

# MAINTENANCE

## 22.1 Introduction

**22.1.1** Based on the findings of the risk assessment, appropriate control measures should be put into place to protect those who may be affected. This chapter highlights some areas which may require attention in respect of maintenance.

## 22.2 General

**22.2.1** No maintenance work or repair which might affect the supply of water to the fire main or sprinkler system should be started without the prior permission of the master and chief engineer.

**22.2.2** No alarm system should be isolated without the permission of the master and chief engineer.

**22.2.3** Means of access to fire fighting equipment, emergency escape routes and watertight doors should never be obstructed.

**22.2.4** Safety guards on machinery or equipment should only be removed when the machinery is not operating. If removal is essential for maintenance or examination of the equipment, the following precautions should be taken:

- removal should be authorised by a responsible person, and only a competent person should carry out the work or examination;
- there should be adequate clear space and lighting for the work to be done;
- anyone working close to the machinery should be told what the risks are and instructed in safe systems of work and precautions to take;
- a warning notice should be conspicuously posted.

**22.2.5** Solvents used for cleaning can be toxic, and should always be used in accordance with the manufacturers' instructions. The area should be well

ventilated, and in confined spaces, smoking should be prohibited.

## **22.3 Floor plates and handrails**

**22.3.1** Lifting handles should be used when a floor plate is removed or replaced. When lifting handles are not provided, the plate should be levered up with a suitable tool and a chock inserted before lifting. On no account should fingers be used to prise up the edges.

**22.3.2** Whenever floor plates or handrails are removed, warning notices should be posted, the openings should be effectively fenced or guarded and the area well-illuminated.

## **22.4 Maintenance of machinery**

**22.4.1** Before machinery is serviced or repaired, measures should be taken to prevent it being turned on or started automatically or from a remote control system.

- Electrically-operated machinery should be isolated from the power supply.
- Steam-operated machinery should have both steam and exhaust valves securely closed and, where possible, the valves locked or tied shut or some other means employed to indicate that the valves should not be opened. The same care is required when dealing with heated water under pressure as is required when working on steam-operated machinery or pipework.
- In all cases, warning notices should be posted at or near the controls giving warning that the machinery concerned is not to be used.

**22.4.2** Where valves or filter covers have to be removed or similar operations have to be performed on pressurised systems, that part of the system should be isolated by closing the appropriate valves. Drain cocks should be opened to ensure that pressure is off the system.

**22.4.3** When joints of pipes, fittings etc are being broken, the fastenings should not be completely removed until the joint has been broken and it has

been established that no pressure remains within.

**22.4.4** Before a section of the steam pipe system is opened to the steam supply, all drains should be opened. Steam should be admitted very slowly and the drains kept open until all the water has been expelled.

**22.4.5** Maintenance or repairs to, or immediately adjacent to, moving machinery should be permitted only in circumstances where no danger exists or where it is impracticable for the machinery to be stopped. Close-fitting clothing should be worn and long hair should be covered (see 4.5.5). The officer in charge should consider whether it is necessary in the interests of safety for a second person to be in close attendance whilst the work is being carried out.

**22.4.6** Heavy parts of dismantled machinery temporarily put aside should be firmly secured against movement in a seaway and, as far as practicable, be clear of walkways. Sharp projections on them should be covered when reasonably practicable.

**22.4.7** Spare gear, tools and other equipment or material should never be left lying around, especially near to stabiliser or steering gear rams and switchboards.

**22.4.8** A marlin spike, steel rod, or other suitable device should be used to align holes in machinery being reassembled or mounted; fingers should never be used.

**22.4.9** When guards or other safety devices have been removed from machinery, they should be replaced immediately the work is completed and before the machinery or equipment is tested.

**22.4.10** An approved safety lamp should always be used for illuminating spaces where oil or oil vapour is present. Vapour should be dispersed by

ventilation before work is done.

## **22.5 Boilers**

**22.5.1** Boilers should be opened only under the direction of an engineering officer. Care should be taken to check, after emptying, that the vacuum is broken before manhole doors are removed. Even if an air cock has been opened to break the vacuum, the practice should always be to loosen the manhole door nuts and break the joint before the removal of the dogs and knocking in the doors. The top manhole doors should be removed first. Personnel should stand clear of hot vapour when doors are opened.

