CONTENTS

DIESEL ALTERNATORS AND AUXILIARY MACHINERY

The following Technical Procedures apply to all vessels owned or managed by the Company.

1. AUXILIARY DIESELS

The engines used to drive the generators/alternators are the vessels primary source of power. This shall be always taken into account in establishing priorities with regard to the operation, maintenance, and ordering of spares. It is essential that the manufacturer's instructions are closely followed with regard to maintenance and overhaul of critical components such as connecting rods, bottom end bolts, shell bearings, pistons. The BE bolts must be renewed at the recommended intervals, 20,000 hrs, to avoid fatigue failure due to prolonged operating hours. All maintenance, overhauls and repairs shall be fully and accurately recorded.

CE must plan generator maintenance schedule in such a way, as far as practicable, so that all generators are available during vessel's manoeuvring and cargo operation in ports. The auxiliary engines routine inspections shall be carried out at regular intervals depending on maker recommended intervals or condition monitoring if required earlier.

1.1. Engine Performance – Indicator Diagrams

Cylinder compression and firing pressures shall be taken at monthly intervals, and the units adjusted to maintain balanced performance within the manufacturers recommended limits. The company has introduced Dr Diesel an electronic performance monitoring system, should this fail vessel revert back to the equipment supplied by the engine manufacturer. Chief Engineer to ensure that the peak pressure gauge is maintained in working order.

1.2. Overspeed Trips

Over speed trips are to be tested in accordance with the engine maker's instructions, and the results recorded in the Engine Room Logbook. Any defect shall be remedied at earliest possible opportunity.

1.3. Engine Over Heating

Should overheating occur in trunk piston engine, be it on the Cooling water side or Oil side, change over to a standby unit and stop the engine.

1.4. Diesel Engine Crankcase Explosions

For a crankcase explosion to occur, two conditions must prevail: -

A certain mixture of hot oily mist and air in the crankcase.

A hot spot or spark caused by overheating or abnormal operation of some running part and the consequent ignition of the mixture.

Contact by the oil mist with hot running surfaces is likely to cause vaporisation of the oil droplets. A mixture of vaporised oil and air will readily explode.

1.5. Crankshaft Deflections

Auxiliary Engine crankshaft deflections shall be measured in accordance to makers guidelines which can be found in Sharepoint[1], records to be uploaded into Mespas[2] under the document tab, in the job report, and a copy placed in the Machinery Calibration File.

In each case the results obtained shall be compared against the original test-bed data and the maker's limits and recommendations referred to. Irregular readings and trends shall be communicated to the Ship Manager without delay.

1.6. Exhaust Gas Turbochargers

This instruction refers to turbochargers having a lubrication system integral with the engine it serves. Severe damage has been incurred on turbine shafts on account particulate passing the fine filter. Lubricating oil suffers from 'ageing' and aggravated by dirt contamination. Oil purification is to be maintained at optimum level. The Chief Engineer Officer shall also ensure that turbocharger lubricating oil duplex filters are regularly inspected as per maintenances schedule, if damage is observed this is to be brought to the ship managers attention

1.7. Engine Load

Only minimum number of auxiliary engines shall be run to maintain the shipboard electrical requirements. The Chief Officer shall be consulted regarding the deck requirements in port. The reduction in the number of auxiliary engines shall not only result in fuel saving but primarily in a reduction in auxiliary engine maintenance and shall allow better engine performance. In case there is a possibility of blackout engineers shall not delay the decision to shut down non-essential machinery to reduce load.

The load on the generator shall be maintained as close as possible to optimal load, low load running causes poor combustion which increases carbon build up on exhaust valves/seat and increases unnecessary wear down on generator cylinder liners and piston rings etc., this in turn can cause more serious problems which could result in a malfunction, it is also an unnecessary waste of fuel oil. Low load running shortens the life of the lubrication oil. In all case when the electrical load is less than 60% capacity for one generator, then only one generator shall be run/operated. This will ensure better

[1] W 03 / 2024
[2] W 03 / 2024

combustion from the generator in use thus assisting in reducing F.O consumption and maintenance costs.

The exception to the above shall be when vessel is on standby in readiness to manoeuvre for arrival/departure or in confined waters. Two auxiliary engines should be run on load to provide an ample supply of power to cope with any such emergency.

When not being maintained, all non-running engines should be kept in AUTO STAND BY condition to allow quick starting in cases of emergency. Regular checks should be made by an Engineer Officer to ensure that the cylinders of these engines are clear of water or fuel. Diesel engines shall be changed over regularly to ensure all engines are in working condition at its top performance all the time. Routine changeover of Generators should be done preferably in morning when the engine room is manned. However, in emergency changeover of Generators can be done at any time.

1.8. Diesel Engine Starting Air Systems

Cleanliness of diesel engine starting air systems is critical not only from the point of view of reliable operation of the machinery but also for safety considerations.

