PART 6 Electrical installations

Contents

CHAPTER 1 General requirements

Contents

SECTION 1 General

1.1 Scope

1.1.1 The requirements of this part apply to electrical installations where the aggregate generator capacity does not exceed 75 kW. Otherwise the requirements of Part 6 of the Society's "Rules and Regulations for the Classification and Construction of Steel Ships".

1.1.2 Electrical installations in machinery spaces with gasoline engines will be specially considered.

1.1.3 Supplementary to paragraph 1.1.1 yachts with the notation "COMMERCIAL YACHT" shall additionally meet the minimum requirements of Section 6 of this Chapter.

SECTION 2 Documentation

2.1 Documents for approval

2.1.1 The following drawings and data, as applicable, are to be submitted for approval before the commencement of work:

(a) electrical one line diagram,

(b) electrical switchboards and panelboards,

(c) electrical power and lighting systems,

(d) emergency electrical systems,

(e) internal communication system,

(f) alarm systems,

(g) navigating lights,

(h) propulsion control system,

(i) steering gear power and control systems,

(j) impressed current cathodic protection system,

(k) electrical load analysis.

SECTION 3 Installation

3.1 Equipment location

3.1.1 Electrical equipment is to be suitably placed and protected as to minimize the probability of mechanical injury or damage due to the accumulation of dust, oil vapours, steam or dripping liquids.

3.1.2 Apparatus liable to arc is to be ventilated or placed in ventilated compartments in which flammable gases, acid fumes and oil vapours cannot accumulate. Skylights and ventilators are to be so arranged as to avoid the probability of flooding the apparatus.

3.2 Protection from bilge water

3.2.1 All generators and motors are to be so arranged that they cannot be damaged by bilge water.

3.2.2 A watertight coaming is to be provided to form as well around the base of such equipment with provision for removing water from the wall, if it is considered necessary.

3.3 Accessibility

3.3.1 The design and arrangement of electrical apparatus is to provide accessibility to parts requiring inspection or adjustment.

3.4 Watertight equipment

3.4.1 All electrical equipment exposed to the weather or located in spaces where it would be exposed to seas, splashing or other severe moisture conditions is to be of the watertight type or be protected by means of watertight enclosures.

3.5 Corrosion resistant parts

3.5.1 Any parts of electrical equipment which would be damaged or rendered ineffective by corrosion are to be made of corrosion resistant materials.

3.6 Grounding of permanent equipment

3.6.1 Frames or cases of all permanently installed generators, motors, controllers, switchboards, panelboards, instruments and similar equipment, for which the arrangement and method of installation does not assure positive grounding are, normally, to be permanently grounded through separate conductors protected against damage.

3.6.2 Where outlets, switches and similar fittings are of non-metallic construction, grounding of all exposed metal parts is to be insured.

3.7 Lightning protection

3.7.1 A lightning-protection system consisting of a copper spike, and a copper conductor of cross sectional area at least 8 mm^2 is to be installed on each non-metallic mast. The spike is to project at least 150 mm above the uppermost part of the vessel, the conductor is to run clear of metal objects and as straight as practicable to the metallic steel structure of the vessel.

SECTION 4 Bridge control of propulsion machinery

4.1 General

4.1.1 The following are applicable for vessels with length L over 20 m.

4.2 Control capability

4.2.1 Under all sailing conditions, including manoeuvring, the speed, direction of thrust and, if applicable, the pitch of the propeller are to be fully controllable from the navigating bridge.

4.2.2 This control is to be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propulsion machinery.

4.3 Emergency stopping

4.3.1 The propulsion machinery is to be provided with an emergency stopping device on the navigating bridge which is independent from the bridge control system.

4.4 Order of control station command

4.4.1 Where multiple control stations are fitted, remote control of the propulsion machinery is to be possible only from one station at a time; at one control station interconnected control units are permitted. There is to be at each station an indicator showing which station is in control of the propulsion machinery.

4.4.2 The transfer of control between navigation bridge and machinery spaces is to be possible only in the machinery space.

4.5 Local control

4.5.1 It is to be possible to control essential machinery and the propelling machinery locally in the case of failure in any part of the automatic or remote control systems.

