CHINA CLASSIFICATION SOCIETY

RULES FOR CLASSIFICATION OF OFFSHORE FLOATING INSTALLATION

PART VI ELECTRIC INSTALLATION

CCS OFFSHORE ENGINEERING TECHNOLOGY CENTER
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Contents

CHAPTER 1 GENERAL

Section 1 GENERAL PROVISIONS

1.1.1 General requirements

1.1.1.1 This PART applies to electrical installation intended for non-self-propelled floating installation.

For self-propelled floating installation, the propulsion devices are to be in compliance with applicable requirements of Rules for Classification of Sea-Going Steel Ships.

Electrical installation of column stabilized platform are to be in compliance with applicable requirements of Rules for Classification of Mobile Offshore Installation.

1.1.1.2 Although the requirements contained in this PART include those of IMO's International Convention for the Safety of Life at Sea, particular attention is to be given to any relevant statutory provisions of the Administration of the State in which the floating installation is registered.

1.1.1.3 The aspects not covered by this PART and the manufacturing and testing of the electrical equipment onboard the floating installation are to comply with the relevant requirements of the CCS Rules for Classification of Sea-Going Steel Ships, except that ambient conditions are to comply with this Chapter.

1.1.1.4 The equipment on floating installation for industrial production is only to be in compliance with the standards accepted by CCS and such standards are to be revised, where necessary, for ambient conditions.

1.1.1.5 In addition, the electrical installation are to comply with the applicable requirements in PART ONE of the Rules.

1.1.1.6 The electrical installation are to be such that:

(1) All electrical services necessary for maintaining the floating installation in normal operational and habitable conditions will be assured without recourse to the emergency source of power;

(2) Electrical services essential for safety will be assured in the event of failure of the main source of electrical power;

(3) The safety of personnel and the floating installation from electrical hazards will be assured.

1.1.2 Plans and information

1.1.2.1 The following required plans and information, as appropriate, are to be submitted to CCS for approval:

(1) Electrical loading calculations of main and emergency sources of electrical power;

(2) Calculations for short-circuit currents (for installation whose generator capacity is more than 250 kVA);

(3) Analysis for coordination of protective devices in compliance with the requirements of 2.5.1.1 and 2.5.4 of this PART (for installation with generators having a total capacity of more than 250 kVA and capable of being connected in parallel);

(4) Calculations of UPS (uninterruptible power system) capacity;

(5) Single line diagrams of main switchboard, in which the following are to be marked:

① type, specifications and setting of protective devices (e.g. short-circuit, overloading, reverse power and unloading protection);

② instrumentation;

③ synchronizing devices;

④ remote shutoff;

⑤ earth fault indication and alarm;

⑥ interlock;

(6) Single line diagrams of emergency switchboard (or emergency battery charging and discharging board), in which the following are to be marked:

① type, specifications and setting of the protective electrical installation (such as short-circuit, overloading protection);

② instrumentation;

③ earthing breakdown monitoring and alarm;

④ interlock;

(7) Diagrams of power system, in which the following are to be marked:

① main ratings of motors, transformers, batteries and electrical power and electronic equipment;

② all feeders connected to the main and emergency switchboards;

③ section boards (if fitted) and distribution boards;

④ type, size and current loads of cables;

⑤ type and main rating of breakers and fuse.

(8) Arrangement of electrical power equipment, in which the position of the following installation are to be marked:

① main and emergency generators;

② main and emergency switchboards (or emergency accumulator battery charging and discharging board);

③ emergency accumulator battery;

④ essential equipment.

(9) Electric tracer heating system (including calculations for electric tracer heating and electric tracer heating laying and installation diagram for typical nodes);

(10) Schematic diagrams of electrical system for oil transfer;

(11) Schematic diagrams and arrangement of main lighting;

(12) Schematic diagrams of emergency lighting, temporary emergency lighting (if fitted), and additional emergency lighting (if fitted);

(13) Arrangement of main cable runs (for high voltage electrical installation);

(14) Arrangement of the electrical equipment in hazardous areas, indicating all the electrical equipment in hazardous areas as well as the following equipment information:

① explosion types, explosion groups and temperature classes;

② degrees of protection;

③ categories of hazard in installation zones (where the categories of hazardous areas are not indicated in the plans).