All staff need to be aware of the likely sources of oil contamination in starting air systems. Oil carry-over from the compressors and too liberal lubrication of fittings in the system are the more obvious sources.

The Chief Engineer Officer shall ensure that the following precautions are observed:
Compressed air oil-traps and air reservoirs shall be carefully and frequently drained, and automatic drains where fitted shall be checked to ensure they are correctly functioning.
Oil consumption and performance of air compressors shall be closely monitored, as not only does a loss of oil suggest a decline in efficiency, but the oil would conceivably be pumped into the compressed air system.

1.9. Shroud Rings

Experience has shown that turbocharger performance particularly on medium and high-speed engines deteriorates substantially through wear of the shroud ring ("cover ring"). This results in a significant fall-off in engine performance and rise in specific fuel consumption. The deterioration is caused by wear of the shroud ring brought about by abrasion and erosion of the metal on account of hard carbon particles entrained in the exhaust gas flow. Symptoms of shroud ring wear are dropping turbine speed and delivered air pressure, with consequent rise in cylinder exhaust temperature and, especially on medium-speed trunk-piston engines, an appreciably increased rate of fouling of the crankcase lubricating oil.

Chief Engineer Officers and Watch keepers are always to be alert for signs of shroud ring wear and to promptly arrange for its renewal once such diagnosis is confirmed.

1.10. Washing of Air Side Turbochargers

Washing of the air side of Turbochargers shall be carried out using water only, without the use of degreasers or detergents. Provided components are clean to start with, a water wash introduced to the compressor wheel at a high rate once per day will keep the air side clean.

1.11. Connecting Rod Belts

In some makes/types of diesel engines the renewal of bottom-end bolts after a specified elapsed service time is a critical requirement. Failure to comply with such a requirement can lead to a failure. Unless the manufacturer specifically states that bottom, end bolts may be re-used and specifies the conditions under which re-use is permissible.

A number of engine manufacturers require bottom-end bolts and nuts to be returned to the same 'address' in the engine from which they were originally removed and that reference marks on the nut and conrod be aligned to ensure that the correct degree of tightness be reached.

Chief Engineer Officers shall acquaint themselves and their staff with the exact manufacturer’s instructions for the machinery in their care and shall ensure that staff to whom overhauls and reassembly have been delegated, have been made aware of the manufacturer’s instructions, and that such instructions are followed to the letter. When installing new bolts, the date of their installation, month and year shall be stamped with number punches onto the head of the bolts. If the manufacturer specifies that the bolts may be reused only a specified number of times after which they must then be renewed then in addition to the date stamp, a pop-mark must be made next to the date on every occasion that the bolts are removed / refitted. This is in order to accordingly keep track of the number of occasions bolts have been slackened-off / re-torqued.

The Manufacturers specified torque level shall be implicitly followed upon re-tightening of bolts. There are a number of recorded incidents of severe damage which has been attributed to careless re-tightening.

1.12. Crankcase Inspections

The Chief Engineer Officer shall ensure close attention is paid to the following details during crankcase inspections:

Hammer-test of connecting rod and main bearing fastenings. (Note however that a fastening which might not be torqued to the correct degree of tightness might still be sufficiently tight to produce a satisfactory note when 'rung' with a hammer).

Examine all locking devices (wire, plates and/or bolts) for evidence of slackness or disturbances. Such examination is to include locking devices not only on bearing bolts, but also on lube oil pipe connections and any other crankcase fittings. Wherever possible these security fastenings/locking devices are to be felt by hand.

On completion of the first crankcase inspection, all such bearing fastenings are to be clearly marked with white out in such a manner that any subsequent slackening-off of the fastenings will be clearly evident upon inspection at the time of the following crankcase inspection or whenever individual units are accessed for overhaul.

The surfaces to be marked must be entirely oil-free before marking with white out. Whenever the fastenings have been disturbed during unit overhauls, bearing inspections, the original position marks are to be removed and fresh ones applied after re-torqueing.

Search for evidence of abnormal running conditions such as signs of bearing failure white metal foil in crankcase, metal squeezed out of bearings, overheating, and also for fretting of

1.13. Fretting Damage

Bearings and bearing housings of particularly medium and high-speed diesel engines are prone to damage caused by fretting. Fretting occurs when there is relative movement between two contact surfaces and it results in either:

Metal being removed from one or both surfaces, due to the "chattering" of the parts. This typically occurs on the butt-faces of bearing housings of connecting-rod assemblies, and on the mating-faces of main bearing keeps and the bedplate. It will be appreciated that metal loss in this critical area of a bearing assembly is likely to have serious consequences for the bearing itself.

