

Officer of the Watch

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**MCA EOOW Orals
Examination
Revision: Electrical
Knowledge**

1: What is Reverse Power Protection for?

Generators intended to operate in Parallel must have a Reverse Power Protection Trip. A Reverse Power Relay monitors the direction of power flowing between the Generator and the Switchboard.

If a Prime Mover Failure occurred the Generator would act as a Motor. The Reverse Power Relay detects this fault and acts to trip the Generator Circuit Breaker.

2: When would a Star/Delta Starter be used on a Motor?

Where a slow moving high inertia load is involved the starting time must be considered because of the heating effect of the starting current and in this case a Star/Delta Starter would be used.

The Star/Delta Starter first connects the Starter Windings in Star and when running changes over to Delta. The Star connection results in about 58% Line Voltage being applied to each Phase with therefore a reduction in Starting Current. The Starting Torque is also reduced to about 1/3 of its direct on-line value.

3: Describe how an A C Motor works.

Most A C Motors on Ships are of the Induction or Squirrel Cage Motor types, the principle of operation for which is as follows: The Starter is made up of three separately phased Windings, to which a 3-phase supply is connected. The Rotor has a series of Copper Conductors along its Axis, which are joined by rings at the ends to form a Cage. When the motor is started, the Rotating Magnetic Field induces an E M F in the Cage and thus a Current Flow. The Current carrying Conductor in a Magnetic Field produces the Motor effect, which turns the Rotor. The Motor Speed builds up to a value just less than the Speed of Rotation of the Magnetic Field. The Motor Speed depends upon the E M F induced in the Rotor and this depends upon the difference in Speed between the Conductors and the Magnetic Field.

A number of different Fixed Speeds are possible by changing the number of Poles (Conductors).

4: What is meant by the Term, Type Ex'e'?

Ex'e' = Increased Safety Equipment.

Increased Safety Equipment is based primarily on the elimination of "open sparking", i.e. equipment that does not have contacts.

5: What Gas is given off by Batteries while Charging?

Hydrogen.

6: What is meant by Preference Tripping?

Preference Tripping is the tripping of non-essential loads when an overload condition occurs on a Generator.

If a Generator Overload develops the Preference Trip Relay operates an Alarm and acts to trip selected non-essential loads. These loads may trip at set intervals depending on how essential the load is, i.e. 1st trip 5 seconds, 2nd trip 10 seconds.

7: What are the Causes of Single Phasing?

Single Phasing can be caused when one of the three back up fuses blows or if one of the contactor contacts is in open circuit.

8: What would you consider a minimum Insulation Reading Resistance?

Insulation Resistance must be kept above at least 1MW, the higher the Insulation Resistance the better. Companies have their own Regulations, but most Companies only allow readings above 5MOhms.

9: What are the two Main Types of Battery commonly used on board Ships?

Lead Acid and Alkaline.

10: Name the Trips found on a Generator Circuit Breaker.

Over Current
Under Voltage
Reverse Power.

11: What is Sequential Starting?

Sequential Starting is the automatic starting of essential equipment when power is returned after a total power failure, i.e. equipment such as Steering Gear.

12: What is meant by the Term, Type Ex'p'?

Ex'p' = Pressurisation.

This is where Equipment is Pressurised to prevent any gases entering Equipment.

13: What are the Advantages and Disadvantages of Alkaline Batteries?

The Advantages of Alkaline Batteries are that they retain charge on open circuit and even if discharged, it can be left for long periods without adverse effect.

The Disadvantages are that they require a greater number of cells to produce a particular Voltage. They are also more expensive than Lead Acid Batteries.

14: What is meant by the Term, Type Ex'd'?

Ex'd' = Flame Proof Enclosure.

This is an enclosure that will withstand an Internal Explosion of Flammable Gas within itself and dissipate heat from that explosion before reaching outside atmosphere, which could ignite the gas in surrounding atmosphere, i.e. a Ship's Battery Locker could be classed as Ex'd'.

15: What minimum current can be regarded as Fatal?

A shock current as low as 15mA ac or dc can be fatal.

16: What is done to ensure the Emergency Generator is Always Available and Will Start?

The System should be checked regularly and operated weekly to ensure it's availability if required. Fuel tanks should be kept full, ample cooling water in radiator cooling system and starting equipment should be functional, i.e. batteries should be fully charged or air receivers full

17: What is Load Sharing?