(15) Harmonic calculation sheet of the power system of the unit;

(16) For floating installation with additional notations, drawings with corresponding additional notations shall be added to the drawings submitted for plan approval.

1.1.2.2 The specifications for electrical installation are to be submitted to CCS for information.

1.1.2.3 Additional plans and information may be required if considered necessary by CCS.

1.1.2.4 The electrical equipment manufacturers are to additionally submit the related plans and information for approval according to the relevant provisions by CCS.

1.1.3 Definitions

1.1.3.1 Essential equipment is the equipment necessary for the steering and safety of the floating installation and the special equipment on floating installation with special class notations.

(1) Abandoned system relying on electric power;

(2) Air compressors for starting essential machinery;

(3) Ballast pumps, bilge pumps, circulating and cooling water pumps, condense and circulating pumps, lubricating pumps, fuel oil pumps;

(4) Boiler system:

① forced draught fans;

② feed water pumps;

(5) Fire prevention, detection and suppression:

① fire and gas detection and alarm systems;

② fire pumps;

③ inert gas fans, washing towers and deck canned pumps;

④ automatic spraying system;

⑤ fixed gas or foam fire-extinguishing systems and fire extinguishing agent applying alarm system.

(6) Lighting system;

(7) Navigation equipment:

① navigation lights and special signal lights specified by the statutory requirements;

② navigation equipment (if required by the law).

(8) Oil-water separator;

(9) Valve remote control system;

(10) Draught fans in engine room and boiler room;

(11) Draught fans in dangerous area;

(12) Watertight doors and closing devices for other operations;

(13) Warping winch and anchor gear;

(14) Electric tracer heating system (if applicable);

(15) Internal communication system of floating installation;

(16) Turret machines which are important for maintaining the safety of floating installation;

(17) Essential oil & gas processing equipment;

(18) Emergency shutoff system of crude oil pipelines;

(19) Ballasting system;

(20) Power supply and distribution systems provided for above mentioned equipment.

1.1.3.2 Non-essential equipment is that whose temporary disconnection will not impair propulsion and steer of the floating installation, nor endanger the safety of passengers, crew, floating installation and machinery.

1.1.3.3 Emergency consumer is a consumer which, after loss of the main source of electrical power, must be supplied by the emergency source of electrical power.

1.1.3.4 Main source of electrical power is a source intended to supply electrical power to the main switchboard for distribution to all services necessary for maintaining the installation in normal operational and habitable condition.

1.1.3.5 Emergency source of electrical power is a source of electrical power, intended to supply the emergency switchboard in the event of failure of the supply from the main source of electrical power.

1.1.3.6 Dead ship condition is the condition under which the main propulsion plant, boilers and auxiliaries are not in operation and in restoring the propulsion, no stored energy for starting and operating the propulsion plant, the main source of electrical power and other essential auxiliaries is assumed to be available.

1.1.3.7 Primary distribution system is a system having electrical connection with the generator.

1.1.3.8 Secondary distribution system is a system having no electrical connection with the generator, e.g. isolated therefrom by a double-wound transformer.

1.1.3.9 Low-voltage system is an alternating-current system operating with the maximum rated voltage not exceeding 1,000 V inclusive between conductors and with the rated frequency of 50 Hz or 60 Hz, or a direct-current system with the maximum instantaneous voltage under rated operating conditions does not exceed 1,500 V between conductors.

1.1.3.10 High-voltage system is an alternating-current system operating with the rated voltage more than 1 kV but not exceeding 15 kV and with the rated frequency of 50 Hz or 60 Hz, or a direct-current system with the maximum instantaneous voltage under rated operating conditions exceed 1,500 V between conductors. For system with the voltage exceeding this value, CCS's consent is to be obtained.

1.1.3.11 Switch gear and control gear assembly is a combination of one or more switch gears and means of control, measurement, signal, protection and adjustment etc., assembled by the manufacturer together with all internal electrical and mechanical connectors and components.