Transference of metal from the one surface to the other. This condition is most often encountered between the back of a bearing shell and the inside of a bearing housing. It results in metal being plucked from the one component and deposited on the opposite surface, leaving craters in the one and peaks on the other, as if electrolytic transfer had taken place. This phenomenon interferes with the correct nip of the bearing, and together with developing irregular support of the bearing shell, eventually leads to bearing failure.

Rectification of fretting damage is, in most cases, very costly if possible at all. Connecting rod bearing housings may be 're-sized' (i.e. machining-off the butt face to re-establish perfect surfaces then re-boring the housing to standard - or over-size dimensions). A serrated junction between rod and cap would be virtually impossible to recondition if the damage was severe.

Repair of fretting damage on the main bearing housing would most probably entail removal of the crankshaft and the line-boring of the bedplate.

To avoid fretting damage the Chief Engineer Officer shall ensure that the following are observed, and that Manufacturers recommendations are followed strictly, when reassembling the engine or components after overhaul.

a. The parts must be immaculately clean on reassembly. For example, foreign bodies trapped between bearing shell and housing, or between machines faces, introduces unwanted clearances and will permit movement to take place.

b. Mating faces must be undamaged. For example, A burr on a serration will not permit the two surfaces to make perfect contact and movement will eventually ensue.

c. Bolts must be correctly torqued, in the proper sequence to the stipulated level. Uneven tightening could cause deformation of the parts and/or overload of one or more of the bolts which would then stretch. Stretched bolts become slack and this in turn permits relative movement between the parts. Signs of fretting is to be reported to the Ship Manager.

1.14. Lubricating Oil

Since the generator engines are generally 4-stroke trunk piston engines, there are more chances of sump lube oil getting contaminated by fuel oil and the engine cooling fresh water. Oil cleaning arrangement such as filters or similar equipment and centrifuges (if provided) shall be kept in use as practicable whilst the engine running on load. Renewal or reconditioning of crankcase oil is to be based upon the results of oil sample analyses. Oil samples are to be drawn and submitted for analysis at regular intervals as stipulated in the planned maintenance programme. Topping up for normal consumption losses provides for oil freshening and provided that the engine is maintained in optimal running condition and the oil is regularly run through the purifier the oil should remain fit for many hundreds of running hours.

1.15. Fuel Oil for Generator Use

On modern vessels, generators are designed to burn HFO of same grade as the main engine, blended fuels and LSMGO. Maker recommended maintenance schedules shall be adhered to.

2. PURIFIERS/SEPARATOR

The Chief Engineer Officer shall ensure that all staff are fully conversant with the manufacturer's recommended design parameters and operation of the various equipment within the system. The current drawn by purifier motor, vibrations, strength of bowl opening, correct operation of operating and sealing waterlines and valves are to be observed closely by watch keeping engineering officer and purifier is to be stopped immediately in case any abnormality is noticed.

2.1. Purifier Output Rates

The correct feed rate of the fuel centrifuges depends on the daily consumption and on the density/contaminants of the fuel. The optimum feed rate will ensure maximum retention time within the purifier and better-quality of fuel at the fuel rail. Flow rate of fuel through the purifiers shall be controlled as minimum (less than 30% of nominal capacity) for catching catalysts and foreign materials as much as possible.

However, the centrifugal purifier can only remove solid contaminants that are heavier than both fuel and water. Contaminants that are lighter than fuel cannot be removed by a centrifuge. An example is colloidal solids, which are suspended solids commonly found in seawater and have a specific gravity lighter than fuel. It is important to ensure the engine filters are in optimal condition to remove these other contaminants.

Example: the ship's fuel consumption is 18 tonnes/day, this should also be the throughput rate of the separator, or in terms of litres per hour:

$$\frac{18 \times 1\,000 \times 0.98}{24} = 735$$

The separation temperature of the Fuel Oil should not be allowed to drop below 98°C this allows for removal of catalytic fines. The recommended temperature for purification of Lubrication Oil is generally around 85°C. Ensure that the heaters are performing efficiently and being correctly controlled, the higher operating temperatures and contaminants in the oils hasten fouling of heating spaces.

Note: It is common knowledge that the lower the throughput rate of the separator (purifier or clarifier) the better the machine is able to perform its function of separation. With the advent of lower-quality fuel, which embraces all grades from Gas oil through Blended Fuel to Heavy Fuel oil, thorough separation has become essential if premature wear and consequential mechanical failure is to be averted.

Fuel oil with a water content greater than 0.20% and/or combined aluminium silicon content greater than 20 mg/kg must be efficiently purified to ensure that the levels injected to the engine are below the recommended levels. Hard aluminium silicate is used in the catalytic cracking process in the refineries. Carbon is found in increasing proportions in our bunker fuel. These two contaminants amongst a number of others, are largely responsible for the fuel-related engine problems.

Both contaminants are responsible for high piston ring and liner wear rates recorded on most of our engines. Aluminium Silicate causes the extremely rapid wear of the turbocharger nozzle and shroud-rings. Carbon is the cause of filter clogging/rupture and fouling of crankcase oil.

