery survey of all the main engine parts, including all bearings, are generally done in the dry dock
- Surveyor might ask to remove one unit bearings and depending upon the condition, can further ask to remove other unit bearings for inspection
- If he is satisfied with a unit's crosshead bearing condition he may pass the survey for all the units without further opening any unit



Bearing Survey

- Surveyor will decide (in consent with the chief engineer) whether the bearings are in reusable condition or not
- Surveyor will require all the readings and calibration of various parts which are either repaired, renewed, or overhauled
- If surveyor is not present for inspection, he may allow to proceed with the completion of the job after the chief engineer carries out an inspection accompanied by proper photo proof and logged reports

Survey of Auxiliary Engine:

- When the auxiliary engine d'carb or any major overhauling is performed, the surveyor will check the condition of all opened parts
- Surveyor will decide weather the part under d'carb is to be renewed or reused
- All the calibration and readings of various parts are to be made available to the surveyor
- He will check the condition of the crankshaft, gears and other important parts of

the engine



Surveyor Checking AE crankcase

- Surveyor will check the condition of the main and crankpin bearings and accordingly, decide to reuse or replace the bearings
- After completion of d'carb, he will check for running tests, alarms, and trips of the generator engine

Survey of Boiler:

- Boiler survey of any major shell repair is performed by the surveyor
- After overhauling boiler mountings, a survey of all the mountings is carried out along with

that of the safety valves



Boiler Drum Survey

- Internal survey of boiler drum including that of water and steam drum is done
- Survey of boiler burner assembly is carried out
- Survey of alarms and trips of the boiler including emergency shutdown from remote place (ECR) is carried out

Survey of Other Auxiliary Machinery and Systems:

- CMS of various pumps present in the engine room



Survey of Pumps



Plate type cooler Survey

- CMS of all the other auxiliary machinery present in the engine room
- Annual and intermediate survey of various machinery and systems coinciding with dry dock schedule
- Surveys of fire line and bunker line, including pressure testing of the line
- Survey of ballast line and system
- CMS of heat exchanger including air cooler, lube oil cooler, Jacket cooling water cooler, oil steam heater etc.
- If any sea water pipeline is repaired, survey for the same is done
- Survey of quick closing valves, remote stop of E/R fans and pumps is carried out
- Survey of engine room funnel flaps and remote operated water tight doors is also done
- General condition of hull and engine room bulkhead is checked
- General condition of engine room bottom plating, railings, bulkheads, emergency escape routes etc. is checked

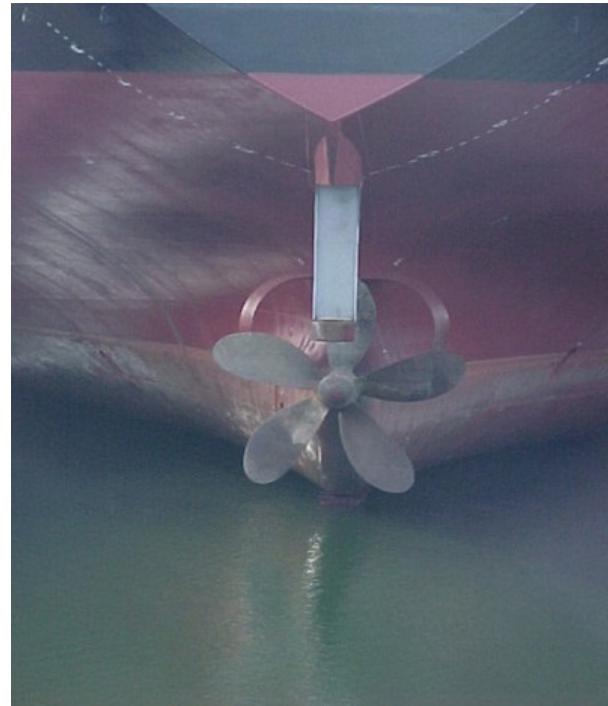
- Survey of fuel and water tanks is performed, especially when repaired with hot work
- Survey of Main and emergency air bottles is also carried out
- Survey of pressure vessels such as calorifier or hydrophore is done, if any repair work is carried out on the shell
- LSA and FFA systems installed in the engine room are checked, including means to isolate fuel supply and air to the engine room

Quick Note for 2nd Engineer: It is the duty of the 2nd engineer to ensure all the survey items are ready for inspection as per the schedule. All the readings, records and photographs must be taken regularly as per the requirement of the surveyor and for attachment as proof of record in the dry dock maintenance file.