1.1.3.12 Main switchboard is a switchboard which is directly supplied by the main source of electrical power and is intended to control and distribute electrical energy to switch gear and control gear assemblies of the floating installation's services.

1.1.3.13 Emergency switchboard is a switchboard which, normally supplied by the main switchboard, in the event of failure of the main electrical power supply system is directly supplied by the emergency source of electrical power or the transitional source of emergency power and is intended to control and distribute electrical energy to switch gear and control gear assemblies of emergency services.

1.1.3.14 Distribution board is a switch gear and control gear assembly arranged for the control and distribution of electrical power to final sub-circuits.

1.1.3.15 Final sub-circuit is that portion of a wiring system extending beyond the final over-current device of a board.

1.1.3.16 Total discrimination (total selectivity) is an over-current discrimination where, in the presence of two or more over-current protection devices in series, the protective device on the load side effects the protection without causing the other protective devices to operate.

1.1.3.17 Partial discrimination (partial selectivity) is an over-current discrimination where, in the presence of two or more over-current protective devices in series, the protective device closest to the fault effects the protection up to a given level of short-circuit current without causing the other protective devices to operate.

1.1.3.18 Back-up protection is the protection equipment or system which is intended to operate when a system fault is not cleared in due time because of failure or inability of the protective device closest to the fault to operate or because of failure of the other protective device.

1.1.3.19 Continuity of power supply means that during and after a fault in a circuit, the supply to fault-free circuits is permanently ensured.

1.1.3.20 Dangerous space is a space where flammable or explosive vapour, gas or dust, or explosives may be normally expected to accumulate.

1.1.3.21 Enclosed space is a space sheltered by bulkhead and deck with doors, windows or other openings which may be opened or closed.

1.1.3.22 Semi-enclosed space is a space limited by top plates, wind breaks and bulkheads etc. in such a manner that the natural conditions of ventilation in the space are notably different from those obtained on open deck, and the gas is uneasily diffuse.

1.1.3.23 A blackout situation of floating installation is a situation where main and auxiliary machinery, including main power supply, are out of operation, but the services for bringing them into operation (e.g. compressed air, starting current from batteries, etc.) are available.

1.1.3.24 Shelf life of battery means the duration of storage under specified condition at the end of which a battery retains the ability to give a specified performance.

1.1.4 Testing

1.1.4.1 On completion of installation on the floating installation, the electrical installation are to be subject to mooring and sea trials in accordance with the test programme approved by CCS.

Section 2 ENVIRONMENTAL AND OPERATING CONDITIONS

1.2.1 Environmental conditions

1.2.1.1 Unless otherwise specified, all electrical equipment is to operate satisfactorily under the following environmental conditions:

(1) The ambient air temperatures are as given in Table 1.2.1.1(1), but the upper limit of ambient air temperature for the electrical equipment is to be 55°C;

Ambient Temperature Table 1.2.1.1(1)

Medium	Location	Temperature (°C)
Air	In closed spaces	0 to 45
	On open deck	-25 to 45
	Spaces equipped with generators and motors	Upper limit to 50

(2) The inclination and swing are given in Table 1.2.1.1 (2):

Inclination and Swing Table 1.2.1.1 (2)

Equipment components	Horizontal (°)①		Vertical (°)①	
	Static	Dynamic	Static	Dynamic
Safety-related equipment	15	22.5	5	7.5
Emergency power supply	22.5	22.5	10	10

Note: ① List and trim or rolling and pitching may occur simultaneously;

(3) The vibration and shock likely to arise under normal operation of installation;

(4) Moisture, sea air, oil vapours and mould.

(5) Petroleum gas and natural gas in dangerous areas;

(6) Special consideration will be given to the operating environment conditions of electrical equipment, e.g. floating installation which permanently works at the same fixed waters.

