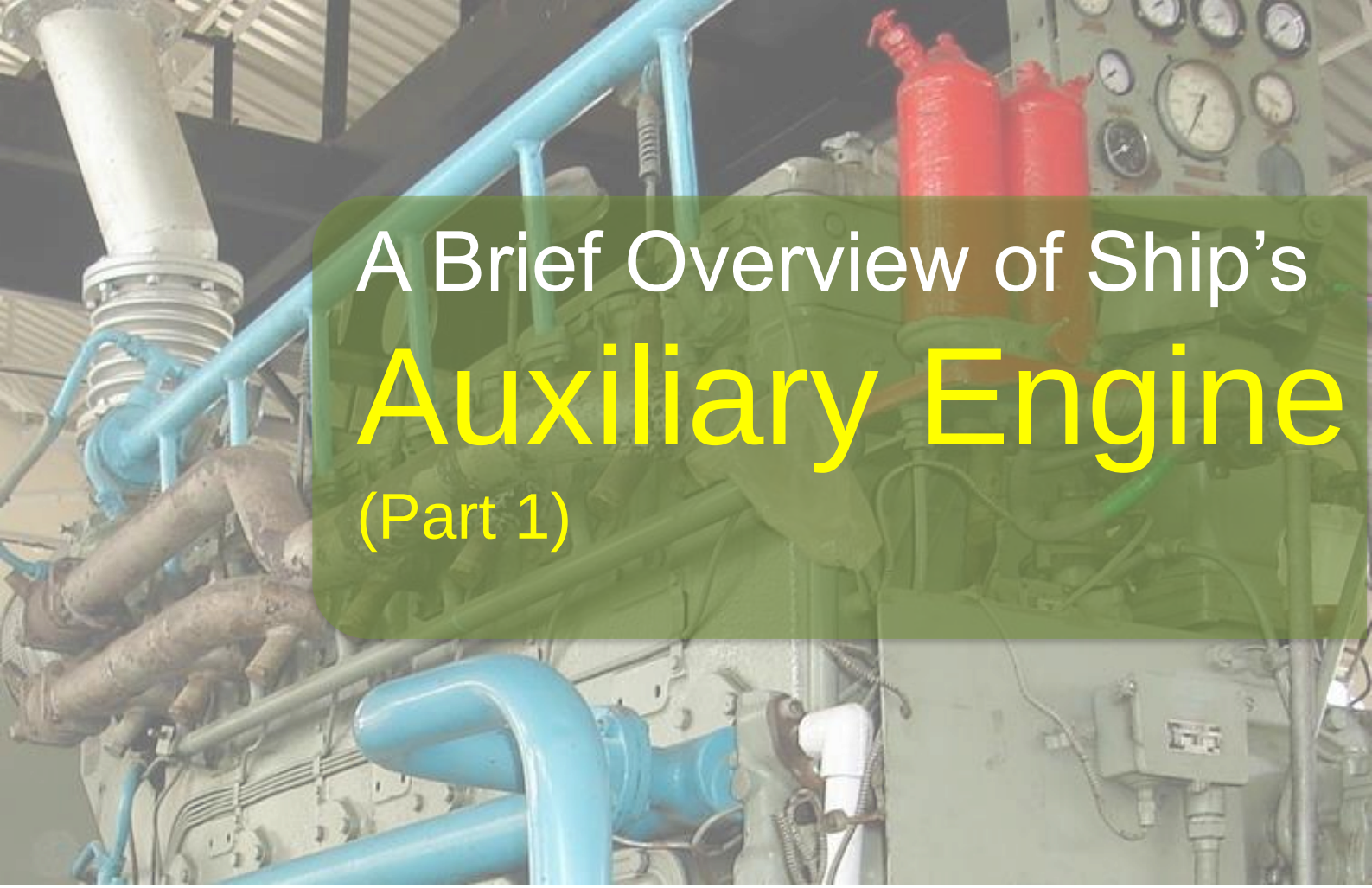

A Brief Overview of Ship's Auxiliary Engine (Part 1)

Operation, Procedures and Safety

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“A Brief Overview of Ship’s Auxiliary Engine- Part 1”

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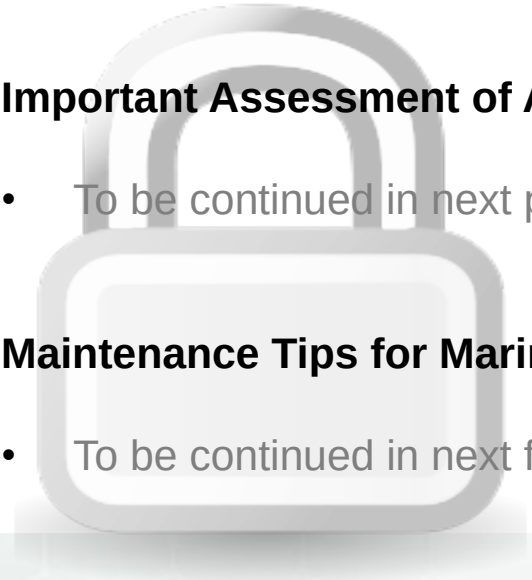
Content



Basic Operations

Marine auxiliary engines are manufactured keeping in mind the rigorous environment they will be installed and operated in, along with maintaining the continuity of operation to provide uninterrupted power supply to various ship systems.

The most important thing for running the machinery system in its best capabilities is to know the correct operating procedure for the same and to bring the machinery back in operation following correct sequence and troubleshooting procedure if it is stopped due to unavoidable circumstances. The ship's engineer in-charge must familiarize himself/herself with the operating manual of the auxiliary engine, the correct operating parameters and scheduled planned maintenance.

How Power is Generated and Distributed On Ships?

A ship is like a floating city with all the privileges enjoyed by any normal city on shore. Just like a conventional city, the ship also requires all the basic amenities to sustain life on board; the main among them is power or electricity. Let's take a look as to how power is generated and supplied on board a ship.

Shipboard power is generated using a prime mover and an alternator working together. For this an alternating current generator is used on board. The generator works on the principle that when a magnetic field around a conductor varies, a current is induced in the conductor.