Quick Note for Chief Engineer: The chief engineer should coordinate with the surveyor for scheduling the survey of various machinery systems and for guiding the 2nd engineer to perform maintenance procedures as per the survey schedule. If the surveyor is not available, he might approve the job completion in consent with the surveyor by providing enough records and photo proofs.

Checks Before Flooding

As much important it is to check the conditions required for entering a dry dock, equally important it is to consider the checks required before the dock is flooded and the ship is taken out of the dry dock.



Flooding the Dock

It is extremely important to maintain a checklist of

things and procedures to be carried out before undocking to avoid missing any vital step which can lead to delay in undocking or unfortunate accident.

Following things must be checked by a responsible engineer/ deck officer before water is filled up in the dock:

- All departments in-charge to confirm that repairs assigned under their departments are completed successfully followed by tests and surveys
- Check rudder plug and vent. Also check if the anodes are fitted back on the rudder



Rudder Anodes

- Check Impressed Current Cathodic Protection System (ICCP) anodes are fitted in position and the cover is removed
- Check anodes are fitted properly on the hull and the cover is removed (If ICCP is not installed)
- Check all external connections for shore water supply, sewage disposal pipe etc. are removed



Fore peak tank drain hole

- Check if all the plugs of double bottom tanks' are secured
- Check if all sea inlets and sea chest gratings

are fitted

- Check echo sounder and logs are fitted and their covers removed
- Check if the propeller and rudder are clear from any obstruction
- Check inside the ship if all repaired overboard valves are in place



New Overboard valve in place

- Check the area near stern tube propeller shaft for any kind of leakages
- The cables for ICCP anode fixed in the hull are carried into the engine room via water

tight ducts. Ensure no water leakage is there and the duct manhole door opening in the engine room is shut

- Secure any moving item inside the engine room
- Check soundings of all tanks and match them with the value that is obtained prior entering the dry dock
- Ensure emergency generator is in ready condition to start manually



Emergency Generator

- If there is any load shifting inside the engine room, which can lead to change in stability, inform about it to the dock master

- Go through the checklist again and the satisfactory checklist is to be finally signed by the master
- Master must sign the authority for flooding certificate
- Once dry dock flooding is in process, a responsible engineer should go to the bow thruster and steering gear room to check the water tightness if any repair is performed on these machinery



BT motor coupling and BT Tunnel

- When dock flooding reaches the overboard valve level, stop the process and check valves and stern tube for leakages

- Shore power cables will be removed once the cooling water is available for suction in the generator system
- If required, use emergency generator power before starting the main generator
- Instructions must be given to all crew members to stay vigilant while undocking. They must continuously keep checking the water tightness of the engine room throughout the process
- If crew member finds any kind of water leakage in the engine room, same must be informed immediately to the chief officer or department in-charge as he/she will ask the dock master to stop flooding immediately

After the completion of the dry dock, the ship is re-floated and thorough sea trials are carried out.

Quick Note: While dock flooding is performed, all the sea chests in the engine room must be purged i.e. vent cock on the top cover of the chests to be kept open. Once the water starts coming inside the sea chest, shut the vent.

Chapter 8

Sea Trials

Initiating Sea Trials

Sea Trial of Main Engine

Sea Trial of Pumps

Sea Trial of Bow Thruster

Sea Trial of Stern Tube System

Sea Trial- Miscellaneous System

Sea trial of the ship is done post-dry dock to ensure that all the major repair works that were carried out on various systems, especially main engine, generators, sea water system etc. are successful and there is no breakdown of any machinery.



Going for sea Trials from Dock

Another important reason for which sea trial is carried out is to check the water tightness integrity of the ship.

In this chapter, we will discuss the importance of the sea trial and the process to start and complete the same with the help of ship staff and shore technicians.