4.6 Bridge control indicators

4.6.1 Indicators for the following are to be fitted on the navigating bridge:

(a) Propeller speed and direction where fixed pitch propellers are fitted.

(b) Propeller speed and pitch position where controllable pitch propeller are fitted.

(c) An alarm is to be provided to indicate low starting air pressure and is to be set at a level which still permits main engine starting operation.

SECTION 5 Trials

5.1 Ship's Service

5.1.1 All auxiliary apparatus is to be tried under working conditions.

5.1.2 Each generator is to be run for a time sufficient to show satisfactory operations. When two or more generators arranged for parallel operation are installed, parallel operation with all possible combinations is to be demonstrated.

5.1.3 Each auxiliary motor necessary to the operation of the vessel is to be run for a time sufficient to

show satisfactory performance. All main switches and circuit breakers are to be operated but not necessarily at full load. The operation of the lighting system, heaters, etc., is to be demonstrated satisfactorily. The entire installation is to operate to the satisfaction of the Surveyors.

SECTION 6 Additional requirements for commercial yachts

6.1 General

6.1.1 Supplementary to paragraph 1.1.1 the requirements of this section shall apply additionally to yachts with the notation "COMMERCIAL YACHT". Moreover, for sailing vessels, this shall also cover the elements necessary to ensure safety of the vessel including control of the sails, where appropriate.

6.2 Yachts of less than 500 gross tons

6.2.1 Particular attention shall be paid to the provision of overload and short circuit protection of all circuits, except engine starting circuits supplied from batteries.

6.2.2 Electrical devices working in potentially hazardous areas, into which petroleum vapour or other hydrocarbon gas may leak, shall be of a type certified safe for the hazard.

6.2.3 Lighting circuits, including those for emergency lighting, shall be distributed through the spaces so that a total blackout cannot occur due to failure of a single protective device.

6.2.4 An emergency source of lighting shall be provided which shall be independent of the general lighting system. This source shall be sufficient for up to 3 hours duration and shall include navigation light supplies. The lighting is to provide sufficient lighting for personnel to escape from the accommodation or working spaces to their muster station, and launch and board survival craft. Additionally, this light, supplemented by torches, shall be sufficient to permit emergency repairs to machinery etc.

6.2.5 Batteries of a type suitable for marine use and not liable to leakage shall be used. Areas in which batteries are stowed shall be provided with appropriate ventilation to prevent an accumulation of gas which is emitted from batteries of all types.

6.2.6 Where batteries are used for propulsion and/or electric power supply purposes during ship operations, the Battery System design and operation shall consider the guidelines provided in L.H.R. "Guidance for the Classification and Construction of Commercial Yachts up to 60 meters", Appendix 4.

6.2.7 Emergency power shall be readily available to supply the required emergency lighting, radio installation and navigation aids for a minimum of 3 hours. As a minimum, the navigation aids to be supplied by emergency power to include Global Navigation Satellite System (GNSS), echo sounder and AIS. The emergency power supply shall be adequate to also supply any electrical emergency equipment fitted, such as fire pumps, bilge pumps, watertight doors, and rescue boat davit. The emergency source of power shall be independent of the main power supply, external to the engine room, and with separate distribution.

6.3 Yachts of 500 gross tons and over

6.3.1 The electrical equipment and its installation shall meet the standards of SOLAS II-1/Part D -Electrical installations and II-1/Part E -Additional requirements for periodically unattended machinery spaces for cargo vessels, where appropriate, so far as it is reasonable and practicable to do so.

6.3.2 The emergency generator, if fitted, should be located above the uppermost continuous deck but may be located below this deck provided it is protected from the effects of fire and flooding as follows: Not affected by flooding if the vessels sustains damage within one fifth of the (a) breadth of the ship, as defined

in Chapter 2, such distance being measured at right angles to the centerline at the level of the design waterline draught; and placed in a compartment with a minimum of 'A-30' Class boundaries and (b) provided with an automatic sprinkler, fire detection and fire alarm system. In all cases, the emergency generator should be separated from main generators and main switchboard by a division capable of ensuring its continued operation. The emergency generator should be self-contained (independent of a sea water suction) and readily accessible from the open deck.