2.2. Inspection of the Fuel Quality Before and After the Purifier

Analysis of representative samples taken from key locations will give an indication of how well the entire fuel pre-treatment system is operating and recommendations issued by the laboratory based on the findings should be understood and closely followed. The sample taken for the analysis should be taken carefully as it cannot be emphasised too strongly that the results are rendered meaningless unless they from a representative sample.

Testing of fuel quality before and after purifier shall be done whenever and independent analysis recommends further treatment.

While taking the please ensure that both samples before and after the purifier are taken simultaneously or promptly one after another. Taking the two samples at significantly different time will not reflect correct functioning of fuel system in the test result.

While landing the Fuel System Check Sample the chief engineer shall make sure that following paperwork are completed and enclosed with the sample:

a. The Laboratory sampling forms are completed
b. A copy of the BDN for the fuel oil in use
c. A copy of the original lab analysis report for the fuel in use
d. Indicate bunker date, bunker port, supplier name, supplying barge and quantity.

The bunker sample shall be tested every time ship receives bunker.

2.3. Draining of Fuel Settling and Service Tanks

Operationally the effectiveness of separation in the settling / storage tank is determined by the viscosity of the fuel bunkered and the temperature at which the tank is maintained. The greater the viscosity the slower is the rate of settling. By heating the tank, the viscosity is reduced and it is usual to maintain a temperature of 50°C. Once every watch, all the fuel oil settling and service tanks shall be drained.

Only fully synthetic lubricating oil of the appropriate grade (as opposed to conventional mineral based oils) shall be used as the gear case lubricant for centrifuges.

2.4. Centrifugal Purifier / Separator Bowls

Although centrifuge bowls are manufactured in stainless steel, if left standing in a dirty condition corrosion can occur. Aggressive salts which may have accumulated in the bowl during the separation process could cause pitting of the machined surfaces. It must be stressed that purifier/separators must be cleaned at frequent intervals as described by the manufacturer

2.4.1. Cleaning and Damage

Dismantling and re-assembly of separators after cleaning shall be carried out under the supervision of the Watch keeping Engineer, the afore mentioned Engineer shall be satisfied that the equipment has been correctly assembled and is ready to be restarted.

It is recommended that before the bowl hood is closed, the bowl be spun by hand. The hood should then be closed and re-opened to prove that the bowl remains spinning without having been fouled by the hood. Disc stacks must be assembled in correct order. On most models, the discs are consecutively numbered for this purpose. Clamping rings are to be re-tightened to their corresponding marks. Always consult the Manufacturer's Instructions on dismantling and re-assembly.

2.5. Electric Fuel and Lube Oil Heaters

Electric heaters are often sent ashore for repair in a deplorable state. The carbon build-up in the elements is so severe that the elements over-heat, distort their housing tubes and burn out. Due to distorted housings, the elements become jammed in them, and the housing tubes have to be destroyed and replacements made thereafter.

The high carbon content of the conventional fuels and consequently the lube oil contamination contributes significantly to this condition, but it can be alleviated in at least three ways: -

a. The heaters must never be switched "on" without having a positive flow of oil across the elements.

b. The overhaul interval should be set at four months and thereafter fine-tuned' according to service experience.

c. Oil flow through the heaters must be maintained for a period of about 5 minutes after they have been switched off to allow the heater elements to cool off.

2.6. Safety Precautions on Liquid Heaters

The latent heat from the heater elements after shut down can cause a build-up of pressure within the heater that is sufficient to lift the relief valve. To prevent serious accident the relief valve outlet must be connected to a drain pipe of suitable size to prevent blockage.

3. STEAM GENERATING PLANT

3.1. Auxiliary Boiler

3.1.1. Precautions Before Lighting Up Boiler

The Engineer Officer in charge of this process shall ensure that procedural checks are carried out. These include but not limited to:

a. That all system valves and boiler mountings are operational and correctly set.

b. That the boiler is filled to the requisite level to allow for expansion with correctly dosed water and no leakage is evident.

c. That the spaces and flue gas passage as uncontaminated.

d. That the burner casing and gas register doors have been correctly fitted.

e. That oil burners and associated system equipment and valves are correctly assembled and set in accordance with the manufacturer instructions.

f. That furnaces have been sufficiently purged (a minimum of five full changes of furnace air).

3.1.2. Raising Steam

Purging

The furnace should be purged before firing. Should the burner fail to ignite, or flame failure occur, then it is essential that the furnace is visually examined for unburned fuel and purged again before any attempt is made to re-ignite the burner.

Manual Firing

If manual firing has to be resorted to, then the procedure shall be in accordance with the manufacturer's instructions and as agreed with the Technical Department of the management office.