1.2.1.2 Where electrical equipment is installed within environmentally-controlled spaces, the ambient temperature for which the equipment is to be rated may be reduced from +45°C and maintained at a value not less than +35°C, provided:

(1) The equipment is not to be used for emergency services and is located outside of the machinery space(s);

(2) Temperature control is achieved by at least two independent cooling systems so arranged that in the event of loss of one cooling system for any reason, the remaining system(s) is capable of satisfactorily maintaining the design temperature;

(3) The equipment is to be able to initially start to work safely at a +45°C ambient temperature until such a time that the lesser ambient temperature may be achieved. The cooling equipment is to be rated for a 45°C ambient temperature;

(4) Audible and visual alarms are provided, at a continually-manned control station, to indicate any malfunction of the cooling systems.

(5) The related electrical cables for their entire length are to be adequately rated for the maximum ambient temperature to which they are exposed along their length.

1.2.1.3 The electrical equipment to be used in an environment containing sulfur dioxide, hydrogen sulphide, petroleum vapor or natural gas are to be suitable for such environmental conditions.

1.2.2 Voltage and frequency fluctuation

1.2.2.1 Electrical equipment is to operate satisfactorily under the voltage and frequency fluctuations (measured at the input end of the equipment) as given in Table 1.2.2.1.

Voltage and Frequency Fluctuations Table 1.2.2.1

Equipment		Parameters	Permanent (%)	Transient	
				(%)	Recovery Time (S)
General AC equipment		Voltage	+6～-10	±20	1.5
		Frequency	±5	±10	5
DC equipment supplied by DC generators or converted by rectifiers		Voltage	±10	--	--
		Voltage cyclic variation deviation	5	--	--
		Ripple voltage	10	--	--
Equipment supplied by accumulator batteries:	Connected to batteries during charging①	Voltage	＋30～-25	——	——
	Not connected to batteries during charging		＋20～-25	——	——

Note: ① Different voltage variations as determined by the charging/discharging characteristics, including ripple voltage from the charging device, are to be considered.

1.2.3 Harmonic components

1.2.3.1 AC electrical equipment shall be able to operate normally under the condition that the voltage harmonic component of the power supply is not more than 8%. When the harmonic component of power supply may be greater than 8%, attention shall be paid to equipment selection to ensure its normal operation. The single harmonic shall not exceed 5%.

Section 3 DESIGN, CONSTRUCTION AND INSTALLATION OF EQUIPMENT

1.3.1 General requirements

1.3.1.1 Electrical equipment is to be so designed, constructed and installed as to ensure safe operation and to facilitate inspection and repair. The operation and maintenance spaces are no less than the values specified in Table 1.3.1.1.

Operation and Maintenance Spaces Table 1.3.1.1

System voltage	Front	Rear
Less than 500V	0.8 m	0.6 m
Greater than 500 V and less than 1,000 V	0.8 m	0.8 m
Above 1,000 V	1.0 m	1.0 m

1.3.1.2 The distance between live parts of different potential and between live parts and earthed metal, whether across surfaces or in air, is to be adequate for the working voltage having regard to the nature of the insulating material and the conditions of service.

1.3.1.3 Equipment is not to remain alive through the control circuits or pilot lamps when switched off by the control switch. This does not apply to synchronizing switches and/or plugs.

1.3.1.4 All nuts and screws used for the connection and fastening of electrical equipment are to be effectively locked so that they cannot work loose by vibration.

1.3.1.5 The material which is used for manufacturing electrical equipment is to comply with the following requirements:

(1) It is to be durable, flame-retardant, moisture resistant unless it is adequately protected in the atmospheres and the temperatures to which it is likely to be exposed;

(2) Insulating materials and insulated windings are to be resistant to moisture, sea-air and oil vapour unless special precautions are taken to protect insulants against such agencies;

(3) The current-carrying parts of electrical equipment are, in general, to be made of corrosion-resistant copper or copper alloys;

(4) Metal parts of electrical equipment are to be covered with proper protective coating against corrosion unless they are made of satisfactory corrosion-resistant material；

(5) Asbestos is forbidden for newly installed electrical equipment.

1.3.1.6 If electrical fittings, not of aluminium, are connected to aluminium, suitable means is to be taken to prevent electrolytic corrosion.

1.3.1.7 All electrical equipment with internal wiring is to be attached with schematic or wiring diagrams marked with circuit designations. All terminals of electrical equipment are to be provided with durable labels or identification marks corresponding to those indicated in the diagrams.