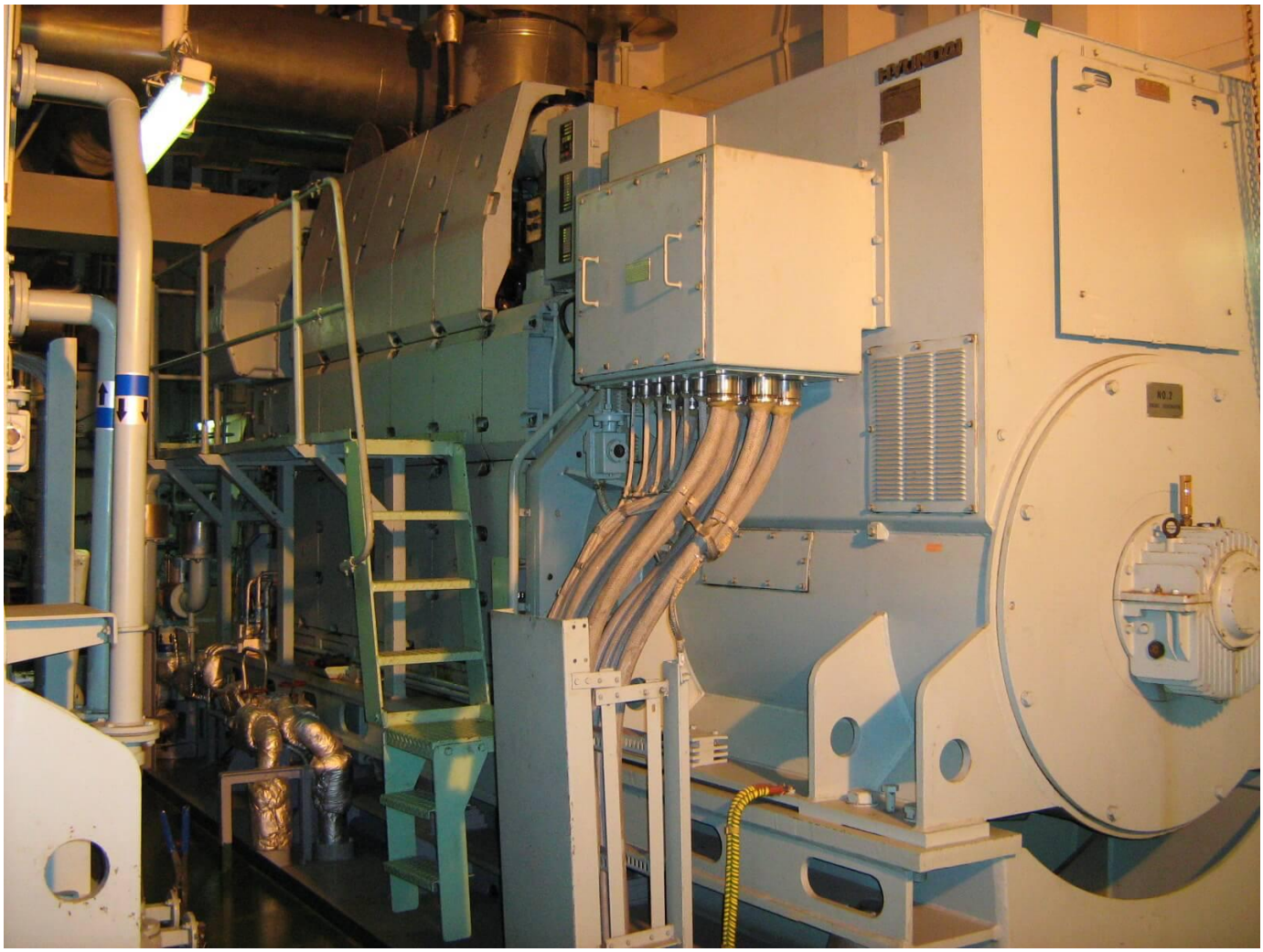
The generator consists of a stationary set of conductors wound in coils on an iron core. This is known as the stator. A rotating magnet called the rotor turns inside this stator producing magnetic field. This field cuts across the conductor, generating an induced EMF or electro-magnetic force as the mechanical input causes the rotor to turn. The magnetic field is generated by induction (in a brushless alternator) and by a rotor winding energized by DC current through slip rings and brushes.

Few points to be noted about power on board are : AC, 3 phase power is preferred over DC as it gives more power for the same size. 3 phases is preferred over single phase as it draws more power and in the event of failure of one phase, other 2 can still work.

Power Distribution On Board

The Power Distributed on board a ship needs to be supplied efficiently throughout the ship. For this the power distribution system of the ship is used. A shipboard distribution system consists of different components for distribution and safe operation of the system. They are as follows:

- Ship Generator consisting of prime mover and alternator
- Main switch board which is a metal enclosure, taking power from the diesel generator and supplying it to different machinery systems



- Bus Bars which acts as a carrier and allow transfer of load from one point to another
- Circuit breakers which act as a switch and in unsafe condition can be tripped to avoid breakdown and accidents
- Fuses as safety devices for machinery
- Transformers to step up or step down the voltage
- When supply is to be given to the lighting system, a step down transformer is used in the distribution system
- In a power distribution system, the voltage at which the system works is usually 440v
- There are some large installations where the voltage is as high as 6600v
- Power is supplied through circuit breakers to large auxiliary machinery at high voltage
- For smaller supply fuse and miniature circuit breakers are used
- The distribution system is three wires and can be neutrally insulated or earthed
- Insulated system is more preferred as compare to earthed system because during an earth fault essential machinery such as steering gear can be lost

The More You Know Your Machine, The Better It Will Perform.

Synchronizing Generators on Ship

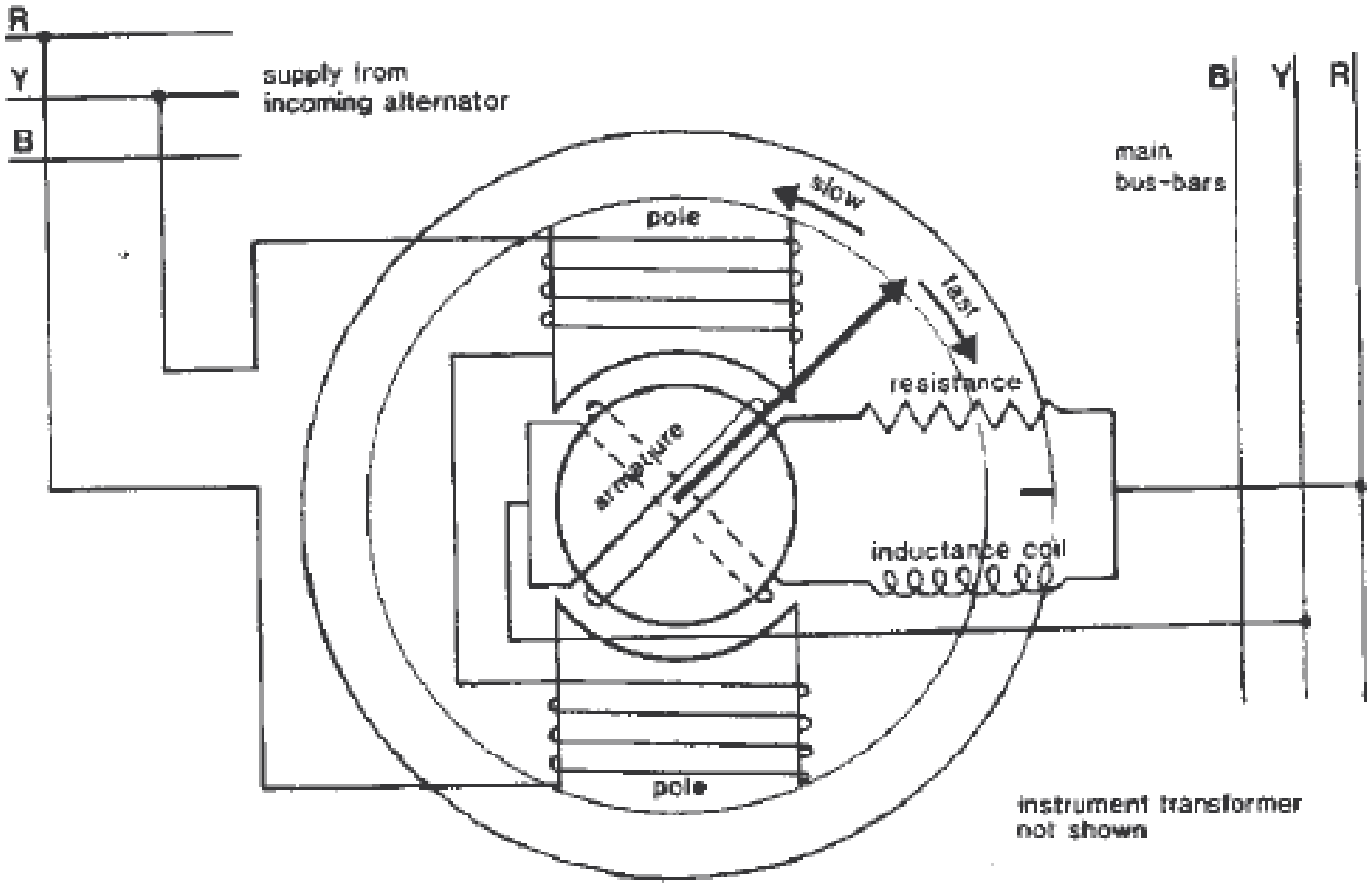
Synchronizing of an incoming generator or alternator is very important before paralleling it with another generator. The synchronizing of the generator is done with the help of synchroscope or with three bulb method in case of emergency. It is of utmost importance that before paralleling the generators the frequency and voltage of the generators need to be matched. In this article we will describe the method for synchronizing generators on a ship.