Load Sharing is the equal balance of loads between Generators irrespective of Load Changes.

18: What is the Normal Reading on an Insulation Test Meter?

Infinity is a normal reading, but readings should be kept above 5 Meg-ohms..

19: What is the Function of a Fuse?

The function of a Fuse is to give Short-circuit Protection and also Overload Protection and operates in milliseconds.

20: How would you go about finding an Earth Fault in the System?

Finding an Earth Fault would be by the process of elimination i.e. circuit breakers would be opened and closed until earth fault disappeared, taking care which breakers were being opened and closed as they maybe supply essential loads at the time. It would be good practice to start with places such as the Galley and Laundry where faults are common.

21: Where on the ship is the Emergency Generator Located?

The Emergency Generator is located remotely from the Engine Room, usually on the Accommodation Deck or at Weather Deck Level or above.

22: What is the purpose of the Over Current Protection Trip?

The purpose of the Over Current Protection is to Trip the Generator in Overload situations. The Trip is usually set at 150% Operating Capacity and has a time delay of usually 20 seconds. This allows for short periods of Overload Currents. It also protects against a Short Circuit in the Generator.

23: What is the purpose of the Under Voltage Trip?

An Under Voltage Trip is fitted to all Generator Breakers. Its main function is to Trip the Breaker when severe Voltage Dip (around 50%) occurs. The Under Voltage Trip on a Generator Circuit Breaker also prevents it being closed when the Generator Voltage is very low or absent.

24: What is the Function of a Circuit Breaker?

The Circuit Breaker is an Isolating Switch that also acts as a Fuse. It has two designed ratings; one of normal safe working current, and the other against overload, which may also have a time delay.

25: When working on Batteries, what precautions should be taken?

Ensure the space is well ventilated, do not smoke or use naked lights and also wear protective clothing such as apron, gloves and face shield.

26: What Conditions are Necessary to Parallel two Generators? ?

The Speed of both Machines must be the Same i.e. the Frequency and the Voltages must be the Same and in Phase.

27: What are the Essentials supplied by the Emergency Switchboard?

Essentials are: Emergency Lighting, Alarms, Communications, Watertight Doors and other services necessary to maintain safety and to permit safe evacuation of the Ship by Lifeboats. Also you will find that a Steering Gear Motor, Emergency Air Start Compressor and Emergency Fire Pump Motor are supplied from the Emergency Switchboard.

28: What would you do if you found an Engineer in Electric Shock?

First raise the alarm then isolate or switch off the current.

If this is not possible, pull or push the victim away from the source, taking care not to make electrical contact with the victim or the electrical source, i.e. use something non-conductive.

Once the victim has been removed from the electrical source, if the breathing is feeble or ceased, artificial respiration should be started at once. Delay in starting artificial respiration can prove fatal.

Note: If artificial respiration is started at once, 70% of the victims recover. If there is 3 (three) minutes delay, only 20% of victims recover.

29: What are Batteries used for On-Board Ships?

They are used for supplying essential power to: Radio Equipment, Telephone Exchange, Fire Detection, General Alarm Circuits, etc. These Systems are often supplied from two sets of batteries worked on a regular charge/discharge cycle.

They are also used as Emergency Supplies, i.e. for Emergency Generator Start-up and Emergency Lighting. Being used in this case in a "stand-by" role to give power when Main Supplies fail.

30: Give reasons why Protection Equipment is essential in an Electrical Distribution System.

- To disconnect and isolate faulty equipment in order to maintain the power supply to the remaining healthy circuits in the system.
- To prevent damage to equipment from the thermal and magnetic forces that occur during short circuit and overload faults.
- To protect personnel from electric shock.

31: What is meant by Protection Discrimination?

This is the ability of a Protection System to disconnect only Faulty Circuits and to maintain the Electrical Supplies to Healthy ones.