Firing

The procedure for firing shall be in accordance with manufacturer's instructions. Heating shall be gradual and uniform, starting with one burner using. A period of six hours should normally be allowed for raising steam, but in cases where repairs to refractory, or parts subject to pressure, have been carried out the period should be extended to 24 hours.

The initial firing after a repair or a long gap when boiler is cold, the engineers shall control the warming through process by stopping and starting the burner, in order to ensure uniform temperature rise throughout the boiler at a slow rate to avoid thermal stress on boiler parts until the working temperature is reached.

If continuous operation on 'Low Flame' results in no further increase in boiler temperature, increase the burner firing rate and continue hand controlling the temperature rise until the working temperature is reached.

Air Venting

Throughout the steam raising process, provision shall be made for venting all air from the boiler. This should be done solely by means of a designated air release cock or, if this is not fitted, by means of the steam pressure gauge cock.

3.1.3. Boilers in Operation

Use of Boiler Gauge Glasses

Boiler water is to be kept within the upper and lower limits at all times. If water level disappears from either the top or the bottom of the glass and does not return immediately, then all burners are to be shut off until the water level has been restored in the gauge glass. Any such loss of water must be recorded in the Engine Log Book and reported to the Chief Engineer.

Whenever the water level indicated is suspect, it is essential that the remote water level indications are not used and the readings from the water level gauge glass shall be relied upon.

Water level gauge glasses are to be "blown down" as per maker approved procedure at least once every day or whenever the water level indication is suspect.

3.1.4. Testing of Boiler Water, Controls, Regulators, Alarms and Trips

All boiler controls, regulators, alarms and trips shall be tested regularly in accordance with the applicable Planned Maintenance System and maker's recommendations. Each test shall be recorded with the signature of the Engineer Officer who conducted the test. Boiler level alarms or trip defects shall be rectified immediately. The boiler shall not be operated with any safeguards inoperative unless the office has been informed and only under the supervision of the Chief Engineer.

The Low Water Level Alarm Mechanical Float chamber shall be drained regularly to ensure effective operation. Otherwise deposit of slurry sludge material will interfere with the operation of float and ultimately the float will get stuck rendering low water level alarm inoperative.

The appropriate Ship Manager in the office shall be advised of details of any defects, remedial measures taken, and confirmation of satisfactory re-tests which are also to be recorded in the Engine Room Log Book.

3.1.5. Boiler Water Tests and Treatment

Water in the boilers together with sample of condensate water shall be tested every 3 days. Testing shall be carried out in accordance with procedures laid down

by the suppliers of the water treatment chemicals. Completion of the test shall be recorded in Engine Room logbook and the full results entered on the appropriate computerised tracking program which will be sent monthly for evaluation. Test results indicating contamination or loss of chemical reserve shall be investigated. In case of water being topped up in the system, chemicals shall be dosed accordingly so that appropriate water conditions are always maintained. Any large deviations in the condition report should be advised immediately to the appropriate the Ship Manager.

Arrangement shall be made by head office for on board assessment of boiler water condition by shore service technician of the chemical maker, at an interval of 6 months, at a convenient port.

3.1.6. Boiler Blow Down

Boilers are to be blown down at least once per day dependent upon the frequency required to control the level of dissolved solids contained in the boiler water. Ideally blow down should be carried out under light load conditions, the actual quantity being recorded in the ER log book and the boiler water report forms. Blowing down shall be carried out irrespective of the salinity or chemical reserve readings. Surface blow down shall also be carried once every day to remove scum from the boiler.

3.1.7. Boiler Maintenance at Sea

The maintenance of burners and testing of alarms and trips shall be carried out at sea when auxiliary boiler is generally not used, unless there are some special operation requirements. The boiler shall also be used at sea in case of slow steaming or where the ambient temperature is too low or the exhaust gas boiler is heavily fouled and not being able to cope up with the steam demand.

3.1.8. Cleaning of Gas Side Surfaces

During cargo operations, in the interests of safety, and in particular to avoid the possible emission of sparks, the use of soot blowers or other devices for cleaning the gas side surfaces is prohibited.

3.1.9. Safety Precautions During Operation, Maintenance and Cleaning

During the operation, cleaning and maintenance of boilers safe working practices are of paramount importance. Qualified personnel are to be familiar with correct operational procedures and manufacturer’s recommendations.

Where these operations involve personnel entering the gas or water spaces, the full safety precautions outlined in the Company Safety and Environmental Manual

are to be adhered to. In particular, respirators, protective clothing, and low voltage lamps are to be used.

3.1.10. Spark and Smoke Emissions

You shall be aware that under various regulations applicable to the area your vessel is in, it may be an offence to emit dark smoke. The Master shall therefore request appropriate detailed information from the local agent concerning the area emission regulations and pass the information to the Chief Engineer.