There are two methods to synchronize generators on a ship – one is the normal and other is the emergency method.

Synchroscope method

- The synchroscope consists of a small motor with coils on the two poles connected across two phases
- Let's say it is connected in red and yellow phases of the incoming machine and armature windings supplied from red and yellow phases from the switchboard bus bars
- The bus bar circuit consists of an inductance and resistance connected in parallel.

- The inductor circuit has the delaying current effect by 90 degrees relative to current in resistanceŸ
- These dual currents are fed into the synchroscope with the help of slip rings to the armature windings which produces a rotating magnetic field



- The polarity of the poles will change alternatively in north/south direction with changes in red and yellow phases of the incoming machine Ÿ
- The rotating field will react with the poles by turning the rotor either in clockwise or anticlockwise directionŸ

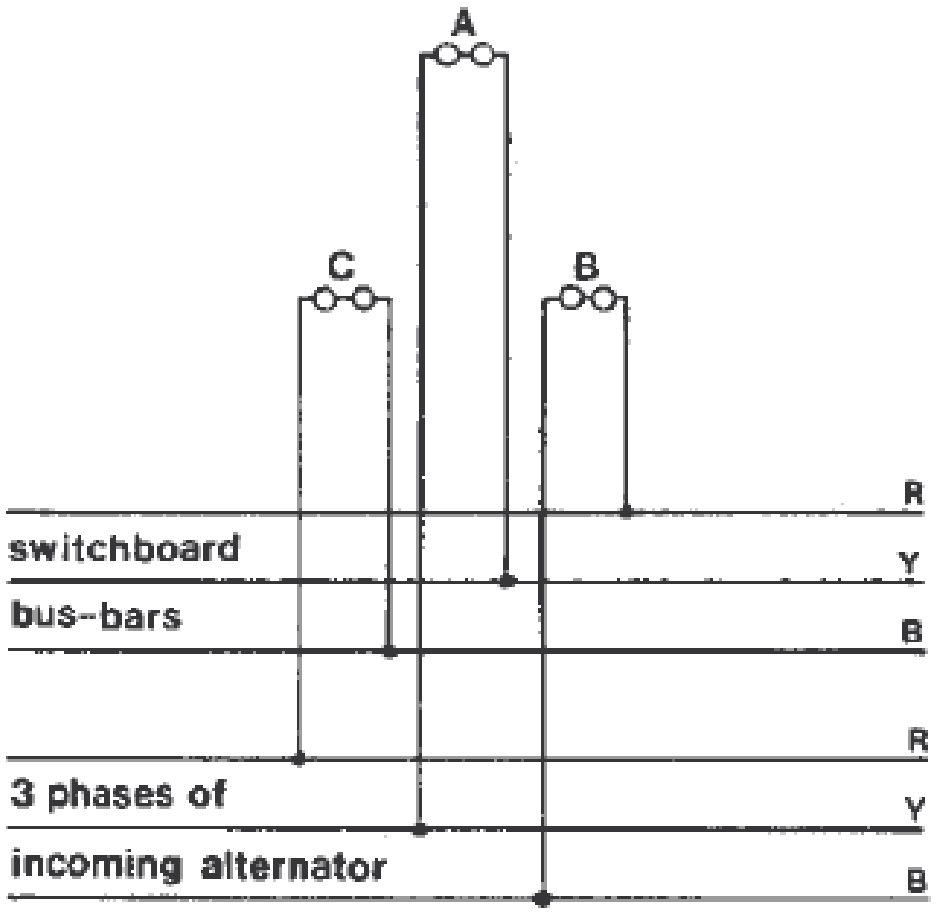
- If the rotor is moving in clockwise direction this means that the incoming machine is running faster than the bus bar and slower when running in anticlockwise direction Ÿ
- Generally, it is preferred to adjust the alternator speed slightly higher, which will move the pointer on synchroscope is in clockwise direction Ÿ
- The breaker is closed just before the pointer reaches 12 o'clock position, at which the incoming machine is in phase with the bus bar

Emergency synchronizing lamps or three bulb method

This method is generally used when there is a failure of synchroscope. In case of failure a standby method should be available to synchronize the alternator, and thus the emergency lamp method is used.

Three lamps should be connected between three phases of the bus bar and the incoming generator should be connected as shown in the diagram:

- The lamps are connected only in this manner because if they are connected across, the same phase lamps will go on and off together when the incoming machine is out of phase with the switchboard Ÿ



- In this method, as per the diagram, the two lamps will be bright and one lamp will be dark when incoming machine is coming in phase with the bus barŸ
- The movement of these bright and dark lamps indicates whether the incoming machine is running faster or slowerŸ
- For e.g. there is a moment when lamp A will be dark and lamp B & C will be bright, similarly there will be instance when B is dark and others are bright and C is dark and other two are bright
- This example indicates that machine is running fast and the movement of the lamps from dark and bright gives a clockwise movement Ÿ

- Clockwise movement indicates fast and anti-clockwise direction indicates slow running of incoming generator
- The lamps are connected only in this manner because if they are connected across, the same phase lamps will go on and off together when the incoming machine is out of phase with the switchboard Ÿ
- In this method as per the diagram the two lamps will be bright and one lamp will be dark when incoming machine is coming in phase with the bus bar
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Clockwise movement indicates fast and anti-clockwise direction indicates slow running of incoming generator.

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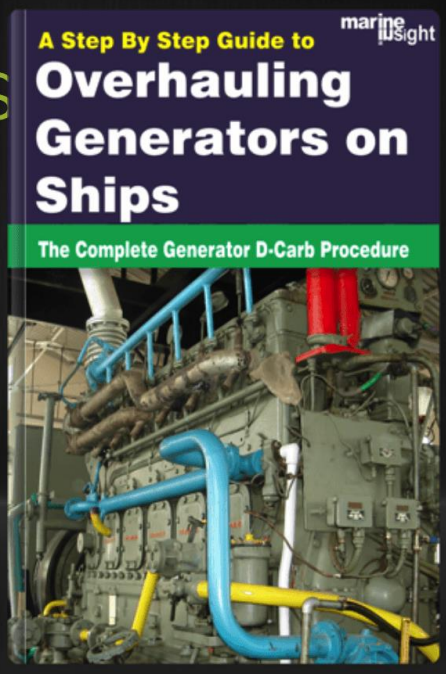

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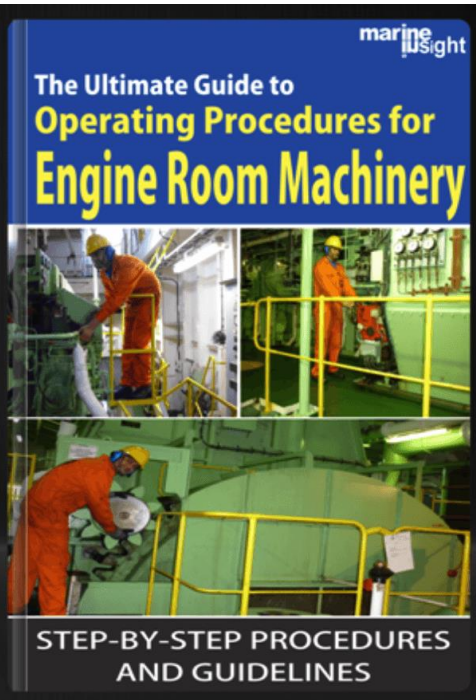


Blackout Situation

Blackout is one condition each and every mariner is familiar with and also afraid of. It is one situation everyone on the ship is terrified of because it brings the whole ship to a standstill. From bridge to engine room, from dinning crew members to the sleeping ones, everyone is affected by a blackout.

Understanding Blackout Condition

Blackout condition is a scenario on a ship, wherein the main propulsion plant and associate machinery such as boiler, purifier and other auxiliaries stop operating due to failure of power generation system of the ship – Generator and alternator.

With technologies and automation, measures are provided to avoid such blackout situation by means of auto-load sharing system and auto-standby system in which the generator set that is running in parallel or standby comes on load automatically if the running diesel generator fails.