**22.5.2** Workers should not enter any boiler, boiler furnace or boiler flue until it has cooled sufficiently to make work in such places safe.

**22.5.3** Before entry is permitted to a boiler which is part of a range of two or more boilers, the engineering officer in charge should ensure that either:

- (a) all inlets through which steam or water might enter the boiler from any other part of the range have been disconnected, drained and left open to atmosphere;
- or, where that is not practicable;
- (b) all valves or cocks, including blowdown valves controlling entry of steam or water, have been closed and securely locked, and notices posted to prevent them being opened again until authorisation is given.

The above precautions should be maintained whilst personnel remain in the boiler.

**22.5.4** Workers cleaning tubes, scaling boilers, and cleaning backends, should wear appropriate protective clothing and equipment including clothing and respirators. Employers should also ensure that Workers familiarise themselves with the accompanying data sheet to any chemical agents they may use in the course of their work. They should also be aware of the potentially hazardous gaseous by-products which may be produced from the reaction of the cleaner/de-scaling product and the object itself or products

used together, as this may result in an asphyxiating, explosive or other hazardous atmosphere.

**22.5.5** A boiler is a confined space, and therefore potentially a dangerous space. Special care should be exercised before a boiler is entered which has not been in use for some time or where chemicals have been used to prevent rust forming. The atmosphere may be deficient in oxygen and tests should be carried out before any person is allowed to enter. See Chapter 17 for advice on entering enclosed spaces.

## **22.6 Auxiliary machinery and equipment**

**22.6.1** Before work is started on an electric generator or auxiliary machine, the machine should be stopped and the starting air valve or similar device should be secured so that it cannot be operated. A notice should be posted warning that the machine is not to be started nor the turning gear used. To avoid the danger of motoring and electric shock to any person working on the machine, it should be isolated electrically from the switchboard or starter before work is commenced. The circuit-breaker should be opened and a notice posted at the switchboard warning personnel that the breaker is NOT to be closed. Where practicable, the circuit-breaker should be locked open.

**22.6.2** No attempt should be made to start a diesel engine without first barring round with the indicator cocks open. The barring gear should then be disengaged before starting the engine.

**22.6.3** Oily deposits of flammable material should never be allowed to build up in the way of diesel engine relief valves, crankcase explosion doors or scavenge belt safety discs.

**22.6.4** Flammable coatings should never be applied to the internal surfaces of air starting reservoirs.

**22.6.5** When testing a diesel engine fuel injector, or other high pressure parts of injection equipment, jets should not be allowed to spray unprotected skin.

**22.6.6** Oxygen should on no account be used for starting engines. To do so would probably cause a violent explosion.

## **22.7 Main engines**

**22.7.1** Where necessary, suitable staging, adequately secured, should be used to provide a working platform.

**22.7.2** Before anyone is allowed to enter or work in the main engine crankcase or gear case, the turning gear should be engaged and a warning notice posted at the start position. The spaces should be well ventilated and the atmosphere tested.

**22.7.3** Before the main engine turning gear is used, a check should be made to ensure that all personnel are clear of the crankcase and any moving part of the main engine, and that the duty deck officer has confirmed that the propeller is clear.

**22.7.4** If a hot bearing has been detected in a closed crankcase, the crankcase should not be opened until sufficient time has been allowed for the bearing to cool down, otherwise the entry of air could create an explosive air/oil vapour mixture.

**22.7.5** The opened crankcase or gear case should be well-ventilated to expel all flammable gases before any source of ignition, such as a portable lamp (unless of an approved safety type) is brought near to it.

**22.7.6** Before the main engine is restarted, a responsible engineer officer should check that the shaft is clear and inform the duty deck officer who should confirm that the propeller is clear.

## **22.8 Refrigeration machinery and refrigerated compartments**

**22.8.1** No one should enter a refrigerated chamber without first informing a responsible officer (see section 15.10). Should it be known or suspected that the refrigerant has leaked into any compartment, no attempt should be made to enter that compartment without appropriate precautions being taken.