6.3.3 Cables and wiring serving essential or emergency power, lighting, internal communications or signals shall be routed clear of galleys, machinery places of Category A and their casings, spaces for storage of petrol, and other high-risk fire areas.

6.3.4 Where batteries are used for propulsion and/or electric power supply purpose during ship operations, the Battery System shall consider the guidelines provided in Guidance, Chapter

6.4 Alternative design and arrangements (all yachts)

6.4.1 Vessels may follow Part 1, Chapter 2, Section 1.9 on Alternative Design and Arrangements for this chapter as allowed by SOLAS II-1/55.

6.4.2 The engineering analysis required by Part 1, Chapter 2, Section 1.9, Paragraph 1.9.3 shall be prepared and submitted to L.H.R., based on the guidelines (SOLAS chapters II-1 and III (MSC.1/Circ.1212)) and shall include, as a minimum, the following engineering analysis elements:

a) determination of the ship type, machinery, electrical installations and space(s) concerned;
b) identification of the prescriptive requirement(s) with which the machinery and electrical installations will not comply;
c) identification of the reason the proposed design will not meet the prescriptive requirements supported by compliance with other recognized engineering or industry standards;
d) determination of the performance criteria for the ship, machinery, electrical installation or the space(s) concerned addressed by the relevant prescriptive requirement(s):
    i. performance criteria shall provide a level of safety not inferior to the relevant prescriptive requirements contained in SOLAS II-1 parts C, D and E; and
    ii. performance criteria shall be quantifiable and measurable;
e) detailed description of the alternative design and arrangements, including a list of the assumptions used in the design and any proposed operational restrictions or conditions;
f) technical justification demonstrating that the alternative design and arrangements meet the safety performance criteria; and
g) risk assessment based on identification of the potential faults and hazards associated with the proposal.

CHAPTER 2 Installations of reduced capacity

Contents

Installations of reduced capacity

PART 6, CHAPTER 2

SECTION 1 General

1.1 Application

1.1.1 The requirements of this chapter are to be applied to electrical installations where the aggregate generator capacity does not exceed 75 kW.

1.2 Ambient temperature

1.2.1 In the requirements of this Chapter an ambiant temperature of 40°C has been assumed for all locations. Where the ambient temperature is in excess of this value, the total temperature specified is not to be exceeded. Where equipment has been rated on ambient temperature less than that contemplated, consideration will be given to the use of such equipment provided the total temperature for which the equipment is rated will not be exceeded.

SECTION 2 Generators

2.1 Capacity

2.1.1 Vessels using electricity for propulsion auxiliaries (e.g., independent fuel pumps, oil pumps) and the safety of the vessel, are to be provided with at least two generators. These generators are not to be driven by the same engine.

2.1.2 The capacity of the generator set or sets is to be sufficient to carry the necessary load essential for the propulsion and safety of the vessel, and minimum comfortable conditions of habitability with any one generator set in reserve.

2.1.3 Vessels having only one generator are to be provided with a battery source to supply sufficient lighting for safety.

2.2 Protection

2.2.1 Generators of less than 25 KW not arranged for parallel operation may be protected by fuses.

2.2.2 All generators of 25 KW and over are to be protected by a trip-free air circuit breaker providing longtime over-current protection not exceeding 15% above either the full-load rating of continuous-rated machines, or the overload rating of special-rated machines. The shutting down of the prime mover is to cause the tripping of the ship service generator circuit breaker.

SECTION 3 Storage batteries

3.1 Location

3.1.1 Storage batteries are to be located in well-ventilated areas as high above the bilges as possible and as far away as practicable from potential sources of ignition.

3.2 Installation

3.2.1 Lead-acid storage batteries are to be installed in liquid-tight trays lined with lead or other suitable materials.

3.2.2 Alkaline storage batteries are to be installed on suitable insulating supports, and when metal cell containers are used these are to be protected against conducting materials that can cause short- circuiting between the containers and metal structure.

3.2.3 Batteries are to have not less than 250 mm vertical clearance and are to be chocked all around to prevent their movement due to the motion of the vessel.

3.3 Charging

3.3.1 Means are to be provided for determining the charged condition of storage batteries and for charging them when necessary.