Careful consideration shall be given to the location and operational circumstance of the vessel before soot blowing. Permission shall be sought from the bridge before soot blowing. Soot blowing shall not be carried out when gas freeing cargo tanks, when bunkering or transferring fuel or when working cargo alongside a terminal or during ship to ship transfer. In order to ensure that sparks are not generated from the funnel flame arrestors and screens must be regularly checked and replaced when required. A high back pressure can be generated if these devices become blocked. Flame screens must not be painted.

Emissions of smokes, soot and exhaust gases such as COx, NOx and SOx (Carbon, nitrogen and sulphur) shall be minimised by controlled running, systematic maintenance and inspection routines of machinery, boilers and funnel. The emissions of exhaust gases contribute to pollution and environmental problems such as acidification and global warming. Everybody on board ships and office shall aim to focus on control and reduction of the emission of these harmful gases.

Special care shall be exercised during port stays and when starting main and auxiliary engines and lighting boilers. Port authorities and regional authorities around the world are increasing degrees regulating emissions from ships. Monitoring the emissions of your ship carefully will contribute positively to our environmental policy. Black smoke has the potential to severely harm that image.

3.1.11. General Safety

Boiler Safety Valves shall be kept securely locked to prevent unauthorised interference or adjustment.

When de-pressurising or emptying a boiler the air cocks shall be left OPEN to prevent the formation of a vacuum.

If the burner flame of boiler is extinguished, the fuel supply shall be shut-off and the furnace purged for at least five minutes before an attempt is made to re-ignite the burner.

No work shall be undertaken on any burner or ancillary equipment unless that equipment has been made safe.

3.1.12. Emergency Firing

In case there is need to fire the boiler under emergency procedure by means of external aid, the maker's instruction manual shall be strictly followed. Head Office should be informed for permission before carrying out the operation. A thorough risk assessment should be carried out and operation should be carried out under the supervision of senior experienced engineer.

3.2. Composite Boiler / Exhaust Gas Economiser

3.2.1. General

Chief Engineer shall be responsible to ensure that all members of the Engine Room Staff are familiar with the procedures for safe operation and maintenance of the exhaust gas boiler/economisers. Principles of safe operation, such as ensuring that valves and mountings are operational and correctly set, and the necessity to warm through and cool down in a gradual manner are similar to those detailed previously for oil fired boilers. As before, the manufacturers recommendations concerning operations shall always be followed.

3.2.2. Soot Fires in Boilers and Economisers

Soot fires in exhaust gas fired boilers and economisers are extremely dangerous, catastrophic and can seriously jeopardise the safety of the vessel. Ship's staff shall be made aware of the dangers and methods of prevention during HSQE monthly meeting.

Soot-fire accidents in exhaust gas economizers (EGE) represent a major risk due to the potential damage. Various factors such as heat transfer, soot deposit, soot calorific value, spark load, and flue gas velocity contribute to the start of a soot-fire. The rise in soot fires in recent times is related to the general poorer fuel quality and often linked to a specific low-grade bunker. The increasing use of low-grade fuel and slow steaming results in higher soot levels. If the cleaning intervals are not adjusted accordingly this will increase the soot fire risk. Such a fire may develop in three steps:

a. Soot burning & heat accumulation
b. Steam build-up, steam blockage, and loss of heat exchange
c. High temperature oxidation of surfaces and meltdown of the EGE.

It is therefore imperative that tubes are maintained in a clean condition by the effective use of soot blowers. In particular, following periods of slow running or manoeuvring for extended periods, it is essential that soot blowing operations are

carried out prior to an increase in power, or in the case of shutting down an engine.

It is also worth noting that the boiler water circulation pump is to be started well in advance of start-up of the main engine, and not stopped for at least 2 to 3 hours after the main engine has been shut down, in order to ensure adequate cooling of the tubes.

3.2.3. Boiler Cleanliness

3.2.3.1. Soot Blowing

The heat transfer surfaces shall be kept clean whilst the boiler is in use by the use of soot blowers. The Ship's Staff shall familiarise themselves thoroughly with the correct operation and maintenance of the soot blowing equipment.

3.2.3.2. Water Washing

In order to ensure that the boiler/economizer on company vessels are working at optimum efficiency/maximum steam production it is imperative that the fire sides are washed down in intervals not exceeding 3 months using fresh water from the domestic system. Soot blowing will remove dry deposits from the tube banks but for heavier accumulations do require water washing. Before carrying out this procedure please ensure to read makers instructions for ship specific guidance.

Water washing Procedure

1. Shut down boiler and allow unit to cool.
2. Water wash using a hand-held hose or lance.
3. If fouling is severe and deposits are difficult to remove, it may be necessary to carry out a second wash

CAUTION: Prior to commencement of water washing ensure all drains etc. are clear and that precautions have been taken to avoid water entering turbochargers and the main engine. In particular, respirators, protective clothing, and low voltage lamps are to be used.
Upon completion of water washing, it is essential that the economiser tube bank be closely examined for any remaining soot deposits. Close up examination from within the economiser casing is required. The possibility of the soot fire increases after washing due to any remaining cold wet soot deposits, and also sparks being emitted from the funnel.