**22.8.2** Personnel charging or repairing refrigeration plants should fully understand the precautions to be observed when handling the refrigerant.

**22.8.3** When refrigerant plants are being charged through a charging connection in the compressor suction line, it is sometimes the practice to heat the cylinder to evaporate the last of the liquid refrigerant. This should be done only by placing the cylinder in hot water or some similar indirect method and never by heating the cylinder directly with a blow lamp or other flame. Advice on the handling and storage of gas cylinders is given in section 23.8.

**22.8.4** If it is necessary for repair or maintenance to apply heat to vessels containing refrigerant, appropriate valves should be opened to prevent build-up of pressure within the vessels.

**22.8.5** Further advice on working with refrigeration plant is given in section 15.10.

## **22.9 Steering gear**

**22.9.1** Generally, work should not be done on steering gear when a ship is under way. If it is necessary to work on steering gear when the vessel is at sea, the ship should be stopped and suitable steps taken to immobilise the rudder by closing the valves on the hydraulic cylinders or by other appropriate and effective means.

## **22.10 Hydraulic and pneumatic equipment**

**22.10.1** Before repairs to or maintenance of hydraulic and pneumatic equipment is undertaken any load should be removed, or if this is not practical, adequately supported by other means. All pressure in the system should be released. The part being worked upon should be isolated from the power source and a warning notice displayed by the isolating valve, which should be locked.

**22.10.2** Precautions should be taken against the possibility of residual pressure being released when unions or joints are broken.

**22.10.3** Absolute cleanliness is essential to the proper and safe operation of hydraulic and pneumatic system; the working area and tools, as well as the system and its components, should be kept clean during servicing work. Care should also be taken to ensure that replacement units are clean and free from any contamination, especially fluid passages.

**22.10.4** Only replacement components which comply with manufacturers' recommendations should be used. Any renewed or replacement item of equipment should be properly inspected or tested before being put into operation within the system.

**22.10.5** Since vapours from hydraulic fluid may be flammable, naked lights should be kept away from hydraulic equipment being tested or serviced.

**22.10.6** A jet of hydraulic fluid under pressure should never be allowed to spray onto unprotected skin. Any hydraulic fluid spilt on the skin should be thoroughly washed off.

## **22.11 Electrical equipment**

**22.11.1** The risks of electric shock are much greater on board ship than they are normally ashore because wetness, high humidity and high



temperature (including sweating) reduce the contact resistance of the body. In those conditions, severe and even fatal shocks may be caused at voltages as low as 60V. It should also be borne in mind that cuts and abrasions significantly reduce skin resistance.

**22.11.2** A notice of instructions on the treatment of electric shock should be posted in every place containing electrical equipment and switchgear. Immediate on the spot treatment of an unconscious patient is essential.

**22.11.3** Before any work is done on electrical equipment, fuses should be removed or circuit breakers opened to ensure that all related circuits are dead. If possible, switches and circuit breakers should be locked open or, alternatively, a 'not to be closed' notice attached (see section 22.6). Where a fuse has been removed, it should be retained by the person working on the equipment until the job is finished. A check should be made that any interlocks or other safety devices are operative. Additional precautions are necessary to ensure safety when work is to be undertaken on high voltage equipment (designed to operate at a nominal system voltage in excess of 1kV). The work should be carried out by, or under the direct supervision of, a competent person with sufficient technical knowledge and a permit-to-work system should be operated.

**22.11.4** Some parts of certain types of equipment may remain live even when the equipment is switched off. Power should always be cut off at the mains.