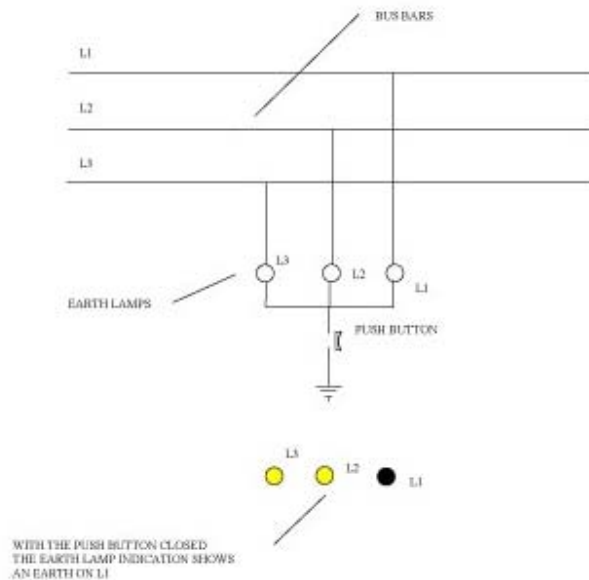
Discrimination is achieved by co-ordinating the Current Ratings and the Time Settings of the Fuses and Over-current Relays used between the Generator and the Load.

The Devices nearest the Load having the lowest Current Rating and shortest Operating Time; those nearest the Generator having the highest Current Rating and longest Operating Time.

i.e. a Motor Fault on a Centrifugal Pump would not cause the Generator Breaker to Trip.

32: Draw and explain how Earth Lamps works.

A direct earth on one pole will short circuit it's lamp, causing the other two to shine brightly.



33: What is Single Phasing of a Motor?

Single Phasing is where one of the 3-phase's supplying the Motor becomes disconnected. The Motor will continue to run if this happens and can result in Motor Burnout. The effect of Single Phasing is to increase the Current in the two remaining Lines and cause the Motor to become very noisy due to uneven Torque produced.

34: Explain what would happen if you were to lose a Generator.

First the Standby Generator set would start up and automatically put itself on the Board. If this did not happen, the Ship would "Black Out" and after a time delay, usually 30 seconds, the Emergency Generator would start up and supply the Emergency Switchboard, which supplies essential equipment.

35: Describe how Synchronising Lamps are used to Parallel a Generator.

This is normally used as a back-up or alternative way to the Synchroscope, the Lamps are connected between the Incoming Generator and the Bus-bars. The "Sequence Method" is the preferred one as it displays a rotation of Lamp Brightness, which indicates, whether the incoming machine is running fast (clockwise) or slow (anti clockwise). As with the Synchroscope, the Lamp Sequence must appear to rotate slowly clockwise. Correct synchronisation occurs when the top or "Key" lamp is dark and the two bottom lamps are equally bright.

36: What Loads are considered Non-essential?

Loads considered as Non-essential are: Air Conditioning and Ventilation, Laundry, Galley, Refrigeration and Deck Equipment.

37: Explain Regulations regarding Power Supplies for Steering Gears.

The Electrical Power Supply must be from two widely separate supplies i.e. one from the Main Switchboard and the other from the Emergency Board.

Electrical leads and fuses are to allow 100% overload, giving only short circuit protection.

If failure does occur on one system, the stand-by system will cut in within 45 seconds. The Steering Motors will have sequential starting.

38: Why do you require Earth Lamps on 220V Distribution Board when you have them on the Main Switchboard?

You require Earth Lamps on the 220V Distribution Board as well as the Main Board, due to the air gap in step down transformer, i.e. 440V Earth Lamps can not detect Earth on 220V systems due to the gap.

39: Explain how the Emergency Generator starts up in the Event of Total Power Failure.

The Start-up of the Emergency Generator is initiated by an Electrical Relay, which monitors the normal Mains Power Supply. Falling Mains Frequency or Voltage causes the "start-up" relay to operate the Generator Starting Equipment. The Prime Mover may be electrically cranked from its own 24V battery and starter motor or air started from its own air reservoir fitted local to the Generator Engine. A manual start-up may also be initiated by push buttons in the Main Control Room and in the Emergency Generator Room.

Also when power loss occurs, the Breaker feeding the Emergency Switchboard from the Main Switchboard opens. This Breaker is interlocked with the Emergency Generator Breaker, which is normally open under normal circumstances, but in the event of Total Power Failure, this breaker will close when the Breaker feeding the Emergency Board from the Main Board opens. Thus the Emergency Generator will feed the Emergency Switchboard.

40: How would you go about finding an Earth Fault in the System?

Finding an Earth Fault would be by the process of elimination i.e. circuit breakers would be opened and closed until earth fault disappeared, taking care which breakers were being opened and closed as they maybe supply essential loads at the time. It would be good practice to start with places such as the Galley and Laundry where faults are common.