Precautions are to be taken, mooring ropes protected etc., and fire-fighting equipment is to be on standby.

Depending on vessel, boiler washings should be collected in either the Soot Collection Tank or Drums using the cascade method. This will allow the soot to precipitate into the drums, the remaining water is then be decanted into one of the sludge retention tanks for disposal (Evaporation in the Incinerator Waste Oil tank or to a Shore reception facility). It is important to make a record of this process in the Oil Record Book (ORB) using the correct code. If the maintenance interval above is followed it will ensure minimum waste water and soot production.

At no stage should the cascaded water be disposed of to the bilge holding tank as the fine soot particles will interfere with the operation of the Oily Water Separator.

The solid soot residues should be collected and either discharged to a shore facility as soot or burnt in the Incinerator and disposed of as ash to a shore reception facility. Whichever method of disposal is used, it must be must be recorded in the Garbage Record Book (GRB) as “operational waste”.

NOTE: It is important that all the process along with waste generated/disposed of is recorded in the Engine Room Log Book

3.2.4. Ship Specific Procedures

Vessels are to generate a document with ship specific procedures for the below.

Normal operation of boiler on high sulphur fuels

- Normal operations of boiler on LSMGO/FO
- Emergency operations of boiler
- Soot blowing procedures
- Economiser washing NB Include the temperature of the economiser space before entry, the tube plate must not be more than 60degC, the steam pressure must be ZERO. At no time must a boiler be entered if there is any pressure on the steam drum.
- Control of washings and soot collection,

3.2.5. Dry Running

The practice of operating an exhaust gas boiler without circulation through the tubes should be avoided except in emergency situations. The office should be duly informed.

The following normal dry running procedures must be adhered to:

a. The engine exhaust gas temperature must be no higher than the expected maximum.

b. The period of dry running must be as short as possible.

c. Prior to dry running the tube banks must be cleaned to remove all traces of soot and other accumulations.

d. Cleaning by soot blowing must continue throughout the dry running period with at least the same frequency as for normal operation.

e. The tube bank must be drained and vented.

f. Monitoring of inlet and outlet gas temperatures is important to ensure no sudden rise occurs. Temperature excursions may indicate the presence of a soot fire.

Read instruction manual section before operating the equipment in a dry condition.

4. FRESH WATER GENERATOR

The Fresh Water Generator shall be maintained in good condition to facilitate production at optimum capacity. The generator shall not run under capacity and neither shall be stretched to maximum capacity. Fresh water Generator shall not be run in coastal / harbour water and with the aid of steam at any time. Any need to do so should be consulted with Office.

Attention must be paid to maintain the parameters of the fresh water generator at optimum and thus increase the efficiency of production. The shell temperature shall be maintained about 50 to 55 °C to avoid heavy salt deposit on the Evaporator tubes / plates and to maintain internal seals and their bonding in good condition. The deviation in operating parameters shall be investigated and analysed to eliminate the root cause. To avoid heavy deposit on the plates/tubes metered dosing of approved chemicals is highly recommended.

The fresh water generator daily production is to be logged. In vessel where Distilled Water Tank is provided, the cooling water and boiler water shall be used from this tank. In absence of Distilled water tank, one of the fresh water tanks should be dedicated for filling fresh water generator output and mixing with shore water shall be avoided as far as practicable.

Equipment for sterilization for drinking water shall be maintained in good working condition.

Potable water tanks are to be emptied for inspection and maintenance as specified in the vessel's planned maintenance system. They are to be thoroughly scrubbed, flushed out and the entire system disinfected with chlorine as described in the International Medical Guide for Ships or the UK Ship Captain's Medical Guide.

Every vessel shall carry designated hoses for taking on potable water. They are to be carefully stowed and labelled "Potable Water Use Only." Care must be taken to ensure that these hoses are kept clean and are kept free from any contamination.

Refer to Fleet Procedure Manual Section 15.2 Chapter 6, regarding the management of Fresh and Drinking water aboard.

5. WATER TESTING

Chemical dosing of Boiler water and engine cooling water shall be carried out and must be sampled frequently. The record of testing and dosing shall be maintained in separate log. Once every 6 month the company supplying the chemicals shall carry out and independent analysis in a convenient port

6. RUDDER, STEERING AND TELEMOTOR GEAR

6.1. Steering Gear

The ship steering and Auto Pilot systems include many parts and types of equipment and may widely vary from vessel to vessel. Master and Chief Engineer to verify maker's instruction manual and make a ship specific operational procedures & maintenance based on the guidelines given.