**22.11.5** Flammable materials should never be left or stored near switchboards.

**22.11.6** Work on or near live equipment should be avoided if possible but when it is essential for the safety of the ship or for testing purposes, the following precautions should be taken:

- A second person, who should be competent in the treatment of electric shock, should be continually in attendance.
- The working position adopted should be safe and secure to avoid accidental contact with the live parts. Insulated gloves should be worn where practicable.
- Contact with the deck, particularly if it is wet, should be avoided. Footwear may give inadequate insulation if it is damp or has metal studs or rivets. The use of a dry insulating mat at all times is recommended.
- Contact with bare metal should be avoided. A hand-to-hand shock is especially dangerous. To minimise the risk of a second contact should the working hand accidentally touch a live part, one hand should be kept in a trouser pocket whenever practicable.
- Wrist watches, metal identity bracelets and rings should be removed. They provide low resistance contacts with the skin. Metal fittings on clothing or footwear are also dangerous.

**22.11.7** Meter probes should have only minimum amounts of metal exposed and insulation of both probes should be in good condition. Care should be taken that the probes do not short circuit adjacent connections. When measuring voltages that are greater than 250V, the probe should be attached and removed with the circuit dead.

## **22.12 Main switchboards**

**22.12.1** The internal cleaning and maintenance of the Main Switchboard must only be carried out while it is in a “dead” condition; after a full **Risk Assessment** has been carried out, as described in **Chapter 1**; and, a formal **Permit-To-Work** issued, as described in **Chapter 16**.

**22.12.2** The Risk Assessment will identify the actions and checks required to make the Switchboard safe, and these actions and checks will be identified in the Permit-To-Work. The major checks to be listed on the Permit-To-Work will identify and verify that the necessary Inter-Connections to and from; and/

or within, the Main Switchboard are disconnected. These will include but are not limited to:

- (a) the Shore Power Supply,
- (b) the Emergency Generator,
- (c) the Emergency Power Supply,

**22.12.3** The internal cleaning and internal maintenance of the Main Switchboard would, in general, be an integral part of a ships dry-dock programme or that of an extended maintenance programme.

**22.12.4** Further safety guidance on working on electrical equipment is to be found in **22.11**.

## **22.13 Distribution switchboards**

**22.13.1** Safety guidance on working on electrical distribution switchboards is to be found in **22.11**.

## **22.14 Electrical machinery**

**22.14.1** Safety guidance on working on electrical machinery is to be found in **22.11**.

## **22.15 High Voltage Systems**

**22.15.1** Additional precautions are necessary to ensure safety when work is to be undertaken on high voltage equipment (designed to operate at a nominal system voltage in excess of 1kV).

### **22.15.2 Definitions**

The following defines the terms used with respect to the High Voltage Equipment / Installations

**Additional Earth** - An earth connection applied to apparatus after the application of a Circuit Main Earth, normally applied at the point of work if not already fitted with Circuit Main Earth.

**Approved** - A type of form sanctioned for use by the Superintendent / Senior Electrical Engineer.

**Authorised Person** - An Authorised Person is appropriately trained and appointed in writing by the Superintendent / Electrical Engineer to carry out work as permitted by these Rules.

**Caution Notice** - A notice conveying a warning against interference with the apparatus to which it is attached.

**Chief Engineer** – Senior Engineer onboard the vessel responsible for all vessel technical operations and maintenance.

**Circuit Main Earth** - An earth connection applied for the purpose of making apparatus safe to work on before a Permit to Work or Sanction for Test is issued and which is nominated on the document.

**Competent person** - A Competent Person is appropriately trained and has sufficient technical knowledge or experience to enable him to avoid danger. It is the duty of the Authorised Person issuing a permit to work covered by these Rules to satisfy himself that persons are competent to carry out the work involved.

**Danger Notice** - A notice calling attention to the danger of approach or interference with the apparatus to which it is attached.

**Dead** - At or about zero voltage and disconnected from all sources of electrical energy.

**Earthed** - Connected to the general mass of earth in such a manner as will ensure at all times an immediate discharge of electrical energy without danger.

**High Voltage** - A voltage exceeding 1000 Volts.

**High Voltage Apparatus** - Any apparatus, equipment or conductors normally operated at a voltage higher than 1000 Volts.

**Isolated** - The disconnection and separation of the electrical equipment from every source of electrical energy in such a way that this disconnection and separation is secure.

**Key safe** - A device for the secure retention of keys used to lock means of isolation, Earthing or other safety devices.