Initiating Sea Trials

The sea trial is a combined effort of various shore technicians, who are involved in maintenance and repair work of the ship during the dry dock.



Workshop representative in Sea Trial

Before starting any major maintenance on machinery such as main engine, sea water system etc., a contract is made with the shore workshop, which includes the assistance of expert technicians when the ship is re-floated to ensure that the maintenance work done on the machinery systems

are up to required standards and no further trouble is experienced.

It is the duty of the ship superintendent and the owner representative to ensure that the contract with the shore workshop comes with a clause of sea trials, which includes an expert professional, who represents the shore workshop and makes sure that the ship and the owner representative are satisfied by the job done.

What Happens in Sea Trials?

In a sea trial, the ship staff along with the shore representatives do a complete inspection of those machinery systems on which repair jobs were performed during the dry dock.

Sea trial plays a very important role in discovering problems with the vessels machinery and instrumentation systems.

The sea trial are done in open water, wherein all the machinery systems of the ship are operated for a longer duration to ensure that no trouble is associated with any of the repaired parts

Sea Trial of the Main Engine

In dry dock, the main engine undergoes various repairs and maintenance procedures and hence during sea trials, one of the shore personnel representing the main engine specialist department, comes overboard to perform the checks along with the ship's staff.



Engine Parameter in Sea Trials

As the engine starts, following inspections are usually carried out by the ship's staff and shore

representative:

- If fuel pump maintenance and repair is performed, the complete fuel pump area along with high pressure pipes are checked when the main engine is running



Fuel Pump platform

- All units combustion parameters are checked to ensure that every unit is firing correctly. If a unit is d'carbed or any major overhauling is carried out, the combustion chamber is monitored for all parameters including temperature and pressure along with abnormal noises and vibrations
- When connecting rod, crosshead, or bearings

are removed, the lube oil splash is checked by starting the lube oil pump with crankcase doors open. This is done before hand, with main engine in stop position

- All main engine parameters are noted down and thorough inspection is carried out while the engine is in running condition
- Turbocharger speed, noise and vibrations are monitored along with lube oil and cooling water temperatures
- The exhaust gas in and out temperatures are also monitored and compared with the values given in the manual for that particular speed
- Engine cylinder lubrication is also monitored
- Crank case and under piston temperatures are continuously monitored
- The engine RPM and load are continuously monitored and compared with load/ RPM graph at given draught and weather condition

All main engine parameters are recorded and filed in sea trial report.

Sea Trial of Pumps

All the pumps including lube oil, sea water, ballast water etc. which were overhauled or repaired in dry dock are also tested in sea trials



Pump under test

While testing these pumps, the shore representative is present along with the chief engineer, who is assisted by the electrical officer.

Following procedure is done for testing pumps in sea trials:

- The pump which needs to be taken under

trial is first checked for the power supply

- Ship staff is well informed of the pump trial
- All the valves in the inlet and outlet line of the pump are then opened
- If required, purging is done to avoid dry running of the pump
- The motor is properly secured and earthed
- The motor is started for few seconds to check the sound, vibration and starting current and then the pump is stopped
- Once the sound and vibrations are within limits, the pump is started again for checking suction and discharge pressures
- The temperature of the pump's motor is continuously monitored by the temperature gun
- Some pumps in the engine room are connected to the motor using belts. These belts must be checked to avoid excessive or lack of tension

Sea Trial of Bow Thruster

The bow thrusters are tried out once the ship is well submerged in water. Normally when the ship is out of the dry dock, the draught of the ship is still very less to allow submerging of bow thruster propellers inside the water.



Bow Thruster operating lever

Hence ballasting is done to ensure BT system is completely submerged under water and then trials are performed following the below mentioned steps:

- Ensure enough power is available onboard

for testing else start the generators.