"Never panic in such situation, be calm and composed. Emergency generator will restore the power in no time"

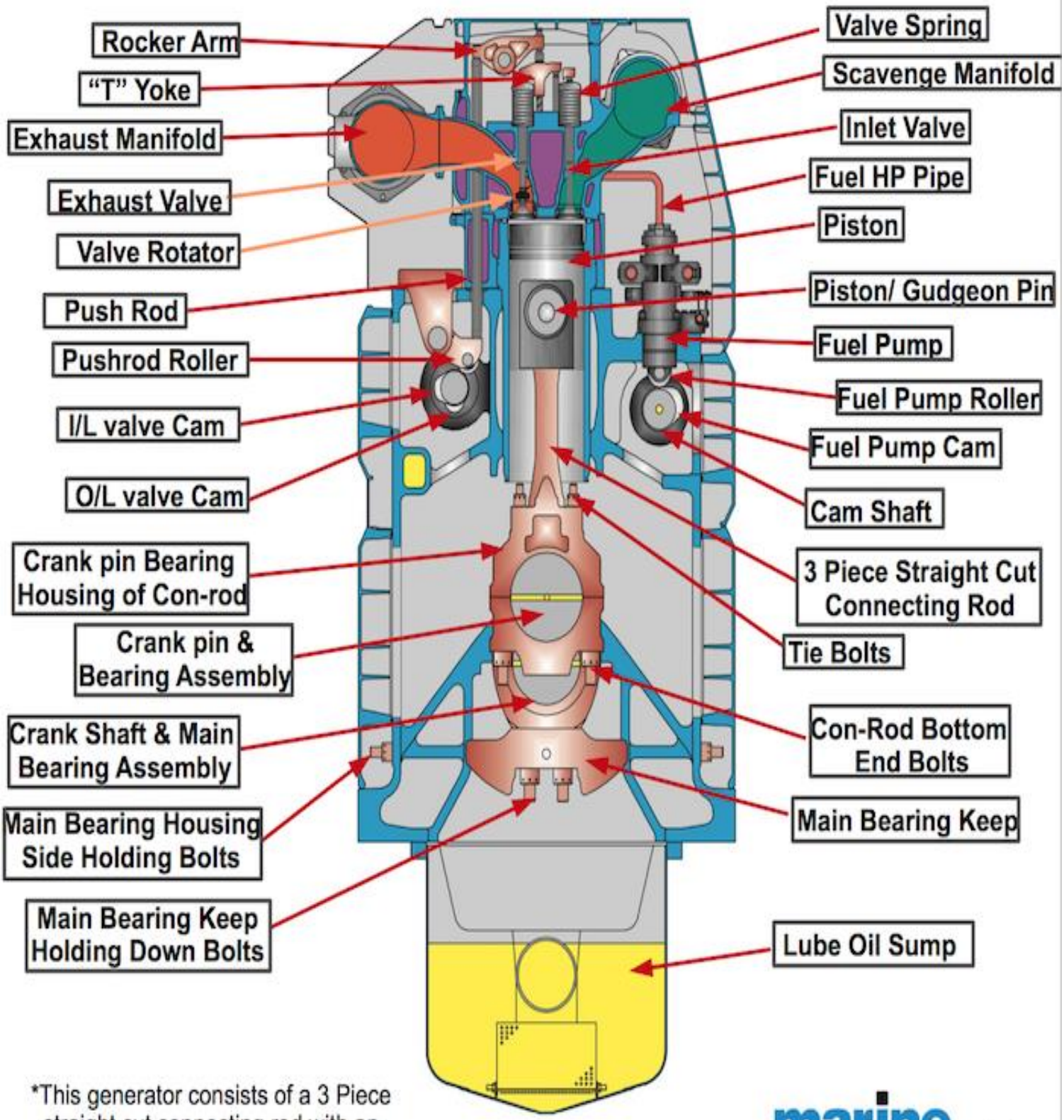
"It requires both skill and patience to tackle a situation like blackout specially when the vessel is sailing or maneuvering. However, the best way to tackle such situations is to be calm and composed; and to know your engine room and machinery well in advance"

What to Do in Case of a Blackout?

In case of blackout following precautions and actions should be taken:-

- Inform officer on bridge briefly about the condition. Call for man-power and inform the chief engineer
- If the main propulsion plant is running, bring the fuel lever to zero position
- Close the feed of the running purifier to avoid overflow and wastage of fuel
- If auxiliary boiler was running, shut the main steam stop valve to maintain the steam pressure
- Find out the problem and reason for blackout and rectify the same
- Before starting the generator set, start the pre- lubrication priming pump if the supply for the same is given from the emergency generator; if not, then use manual priming handle (provided in some generator)
- Start the generator and take it on load. Then immediately start the main engine lube oil pump and main engine jacket water pump
- Reset breakers and start all the other required machinery and system. Reset breakers that are included in preferential tripping sequence (Non-essential machinery)

FOUR STROKE MARINE GENERATOR ON SHIPS



*This generator consists of a 3 Piece straight cut connecting rod with an underslung crankshaft

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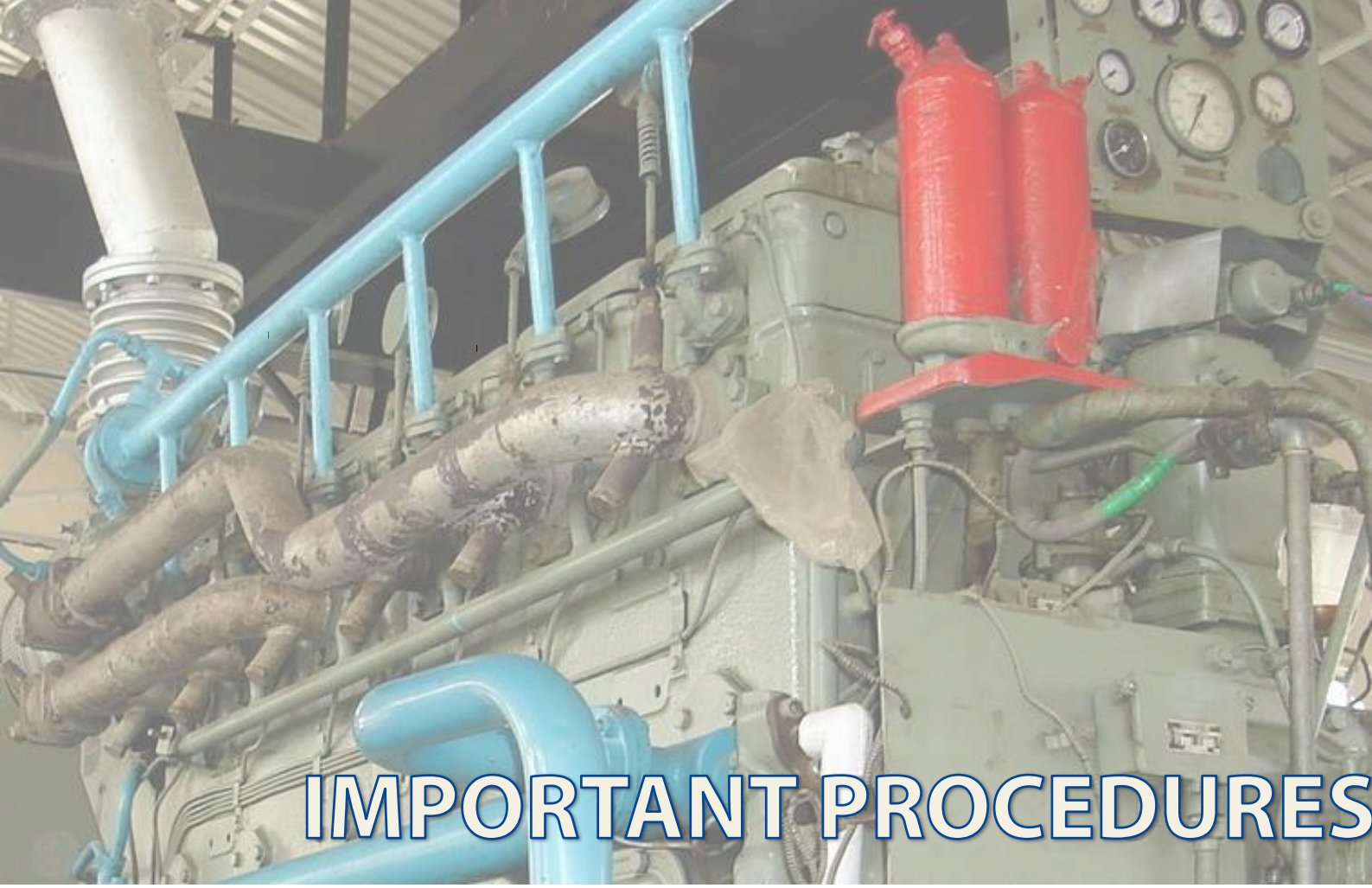