3.3.2 Where voltage-dropping resistors are utilized, they are to be mounted in a well-ventilated non-combustible enclosure situated away from other combustible material.

3.3.3 Battery-charging circuits are to have over-current and reverse-current protection. In addition a disconnect switch should be provided before the battery charger.

3.4 Connections

3.4.1 Connections to storage batteries are to be made with fitted connectors providing good mechanical and electrical unions. Spring clips or other temporary clamps are not to be used.

SECTION 4 Cables

4.1 Construction

4.1.1 Cables are to have copper conductors constructed and sized in accordance with a recognized standard and are to be of the stranded type, except sizes not exceeding 1,5 mm^2 may have solid conductors.

4.2 Installation

4.2.1 All wiring is to be placed as high as possible above the bilges, and cable runs are to be made without splices and be as straight and accessible as practicable.

4.2.2 Cables installed in machinery spaces are to have an insulation with a temperature rating of not less than 75°C. They are to be effectively supported and secured, and protected against mechanical damage.

4.2.3 Cables exposed to moisture are to be moisture-resisting jacketed. All cable entrances in exposed locations and all penetrations through watertight decks and bulkheads are to be made watertight.

SECTION 5 Distribution boxes and panels

5.1 Construction

5.1.1 Distribution boxes and panels are to be of non-combustible material and are to be preferably of the dead-front type. They may be of metal or of non-conductive material. If of metal, they are to be grounded in accordance with the requirements of Part 6, Chapter 1, SECTION 3, 3.6.

5.1.2 All terminal strips, fuse blocks, switches, and similar equipment are to be of non-combustible high-dielectric-strength insulating material.

5.2 Installation

5.2.1 Distribution boxes and panels are to be installed in dry accessible, and well-ventilated spaces.

5.2.2 Adequate clearance, not less than 610 mm, is to be provided in front of distribution boxes and panels. When located at the helm or other area adjacent to or part of an open cockpit or weather deck, they are to be protected by a watertight enclosure.

5.3 Instrumentation

5.3.1 For each installed generator the following instruments are to be provided:

(a) voltmeter,

(b) amperometer,

(c) frequency meter, and

(d) voltage regulator.

5.3.2 Control equipment and measuring instruments are to be provided as necessary to insure satisfactory operation of the generator or generators.

5.3.3 If the electrical installation is designed for single generator or non-parallel operation, the requirement for a frequency meter is not required.

5.3.4 In case of generators which may be operated in parallel, a synchroscope with lamp, prime mover control, and wattmeter is also to be provided.

SECTION 6 Protective devices

6.1 General

6.1.1 All conductors are to be protected in accordance with 6.2. Feeder and branch circuits for lighting, heating or ship's service power are to have each ungrounded conductor protected by a circuit breaker or fuse of suitable interrupting capacity.

6.1.2 Circuit breakers are to be of the independent-arm or trip-free type. Circuit breakers may be equipped with time trips, instantaneous trips or trips consisting of both time over-current and instantaneous features.

6.2 Over-current protection devices

6.2.1 Fuse rating and ratings (or settings, if adjustable) of time-delay trip elements of circuit breakers are not to exceed the rated current capacity of the conductor to be protected except as otherwise permitted for motor branch-circuit protection. If the standard ratings and settings of over- current devices do not correspond with the rating and setting allowed for conductors, the next higher standard rating setting may be used, but not exceeding 150% of the allowable current carrying capacity of the conductor. Except as otherwise permitted for motor branch-circuit protection, adjustable-trip circuit breakers of the time-delay or instantaneous type are to be set to operate at not more than 150% of the rated capacity of the conductor to be protected.

6.2.2 The rating or appropriate setting of the overload protective device for each circuit is to be permanently indicated at the location of the protective device.

6.2.3 Branch lighting circuits are to be protected by over-current protective devices rated or set at not more than 30 amperes. The connected load is not to exceed the rated current carrying capacity of the conductor or 80% of the over-current protective device rating or setting. Where the over-current protective device rating or setting exceeds 20 amperes, lighting fixtures are to be of the heavy duty type and switches are to be rated for the load controlled.