- Switch on the hydraulic pump 15 minutes prior to operating the BT
- Start BT and check the current and voltage of BT motor for a certain pitch and compare it with the rated value given in the manual
- Check for any oil leakages
- One responsible officer must be present in the BT room to check BT motor for noise and vibrations
- The temperature of the motor must be continuously monitored by the temperature gun
- Complete round of BT room bilges is taken for any water ingress. Monitor and note the level of oil at regular interval of time
- Compare the actual and the ordered pitch while operating the BT
- The operation of BT is performed from both remote (Bridge) and local (Engine control room) positions

Sea Trial of Stern Tube

Repairing work of the stern tube system mainly includes renewal of seals, liners etc. Once the ship is out of the dock and the main engine starts running, the stern tube system is also inspected following the below mentioned steps:

- Check the level of oil in the header tanks
- Check the temperature of stern tube when the propeller shaft is rotating
- Check for any water ingress
- Check for any oil leakages by monitoring the oil level and stern oil tank soundings
- Check oil spill at the aft part visually

Quick Note: Lube oil water content test to be performed by responsible engineer officer before and after performing the sea trial of the stern tube. The value comparison of the tests can be used to ensure no water ingress has taken place.

Sea Trial- Miscellaneous Jobs

- Sea chests are checked for leakages from the cover
- If any major pipe line repair is done in the sea water system, same is checked for pressure and leakage



Steering gear system

- Steering gear system is checked for operation and leakage of oil. Water leakage from rudder carrier side is also checked
- Fresh water generator (FWG) is started and

checked for proper operation if the condenser is removed for cleaning in the dry dock

- Pressure vessels like air bottle, hydrophore, hot water calorifier etc. are tested after approval of surveyor



Air bottles

- If major overhauling of sea water cooled air compressor is done, the capacity test of the compressor is performed by filling the empty air bottle in the required time interval
- Air conditioning system is also checked for operation and leakage in the sea water side
- All other job which are to be checked at sea

are carried out

Once sea trials are completed and all other necessary checks are made, only then the ship is allowed to sail and go back to its normal routine.

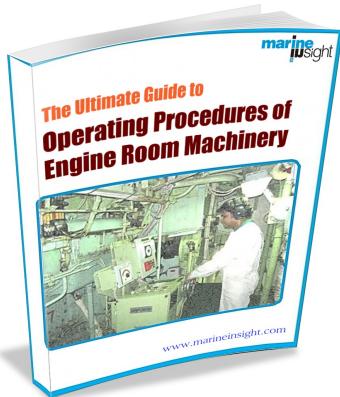
A well planned and coordinated dry docking operation allows maintenance of not only those systems and parts which are due for repair/renewal but also of the ones that might need attention in near future.

Dry docking is definitely a tedious task, especially for the ship's crew members. With a number of jobs to be carried out simultaneously, there are high chances of missing out a few important steps/procedures during planning or executing the dry docking operation.

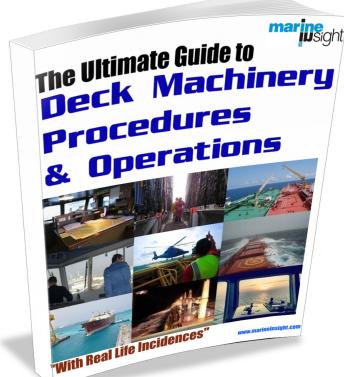
Following a systematic approach by making use of checklists, adhering to the safety guidelines, and preparing all the necessary records/reports is the key to have a successful dry dock with least errors and utmost safety.

For any questions/doubts regarding dry dock procedures, contact us at info@marineinsight.com

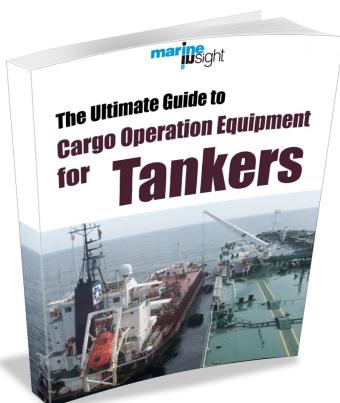
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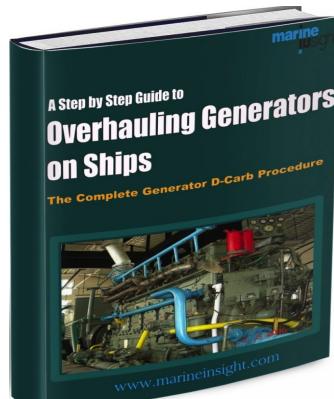
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