IMPORTANT PROCEDURES

The new generation marine auxiliary engines are provided with state-of- the-art automation and safety features, which reduce the human interference for operation of the machinery such as sequence starting and stopping, manual load sharing etc. but it is still very important to thoroughly understand the step-by-step procedures for operating a marine generator engine in case of automation fault or when doing the running in checks after major overhauling.

While operating the engine, it is the responsibility of the engineer in-charge to ensure the generator is working close to its maximum capacity to achieve highest possible rated efficiency which require all the basic operating procedures to be in correct order at all times.

Starting and Stopping of Generators

A generator on a ship is the heart of the ship. It is that life-line which supports almost each and every function of the ship. Generator requires special care, attention, and maintenance for its effective and economic running. Moreover, when it comes to operating a generator on a ship, a standard procedure needs to be followed considering several important aspects.

Unlike the conventional generators that we use on land, a ship's generator requires a special step-by-step method for starting and stopping it. Though not a very complex one, the process demands a proper system to be followed. Missing even a single step might lead to failure in starting or stopping the generator and can even result into "black-out", a situation which everyone on ship tries their best to stay away from. Let's take a look at the step-by-step procedure for starting and stopping a generator on a ship.

Generator starting procedure

Automatic Start

- This method is only possible if sufficient amount of starting air is available. The air valves and interlocks are operated like in the

turning gear operation

- In this method the operator has nothing to do, for the generator starts itself depending on the load requirement
- However, during the maneuvering process and in restricted areas, the operator has to start by going into the computer based Power Management System (PMS). Once inside the system, the operator needs to go to the generator page and click start
- In PMS system, the automation follows sequence of starting, matching voltage and frequency of the incoming generator and the generator comes on load automatically
- In case of a blackout condition or a dead ship condition, the operator might have to start the generator manually

The manual process is totally different from the automatic start system. The following steps need to be followed:

- Check that all the necessary valves and lines are open and no interlock is active on the generator before operating
- Generally before starting the generator the indicator cocks are opened and small air kick is given with the help of the starting lever. After this, the lever is brought back to the zero position, which ensures there is no water leakage in the generator. The leakage can be from cylinder head, liner or from the turbocharger .
- The step is performed by putting the control to local position and then the generator is started locally
- In case any water leakage is found, it is to be reported to a senior officer or chief engineer and further actions are to be taken
- It is to note that this manual starting procedure is not followed generally on UMS ships, but it is a common procedure on manned engine room
- In engine rooms having water mist fire fighting system installed, this procedure is not followed because when the engine is given a manual kick with open indicator cocks, small amount of smoke comes out of the heads which can lead to false fire alarm, resulting in release of water mist in the specified area
- After checking the leakage, in case of any, the indicator cocks are closed and generator is started again from the local panel
- The generator is then allowed to run on zero or no load condition for some time for about 5 minutes

- After this the generator control is put to the remote mode. If the automation of the ship is working after putting in remote mode. the generator will come on load automatically after checking voltage and frequency parameters
- If this doesn't happen automatically, then one has to go to the generator panel in engine control room and check the parameters
- The parameters checked are voltage and the frequency of the incoming generator
- The frequency can be increased or decreased by the frequency controller or governor control on the panel
- The incoming generator is checked in synchroscope to see if it's running fast or slow, which means if frequency is high or low
- In synchroscope, it is checked that the needle moves in clockwise and anti-clockwise direction
- Clockwise direction means it is running fast and anti-clockwise means it is running slow
- Generally the breaker is pressed when the needle moves in clockwise direction very slowly and when it comes in 11'o clock position
- This process is to be done in supervision of experienced officer if someone is doing for the first time, for if this is done incorrectly the blackout can happen which can lead to accidents, if the ship is operating in restricted areas.
- Once this is done, the generator load will be shared almost equally by the number of generators running.
- After this the parameters of the generator are checked for any abnormalities.

Stopping Procedure

Automatic Procedure

ŸIn this procedure the generator is stopped by going into the PMS system in the computer and pressing the stop button to stop the generator.

- This is to be followed only when two or more generators are running
- Even if you are trying to stop the only running generator it will not stop due to inbuilt safety feature. The safety system thus prevents a blackout
- When the stop button is pressed the load is gradually reduced by the PMS and after following the procedure the generator is stopped

Manual Procedure

- In this procedure the generator to be stopped, is put-off load from the generator panel in the engine control room
- The load is reduced slowly by the governor control on the panel
- The load is reduced until the load comes on the panel below 100 kw
- When the load is below 100kw the breaker is pressed and the generator is taken off-load
- The generator is allowed to run for 5 minutes in idle condition and the stop button is pressed on the panel
- The generator is then stopped

Understanding Diesel Engine Performance

On ship, it is important to check the performance of the engine from time to time so as to ascertain working condition and fault finding. In earlier days, the performance of diesel engine was taken manually, but with the advancement of technology, automatic monitoring systems are used.

Types of Diesel Engine Monitoring Systems

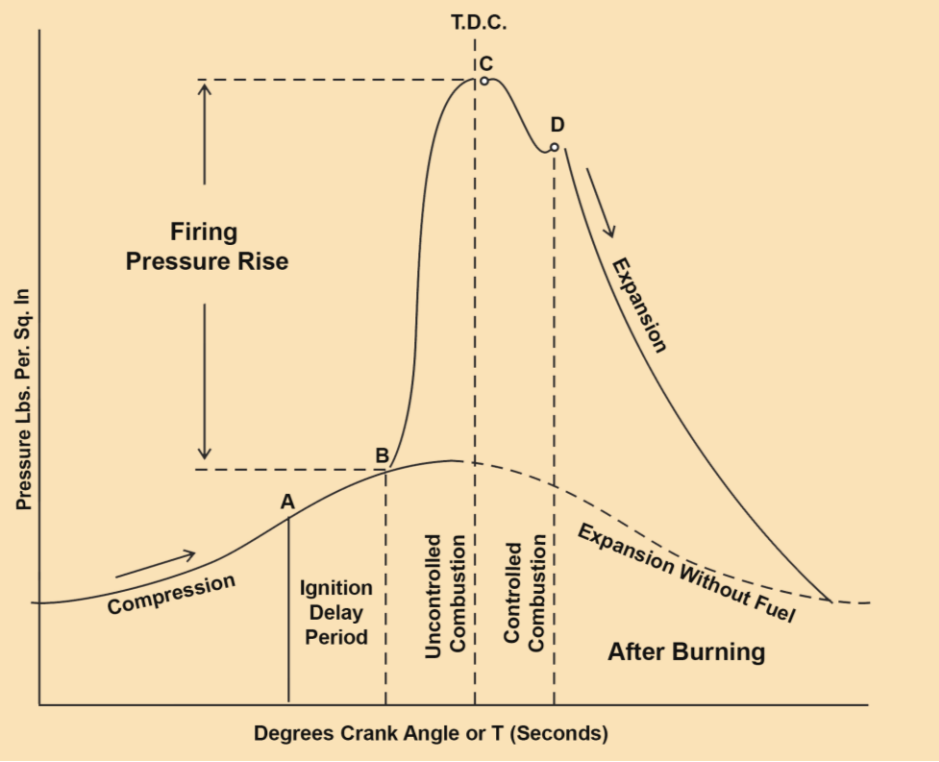
With the help of monitoring systems, the diesel performance of the engine can be taken easily and within no time. The new technology provides two types of monitoring systems.