**Limitation of Access** - A form issued by an Authorised Person to a

Competent Person, defining the limits of the work to be carried out in the vicinity of, but not on, High Voltage electrical apparatus.

**Live** - Electrically charged from a supply of electricity.

**Permit to Work** - A form of declaration signed and given by an Authorised Person to a Competent Person in charge of the work to be carried out on or in close proximity to High Voltage Apparatus, making known to him the extent of the work, exactly what apparatus is Dead, is Isolated from all Live conductors, has been discharged and Earthed and, insofar as electric hazards are concerned, on which it is safe to work.

**Safety lock** - A lock used to secure points of isolation, safety devices and circuit earths, being unique from any other locks used on the system.

**Sanction for Test** - A form of declaration, signed and given by an Authorised Person to another Authorised Person in charge of testing High Voltage Apparatus making known to the recipient what apparatus is to be tested and the conditions under which the testing is to be carried out.

**Superintendent / Senior Electrical Engineer** - A senior Electrical/Mechanical Engineer suitably qualified and appointed in writing by the Company to be responsible for compilation and administration of rules for High Voltage Installations and Operations.

### **22.15.3** Work on High Voltage Equipment/Installations

No work shall be carried out on High Voltage Equipment/Installations unless the equipment/ installations are:

- (a) Dead
- (b) Isolated and all practicable steps have been taken to lock off live conductors, voltage transformers (except where the connections are bolted) and dead conductors that may become live.
- (c) Earthed at all points of disconnection of High Voltage supply and caution notices attached in English and any other working language of the vessel.
- (d) Released for work by the issue of a Permit to Work or a Sanction for Test.

- (e) The Competent Person designated to carry out the work fully understands the nature and scope of the work to be carried out and has witnessed a demonstration that the equipment/installation is dead at the point of work.

A Limitation of Access instruction should be used to give written instructions defining the limits of work to be carried out in the vicinity of but NOT on High Voltage Equipment/Installations.

#### **22.15.4** Operation of Switchgear

High Voltage switching shall only be carried out by an Authorised Person or by a Competent Person acting in the presence of and to the instructions of a person so Authorised or a person competent to do so and in the normal course of their duties and using equipment provided for the purpose.

In an emergency High Voltage switching to cut off supply may be carried out by any person competent to do so.

Any message relating to the operation of the High Voltage system and which has been transmitted by telephone/radio shall be repeated in full by the recipient and confirmed by the sender to ensure that the message has been accurately received.

Making Live or Dead by signals or pre-arranged understanding after an agreed time interval is not permitted.

#### **22.15.5** Withdrawn Apparatus

High Voltage Apparatus which has been Isolated and removed from its normal operating position may be worked on without a Permit to Work or Sanction for Test, provided that:

- (a) It has been discharged
- (b) It is prevented by barriers and locking from being restored to a Live

position.

(c) Access to High Voltage conductors on the switchboard is prevented.

#### **22.15.6** Locking Off

All spout (orifice) shutters not required for immediate work or operations shall be locked shut. (Exception: On certain types of switchgear, access to the shutters is restricted whilst the circuit breaker is still in the cubicle.

Under these circumstances it is acceptable to lock either the cubicle door or the racking mechanism, whichever is appropriate, which must prevent further withdrawal of the circuit breaker, so long as the circuit breaker has been withdrawn from its normal operating position).

#### **22.15.7** Protective Equipment

Protective equipment associated with the High Voltage Equipment/ Installations and forming part of the system shall not be adjusted, put into or taken out of commission without the sanction of the Chief Engineer or Superintendent / Senior Electrical Engineer.

High Voltage Equipment/Installations shall not be commissioned or re-commissioned (after major work) until the protective devices have been proved to be functioning correctly.

#### **22.15.8** Insulation Testing

All High Voltage Equipment/Installations which are either new or have undergone substantial maintenance or alteration shall be subject to a High Voltage test in accordance with figures approved in writing by the Chief Engineer or Superintendent / Electrical Engineer.

#### **22.15.9** Failure of Supply

During failures of supply all apparatus, equipment and conductors shall be regarded as being Live until Isolated and proved Dead.