6.2.4 Isolated heaters or groups of heaters may be supplied by branch lighting circuits.

6.2.5 Running protection is to be provided for all motors except such protection is not to be provided for steering gear motors. The running protection is to be set between 100% and 125% of the motor rated current.

SECTION 7 Emergency source of power

7.1 General

7.1.1 All vessels having only one generator are to be provided with a source of emergency electrical power sufficient to supply emergency lighting for at least 6 hours. The power source may be any one of the following:

(a) An automatically connected or manually controlled standard battery; or

(b) An automatically or manually started generator; or

(c) Relay-controlled, battery-operated lanterns.

SECTION 8 Navigating running lights

8.1 General

8.1.1 Mast head, port, starboard, and stern lights when required are to be controlled by a running light indicator panel. A fused-feeder disconnect switch is to be provided; the rating of the fuses is to be at least twice that of the largest branch fuse and greater than the maximum panel load.

SECTION 9 Distribution cables

9.1 General

9.1.1 All electric cables for power, lighting, communication, control and electronic circuits are to have insulations suitable for a conductor temperature of not less than 75°C. The rated operating temperature for the insulating material is to be at least 10°C higher than the maximum ambient temperature likely to exist, or to be produced, in the space where the cable is installed.

9.1.2 Electric cables are not to enter oil tanks.

9.1.3 Cables are to be installed in such a manner that stresses on the cable are not transmitted to the conductors.

9.1.4 Joints in wires and cables are to be made in flame-retarding wire appliances. Special consideration may be given to methods of splicing that retain the original mechanical and electrical properties of the cable.

9.1.5 Terminal boxes are to be secured in place and the moisture-resistant jacket is to extend through the cable clamp.

9.1.6 Enclosures for outlets, switches, and similar fittings are to be flame and moisture-resistant, and of adequate mechanical strenght and rigidity to protect the contents and to prevent distortion under all likely conditions of service.

9.2 Cables behind paneling and in dome fixtures

9.2.1 Cables may be installed behind paneling, provided all connections are accessible and the location of concealed connection boxes is indicated.

9.2.2 Dome fixtures are to be installed so that they are vented, or they are to be fitted with fire- resistant material in such a manner as to protect the insulated wiring leading to the lamps and any exposed woodwork from excessive temperature.

9.3 Cables behind sheathing

9.3.1 Cables may be installed behind sheathing, but they are not to be installed behind or imbedded in structural insulation; they are to pass through such insulation at right angles and are to be protected by a continuous pipe with a stuffing tube at one end. For deck penetrations this stuffing tube is to be at the upper end of the pipe and for bulkhead penetrations it is to be on the uninsulated side of the bulkhead.

9.3.2 Cable supports and bends

Cables are to be adequately supported. Supports for cables are to be spaced not more than 0,61 m apart in both horizontal and vertical directions. Cables grouped in a single support are to be limited to two banks except for turnouts. Cables running transversely to the underside of beams are to be supported in cable racks or the equivalent. Cables are not to be bent to a smaller radius than 6 diameters (8 diameters for armored cable).

9.3.3 Deck and bulkhead penetrations.

Where cables pass through watertight, firetight, or smoke-tight bulkheads or decks, the penetrations are to be made through the use of approved stuffing tubes, transit devices, or pourable materials which will maintain the watertight, firetight or smoke-tight integrity of the bulkheads or decks. Additionally, each stuffing tube, transit device, or pourable material is not to damage the cable physically or through chemical action or heat build-up. When cables pass through nonwatertight bulkheads where the bearing surface is less than 6,4 mm, the holes are to be fitted with bushings having rounded edges and a bearing surface of at least 6,4 mm, in length. Where cables pass through deck beams, or similar structural parts, all burrs are to be removed in way of the holes and care is to be taken to eliminate any sharp edges.

9.3.4 Grounding of cable metallic covering

Each armored cable and each mineral-insulated metal-sheathed cable is to have the metallic covering electrically and mechanically continuous and grounded to the metal hull of each end of the run except that final subcircuits may be grounded at the supply and only.