The Steering Gear and Auto pilot system shall be fully operational at all times. Regular preventive maintenance as per PMS and tests shall be carried out to avoid break down of the system. Chief Engineer and duty engineer shall additionally carry out performance based monitoring on day to day basis.

6.1.1. Operations

The main steering motor and the auto pilot system shall be changed over daily at Noon to ensure that both the systems are operating at maximum efficiency at all the time.

While operating at harbour, restricted waters, and heavy traffic areas or as Master deems necessary, run both steering gear pumps to get swift response and to prevent lost motion. While manoeuvring the vessel under restricted water or at harbour change over steering to hand and avoid auto pilot.

6.1.2. Test

Both steering gear system shall be tested monthly, one at a time, to check that it conforms to the timing of SOLAS requirement. The time taken should not be more than 28 seconds for hard over from one side to 30° on the other side. When both pumps are running, the time taken is halved

All vessels are fitted with alarms including but not limited to power failure, low hydraulic pressure/fluid level alarms, Control circuit, overload, over-current etc. and are to be tested once a month. Fire/Smoke detectors fitted in steering flat shall be tested as per company maintenance plan. Auto changeover of steering system, where equipped, shall be simulated and tested once in a month.

All of the above test shall be recorded in the deck log book clearly and shall be kept ready for presenting to external authorities at any time as and when required.

Additionally, vessel going to USA must comply with USCG 33CFR 164.25 (Tests before entering or getting underway) and record them.

Please take note that as per SOLAS requirement, it is necessary to continue running of the steering motor even if the alarm condition occur. In order to avoid damage to the motor, the steering must immediately be changed over as soon as the alarm is sounded and investigation must be made to find out the cause of alarm.

6.1.3. Emergency Operation

The emergency steering drill shall be carried out every 3 months as per SOLAS. All ship staff shall be encouraged to have hands on experience to get a feel for operating the steering gear in emergency mode.

During emergency Generator load test, the power feed of one of the steering motor from the emergency switchboard shall be checked and the said steering system shall be checked for normal operations.

6.2. Rudder

Semi-balanced spade rudders. Such rudders are suspended from only one point, namely the lower end of the rudder stock. The pintle situated at a lower point merely locates the rudder in a vertical axis but does not arrest vertical movement of the rudder.

Should the securing nut on the lower end of the Stock slacken off, the rudder would back off on its taper. At that stage, heavy knocking should be very evident on account of the fretting damage then taking place on the key and keyway. Continued slackness would

damage the mating surfaces beyond repair and loss of the stock nut would result in immediate loss of the rudder. Stocks have had to be renewed and repaired by welding all on account of the stock nut becoming slack.

Should abnormal noises or irregular movement in the steering system become apparent at any stage efforts to establish whether the fault is structural or hydraulic are to be made, and the necessary repairs instituted.

It is very important from the point of view of safety that before proceeding from any berth or anchorage the steering system should be thoroughly tested and examined. Particularly following any repair work, it is especially necessary to check the co-ordination of helm, steering gear, rudder and indicators. This testing should be carried out to the satisfaction of a responsible Deck and Engineer Officer and appropriate entries recorded in the respective Log Books.

Rudder carriers are to receive adequate lubrication through the plugs or nipples provided for this purpose: tapered cast iron bearings must be greased on a daily basis as they are very susceptible to damage.

7. COMPRESSOR VALVE RECONDITIONING

Considerable expenditure is incurred on the purchase of compressor valves. As this equipment, would usually involve airfreight, the capital cost is aggravated.

The facility exists for worn compressor valves of almost any description to be reconditioned. Reconditioning time is about 10 days, but may be improved upon in urgent cases.

Should compressor valves require refurbishing, they are to be landed for the attention of the Ship Manager and are to be labelled, bearing all identification details concerning make, type and serial number of compressor and duty of the valves in question.

8. ROLLER AND BALL-BEARING - FRETTING DAMAGE

Idle machinery should either be turned by hand to a new position periodically, or where duplicate equipment is installed, each unit should be run on alternate days.

Shipboard vibration is known to cause fretting or brinelling damage or wear in the form of indents in the outer race in way of the stationary rollers or balls.

For this reason, it is undesirable to leave machinery equipped with this type of bearing standing idle in one position for too long.

9. DECK MACHINERY

To preclude accidents caused by unauthorised operation of deck equipment, or 'creeping' of hydraulically-powered winches, or cranes, proper care and attention shall be given to the safety aspect of this machinery as follows:

Deck machinery is not to be left unattended without isolating the power. Winches are to be maintained in good working order and limit switches and safety - cut outs where fitted are to be kept operational and tested regularly.

After use of the winches by stevedores, all power, whether hydraulic or electrical, is to be isolated by a Duty Officer.

The cooling water supply to the hydraulic oil coolers or fans, their relevant intake and exhaust covers, as applicable, are to be shut down and secured on completion of use of the deck machinery.