In the first system, the diesel performance is monitored continuously and is thus known as online monitoring. Whereas in the second system, the

"A wise engineer will not only operate the generator correctly but assess the current running condition to enhance the performance by doing correct maintenance and parameter settings with respect to the current load, surroundings and machinery condition."

engineer has to manually put the instrument onto the cylinder head, connecting the wire to rpm sensor and taking the readings manually and later transferring to the computer. Generally on ships, the main engine has an online diesel performance system whereas for diesel generators has a manual system.

The type of system that is to be installed depends on the company and the type of ship and engine. The online system is quite costly than the manual one. In online system the diesel performance can be seen remotely in the control room as well as in the cabin of the chief engineer. The system also provides several graphs which precisely analyzes the condition of the engine. The graphs provide as similar to draw and indicator cards plotted by the manual system.



From the graphs obtained, various characteristics such as engine timing, compression pressure, cylinder output etc. can be analyzed.

They also tell us whether the engine is balanced or if some units are overloaded. The graphs also indicates if the timing has to be adjusted, information on piston rings leaking etc.; thus providing necessary maintenance and adjustments to avoid engine failure or damage.

Generally, the diesel performance of main engine and auxiliary engines are taken once every month and the report is then analyzed. A copy of the report is also sent to the company's technical department along with the chief engineer's comments on the report. The technical department checks and gives necessary feedback.

For emergency purpose, the old method for checking diesel performance is kept as the standby method. This is done keeping in mind, monitoring system failure and lack of spare parts for repair. The diesel performance reports are kept as records so that it can be compared with the recent reports and the trend can be checked to analyze if the diesel performance has deteriorated or improved. If the report shows a downward trend, then maintenance is done and necessary parts are replaced or adjusted.

Advantages of Diesel Performance System

1) Efficient and reliable operation of the engine.
2) Helps in saving fuel and optimizing SFOC(Specific Fuel Oil Consumption.
3) Helps in predicting the necessary repairs to prevent engine failure.
4) Helps in reducing spare parts cost and increasing time between overhauls.

Fuel Change-Over Procedure for Auxiliary Engine

Some ports have regulations of using gas oil for generators and boilers while the ship is at port (for e.g. European ports). Change over generators and boiler to diesel oil with sulfur content less than 0.1 % is therefore carried out.

Generators must be changed over from one grade to another while at load as this will help in better flushing of the system. If only one generator is being changed over, keep running another generator for emergency purpose incase something goes wrong.

Procedure for changeover of fuel:

- Shut the steam to the fuel oil heaters of boiler
- When the temperature drops below 90 degree, open the diesel oil service tank valve going to generator system

- Open the local diesel inlet valve and shut the heavy oil inlet valve simultaneously and slowly by keeping an eye on the fuel pressure and changing only one generator into diesel with the help of separate diesel pump
- Let the heavy oil outlet be kept open and the diesel oil outlet kept shut till the system is flushed thoroughly
- After some time open the diesel oil outlet and shut heavy oil outlet
- If the complete system is to be changed into diesel oil, open the diesel oil inlet valve to generator supply pump simultaneously closing the heavy oil inlet valve
- If the return line is provided to diesel service tank, open it after some time, simultaneously closing the heavy oil return only after the system is flushed properly

IMPORTANT SAFETY POINTS

The marine generator engine is amongst the most vital machinery in the engine room and to ensure it is operated without any major trouble or breakdown, it is provided with several safety alarm and trip systems. This not only ensures that the engineers are notified about the problem in the generator but also ensures shut down of the machine in case the trouble is not attended in time or it escalates quickly which can damage the moving parts and also lead to fatal accidents.

It is important to not only know different types of trips present in the generator engine but also how they are activated and what are the different causes to troubleshoot the matter at the earliest.

Over-Speed Trip

An over speed trip is a safety feature provided on the diesel engine of the ship to restrict uncontrolled acceleration of the engine, which can lead to mechanical failure or untoward accidents. In order to prevent the speed of a diesel engine to go beyond the pre-set speed range, an over speed trip is used in the diesel engines.

How over-speeding can be harmful?

A diesel engine is designed for the mechanical stress associated with the centripetal and centrifugal forces of the moving parts inside it in a specified operational range. Centripetal force is directly proportional to the square of the rotational speed; stress increases rapidly with increase in speed. Mechanical connection strength can be overcome by the exceeding stresses due to the increase in operational speed. This can result in breaking of rotating parts or damage to the machinery itself. Over-speed is thus a serious safety hazard and can lead to a fatal situation.

What Does Over Speed Trip Does?

Due to sudden changes in the load on the diesel engine, the speed of the engine may vary. Though a governor is provided to control the

speed of the diesel engine, the speed might go out of control, damaging the engine. Thus, for this reason over-speed trips are used.

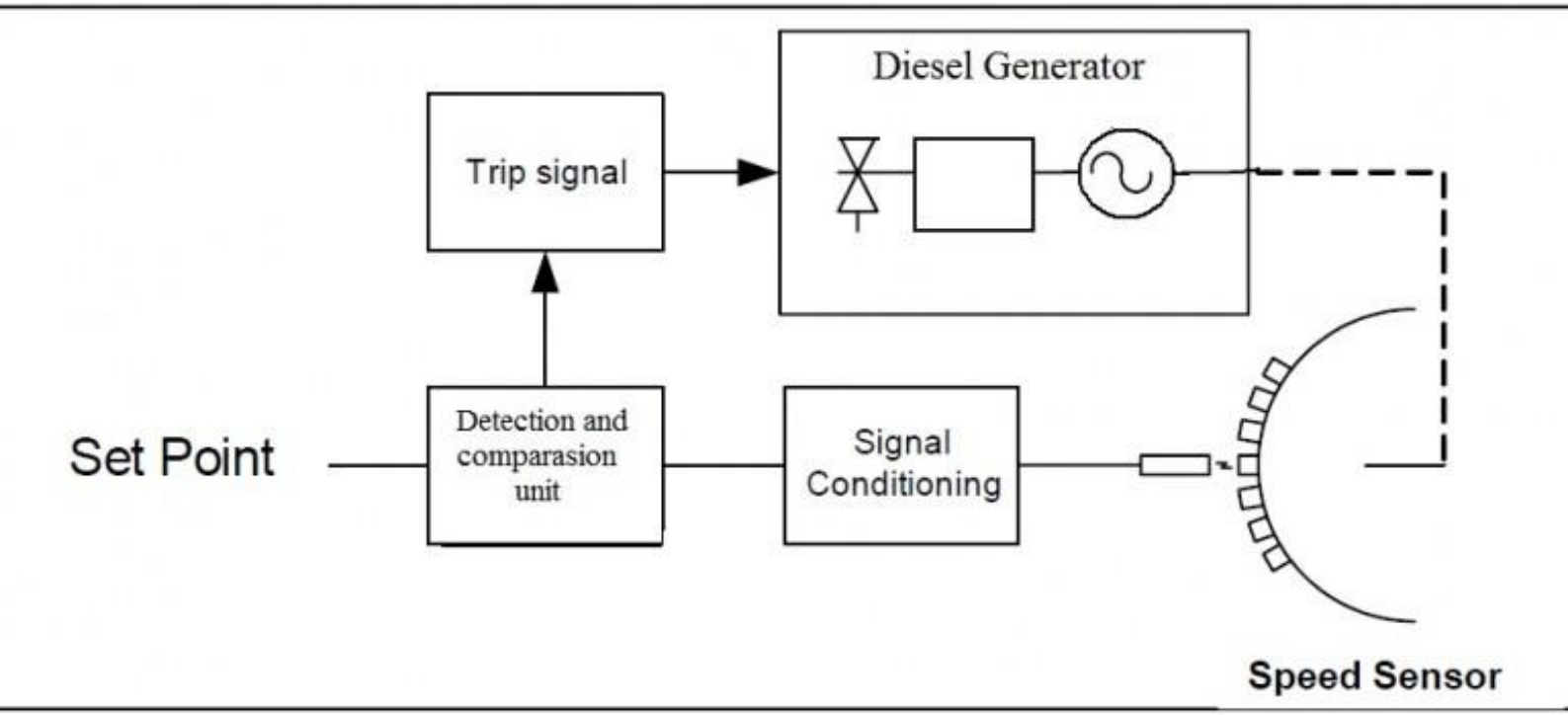
No matter what type of the over speed trip the engine uses, the main aim of the over speed trip is to cut the fuel supply to the engine cylinders in case the engine speed rises above a specific level.