9.3.5 Mechanical properties

All cables liable to damage, such as in locations in way of hatches, open decks subject to seas, and where passing through decks, are to be protected by substantial metal shields, structural shapes, pipe or other equivalent means. All such coverings are to be of sufficient strength to provide effective protection to the cables, and if metallic, are to be electrically continuous and grounded to the metal hull. Horizontal pipes or the equivalent used for cable protection are to be provided with drainage holes and where they are carried through decks or bulkheads, arrangements are to be made to insure the integrity of the water or gas tightness of the structure.

SECTION 10 Splicing of electrical cables

10.1 Location

10.1.1 Electric cables are to be installed in continuous lengths between terminations; however, approved splices will be permitted when necessary to extend existing circuits for a vessel undergoing repair or alteration. Splicing procedure and location of splices are to be submitted for approval.

10.2 Installation

10.2.1 All splices are to be made after the cable is in place and are to be accessible for inspection. The

conductor splice is to be made using a pressure type butt connector by use of a one-cycle compression tool.

SECTION 11 Permanent watertight fixtures

11.1 General

11.1.1 Permanent watertight fixtures are to be corrosion-resistant and are to be used where exposed to the weather or splashing water. Lighting fixtures of this type are to be rendered watertight by means of glass globes protected by substantial guards. Watertight lighting fixtures are not required for any interior locations except for refrigerated compartments or where exposed to splashing water.

CHAPTER 3 FRP Hull vessels

Contents

SECTION 1 General requirements

1.1 General

1.1.1 In case of FRP hull vessels the additional requirements of this chapter should be taken into account.

1.2 Equipment grounding

1.2.1 All electrical encolsures, fittings and similar equipment are to be permanently grounded to the generator frame and engine bedplate with equipment grounding conductors that are at least as large as the conductors supplying the equipment.

1.2.2 All generator frames are to be connected with equipment grounding conductors at least as large as the generator conductors.

1.2.3 On systems using grounded neutrals, the neutral is not to be used as an equipment ground.

1.3 Lighting protection

1.3.1 A lighting-protection system consisting of a copper spike, a copper conductor of at least 8 and a grounding plate of not less than 450 cm^2 is to be installed.

1.3.2 The spike is to project at least 150 mm above the uppermost part of the vessel. The conductor is to run clear of metal objects and as straight as practicable.

1.3.3 The grounding plate is to be located so that it is immersed under all conditions of heel. Metallic rudders may be used as grounding plates.

CHAPTER 4 Aluminium hull vessels

Contents

SECTION 1 General requirements

1.1 General

1.1.1 In case of aluminium hull vessels, the additional requirements of this Chapter should be taken into account.

1.1.2 In general, electrical systems are to be isolated from the hull at all times or a suitable cathodic protection arrangement is to be provided. Floating ground systems between the engine and related machinery components may be installed where it is required. In addition to power supply systems, attention for maintaining electrical isolation is to be given to communication devices, instrumentation and shore-power systems where used.

1.2 DC systems

1.2.1 Batteries generally are not to be grounded to propulsion engines or related machinery components.

1.2.2 Where it is necessary for batteries to be grounded to the hull, the negative plies are to be connected to the hull.

1.2.3 Batteries for engine starting may be grounded to the engine.

1.3 AC systems

1.3.1 AC power supplies are to be isolated from the hull at all times. A high resistance continuity tester is to be carried on board in order that the electrical installation may be checked at the time of installation and at regular intervals to insure correct isolation of AC circuits.

1.4 Shore power

1.4.1 The shore electrical power is to enter the vessel through a 1:1 isolation transformer. Additional precautions to prevent electrolysis of the hull when docking are recommended.

1.5 Impressed current systems

1.5.1 Where impressed current cathodic protection systems are proposed, complete details, including types of anodes, voltages, arrangements and schematic of the wiring system, are to be submitted for review.

1.5.2 Cables for cathodic protection systems are not to be run through oil tanks. Where passing through cofferdams, pump-room and similar hazardous spaces, cables are to be encased in extra- heavy pipe, and are to be shielded from damage in cargo spaces and other areas where they may be exposed to mechanical damage.

1.5.3 If piping used is not aluminium, it is to be isolated from the hull.

1.5.4 Impressed current cathodic protection systems are to be equipped with alarm devices to indicate inadequate or excessive current and reversed polarity.