Preventing Over-Speeding of Engine

Reducing the likelihood of an uncontrolled and catastrophic over speed is essential and can be done by two methods:

a) Mechanical over speed trip

b) Electronic over speed trip



ELECTRONIC OVERSPEED TRIP

Electronic Over-Speed Trip

To understand the electronic over speed trip, a normal lay out of the system is described below. The electronic over speed trip consists of

a) Fly wheel mounted speed sensor

Magnetic speed sensor is preferred in generator engines. Due to the discontinuity of actuator surface (gear tooth of flywheel) voltage is excited in the pick off coil of sensor, producing an electric analog wave. This cyclic wave created by the flywheel is read by the sensor.

b) Signal condition unit

This unit act as a receiver to the speed sensor. Basic function of the signal conditioner is to convert one type of electronic signal, which may be difficult to read, into another type into a more easily read format. This can be achieved by amplification, excitation and linearization of an electrical signal.

c) Detection and comparison unit

There is a set value which is normally 10 % above the rated speed and acts as base value for this unit. Signal condition unit output is continuously detected and compared with the set value.

d) Trip signal unit

If the difference between the set value and detected value is above the limit, then this unit gives a trip signal which in turn shuts down the generator.

Air Circuit Breaker

Generators onboard ships are the power suppliers for the entire vessel as they stand as the primary source of power to all running machinery systems including the propulsion plant. For this reason, safe and efficient running of the ship generator has to be given highest consideration. One of the important safety devices used for ship's generator is Air Circuit Breaker (ACB).

Air circuit breaker is designed to overcome the defects and safeguard the machine before it breakdowns.

The main function of air circuit breaker is to:

- Open and close a 3 phase circuit, manually or automatically
- Open the circuit automatically when a fault occurs. Faults can be of various types – under or over voltage, under or over frequency, short circuit, reverse power, earth fault etc.
- The main feature of ACB is that it dampens or quenches the arcing during overloading

Air Circuit Breaker (ACB) Construction & Working

ACB has two sets of contacts i.e. main and auxiliary contacts. Each set of contact consists of a fixed contact and a moving contact.

The main contact normally carries most of the load current. All the contacts are made of cadmium-silver alloy which has very good resistance to damage by arcing.

When the ACB is closed, the powerful spring is energized and the ACB is than latched shut against spring pressure. The auxiliary contact makes first & breaks last i.e. when ACB is closed, the auxiliary contact closes first then the main contact follows.

When the ACB is open, the main contact open firsts and then auxiliary contact opens. Thus, the auxiliary contacts are subjected to arcing during the opening of ACB and can easily be replaced.

The main contact closing pressure is kept high so that the temperature rise in the contacts while carrying current remains within limit. Closing coil operating on D.C voltage from a rectifier is provided to close the circuit breaker by operating a push button.

How Arc Quenching is Achieved?

Quenching of arc is achieved by:

1.Using arcing contacts made of resistance alloy and silver tips for the

main contacts. Arcing contacts close earlier and opens later then the main contacts

2. When opening contacts have long travelled at high speed to stretch the resultant arc, which is transferred to the arcing contact

3.Cooling and splitting of the arc is done by arc chutes which draw the arc through splitters by magnetic action and quickly cool and split the arc until it snaps. The circuit breaker opens when the arc is quenched.

An accident is a specific, unpredictable, unusual and unintended external action which occurs in a particular time and place, with no apparent and deliberate cause but with marked effects.

Preferential Trips

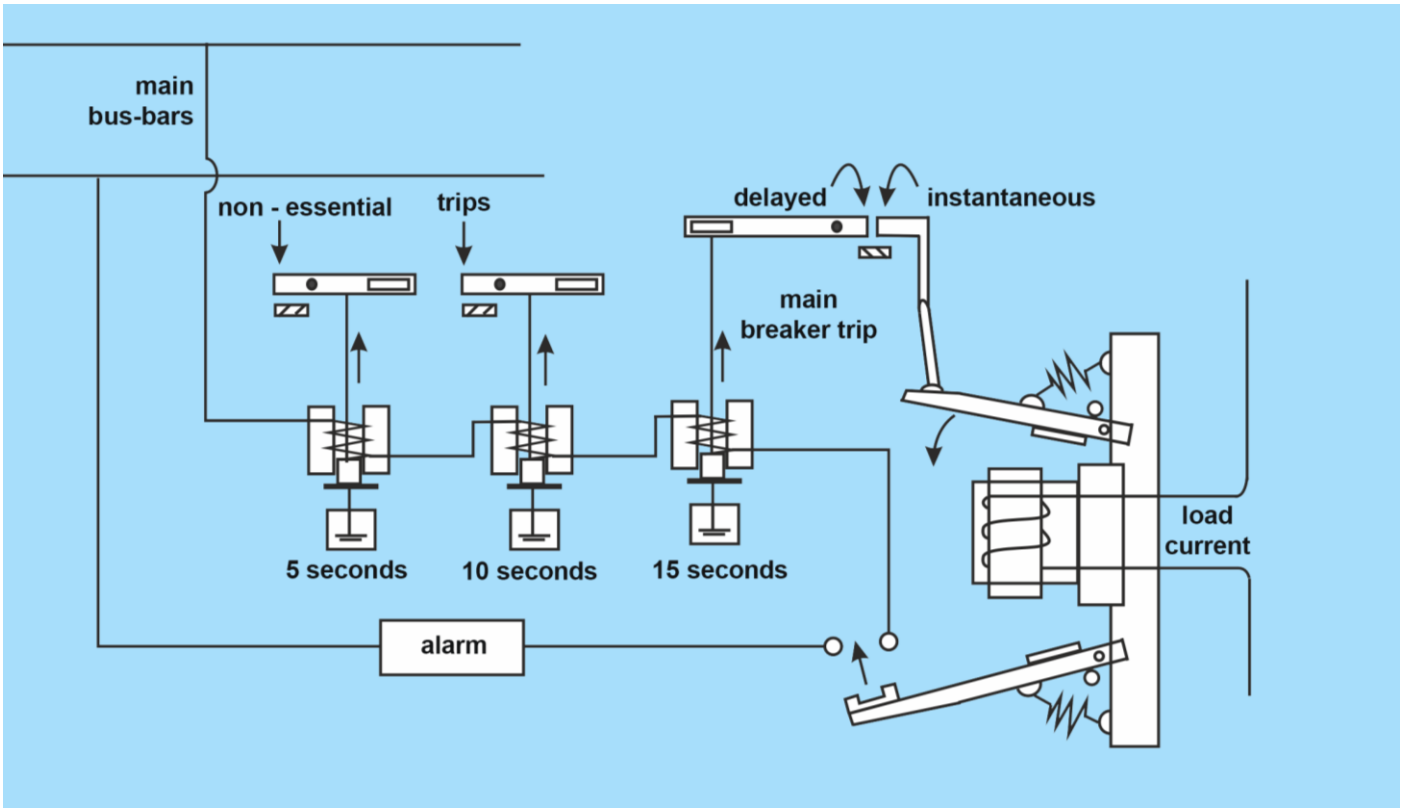
Preferential trip is a kind of electrical arrangement on ship which is designed to disconnect the non-essential circuit i.e. non-essential load from the main bus bar in case of partial failure or overload of the main supply.

The non-essential circuits or loads on ships are air conditioning, exhaust and ventilation fans, and galley equipment, which can be disconnected momentarily and can be connected again after fault finding. The main advantage of preferential trip is that it helps in preventing the operation of main circuit breaker trip and loss of power on essential services and thus prevents blackout and overloading of generator.

Construction and Working

The preferential trip circuit consists of an electromagnetic coil and a dashpot arrangement to provide some delay to disconnect the non-essential circuits. Along with this, there is also an alarm system provided, which functions as soon as an overload is detected and trips start operating. There are some mechanical linkages also in the circuit which instantaneously operates the circuit and completes the circuit for preferential trips.

The dashpot arrangement consists of a small piston with a small orifice and is placed inside a small cylinder assembly. This piston moves up against the fluid silicon and the time delay is governed by the orifice in the piston.



The current passes through the electromagnetic coil and the linkages are kept from contacting using a spring arrangement. As soon as the current value increases the limit, the electromagnetic coil pulls the linkage up against the spring force and operates the instantaneous circuit and the alarm system. The lower linkage completes the circuit for the preferential trip circuit.

The current passes through the coil in the preferential trip circuit which pulls the piston in the dashpot arrangement. The movement of

this piston is governed by the diameter of the orifice and the time delay made by the same. The preferential trip operates at 5, 10 and 15 seconds and the load is removed accordingly. If the overload still persists, then an audible and visual alarm is sounded.

The preferential trip is one of those important electrical circuit diagrams which helps in removing the excessive load from the main bus bar, thus preventing situation like blackout which is a dangerous incident to the ship, especially when the ship is sailing in restricted or congested waters.

Other Important Trips:

Reverse Power Trip:

When multiple generators are running in parallel, the situation arises where one generator acts as a motor and draws in the current from the system instead of supplying it is known as motoring or reverse power in the generator.

A safety device known as reverse power relay is used to trip the generator to prevent the reversing of alternator to work as motor or to stop motoring of generator which may damage the prime mover, alternator coils etc.

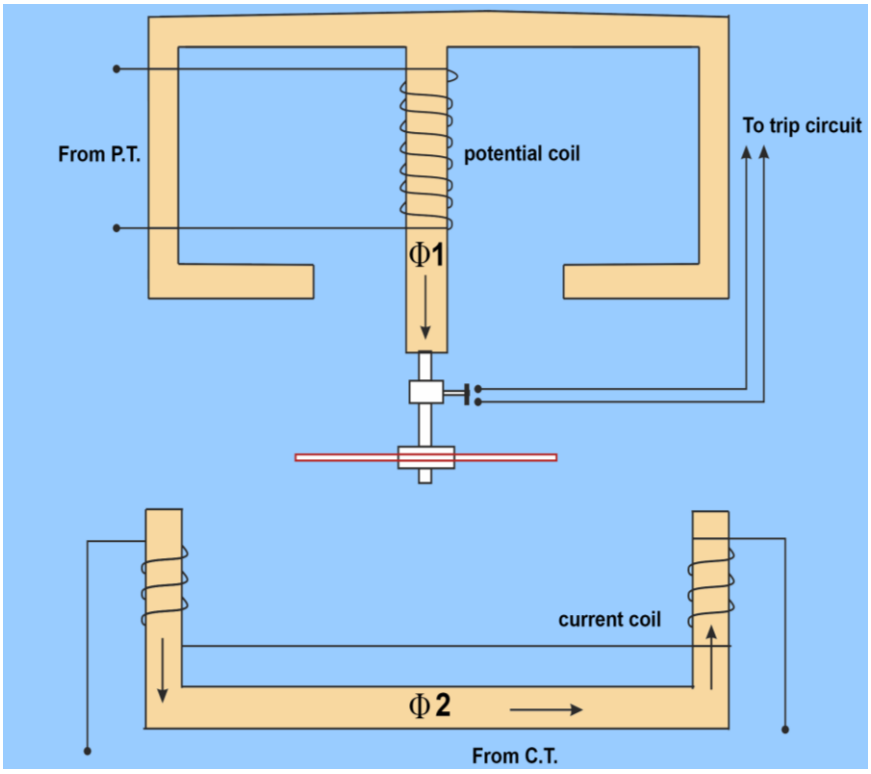
this piston is governed by the diameter of the orifice and the time delay made by the same. The preferential trip operates at 5, 10 and 15 seconds and the load is removed accordingly. If the overload still persists, then an audible and visual alarm is sounded.

The preferential trip is one of those important electrical circuit diagrams which help in removing the excessive load from the main bus bar, thus preventing situation like blackout which is a dangerous incident to ship, especially when the ship is sailing in restricted or congested waters.

Other Important Trips:

Reverse Power Trip:

When multiple generators are running in parallel, the situation arises where one generator acts as a motor and draws in the current from the system instead of supplying and this process is known as motoring



or reverse power in the generator.

A safety device known as reverse power relay is used to trip the generator to prevent the reversing of alternator to work as motor or to stop motoring of generator which may damage the prime mover, alternator coils etc.

Lube oil pressure/ temperature/ level trip:

The generator engine is a high revolution machinery which required continuous lube oil supply of recommended grade to keep the bearing friction-free and at low temperature.

Lube oil is one of the most important supplements for the engine and alternators moving parts, hence various parameters of the engine lube oil are monitored. The three important lube oil parameters which are provided in alarms and trips are:

1. Lube oil Low pressure alarm and trip: If the pressure of lube oil in the generator inlet after the filter is lower than the recommended value, an alarm will be sounded so that engineer can troubleshoot the reason before the pressure goes further low and activate trip to stop the generator from major damages.

2. Lube oil High temperature alarm and trip: If the lube oil cooler is not functioning or any of the internal parts of the prime mover is/

are damage, the lube oil temperature will go up and after a point the oil will start loosing its characteristics leading to damages in the rotating parts and contact points. The temperature of the lube oil is monitored and any abnormal variation will lead to alarm and trip

3) Lube oil Low level: The generator engine is provided with its own sump from where the priming pump and attached lube oil pump takes suction and supplies back to the engine. To safeguard the engine from starvation of lube oil, level alarm and trip is fitted in the prime mover

Cooling Water pressure/ Temperature Trip:

The cooling water for engine jacket, liner and other high temperature parts keeps them in controlled parameter which avoids seizing of the parts. The two important cooling parameters which are installed as alarms and trips are:

1. **Cooling water low pressure alarm and trip:** If the pressure of cooling water in the generator is lower than the recommended value, an alarm will sound so that engineer can troubleshoot the reason before the pressure goes further low which will activate the trip to stop the generator from major damages.

2. Cooling water high temperature alarm and trip: If the cooling water temperature in the jacket of the engine is high, it will activate an alarm and further increase in temperature will activate the trip to avoid boiling off of water and seizing of parts.

Oil Mist Detector

The Oil mist detector takes continuous samples from the main engine crankcase and check whether the sample concentrations of mist are well below the level at which a crankcase explosion can take place.

An overall mist density of the crankcase is also measured by comparing the samples with the fresh air once every rotation of the sampling valve is done. A beam of light from a common lamp is reflected through mirrors and output is measured from a photo cell.

Crankcase relief doors

The Crankcase relief doors are also fitted to prevent any damage to the crankcase and ingress of fresh air inside the crankcase.
The crankcase doors are spring loaded valves which lift up in case there is any rise of pressure inside the crankcase. Once the pressure is released they re-seat to prevent any ingress of fresh air. This helps especially in case of any ingress of air that can lead to a secondary explosion followed by a lot of surge and damage to the crankcase.

The opening pressure and sizes of the valves are specified by different classification societies, depending on the volume of the crankcase. The number of doors to be present also depends on the bore of the cylinder.

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