1.3.1.8 The controls for emergency alarms are to be marked in red and to be provided with durable nameplates indicating their purposes.

1.3.1.9 Rheostats, starting and charging resistors, heating appliances and other apparatus likely to cause high temperatures are to be so placed or provided with suitable means that they will not cause excessive heat to adjacent materials or a risk of fire.

1.3.1.10 All electrical equipment is not to be installed in the immediate vicinity of the surfaces of oil compartments or oil tanks. If it is necessary to do so, electrical equipment is to be installed at a minimum distance of 50 mm from these surfaces, but the electrical apparatus mentioned in 1.3.1.9 is strictly prohibited to be installed in such a manner.

1.3.1.11 No socket is allowed in any enclosed fuel or lubricating oil separator room under the floor plates in machinery spaces.

1.3.1.12 All generating sets are to be installed with their shafts in parallel with the fore-and-after line of floating installation, and all horizontal motors are also to be installed, as far as practicable, with their shafts in parallel with the fore-and-aft line.

1.3.1.13 For all electrical equipment having a working voltage or a voltage to earth exceeding 50 V, other than those installed in a separate compartment, the live parts are to be so protected that they cannot be inadvertently touched.

1.3.1.14 Where the temperature of the enclosures of the electrical equipment is in excess of 80°C, suitable means are to be provided or suitable arrangement is to be made so as to protect the operators from being burnt due to inadvertent touching.

1.3.1.15 Holes are not to be drilled in watertight bulkheads, decks or boundary plating of deckhouses for the purpose of fitting the securing screws for the electrical equipment and cables.

1.3.1.16 Electrical equipment and cables are not to be fitted on the bottom shell plating.

1.3.1.17 Conductors and equipment are to be placed at a distance from the compass, or are to be so screened that the interfering of external magnetic field is negligible.

1.3.1.18 The oil-immersed electrical equipment is to be provided with proper oil receiver to prevent fire hazard due to medium oil leakage.

1.3.2 Type of protective enclosures

1.3.2.1 The type of protective enclosures for electrical equipment is to comply with the relevant standards[1] acceptable to CCS. The designation to indicate the degrees of protection consists of the characteristic letters IP followed by two numerals as follows:

IP × ×

| | └2nd characteristic numeral (see Table 1.3.2.1(2))

| └— 1st characteristic numeral (see Table 1.3.2.1(1))

└———Characteristic letters

[1] Refer to IEC Publication 60529: Classification of Degrees of Protection Provided by Enclosures or equivalent standards.

Degree of Protection Indicated by the First Characteristic Numeral Table 1.3.2.1 (1)

1st characteristic numeral	Degree of protection	
	Brief description	Definition
0	Non-protected	No special protection
1	Protected against solid objects greater than 50 mm	Large surface of human body, e.g. a hand (but no protection against deliberate access). Solid objects greater than 50 mm
2	Protected against solid objects greater than 12 mm	Fingers or similar objects not exceeding 80 mm. Solid objects greater than 12 mm
3	Protected against solid objects greater than 2.5 mm	Tools, wires, etc. of diameter or thickness greater than 2.5 mm. Solid objects greater than 2.5 mm
4	Protected against solid objects greater than 1.0 mm	Wires or strips of thickness greater than 1 mm. Solid objects not exceeding 1 mm
5	Dust-protected	Ingress of dust is not totally prevented, but dust allowed to enter is not to interfere with normal operation of equipment
6	Dust-tight	No ingress of dust

Degree of Protection Indicated by the Second Characteristic Numeral Table 1.3.2.1 (2)

2nd characteristic numeral	Degree of protection	
	Brief description	Definition
0	Non-protected	No special protection
1	Protected against dripping water	Vertically dripping is to have no harmful effect
2	Protected against dripping water when tilted water up to 15°	Dripping water is to have no harmful effect when the enclosure is tilted to any angle up to 15° from its normal position
3	Protected against spraying water	Water falling as spray at an angle up to 60° from the vertical is to have no harmful effect
4	Protected against splashing water	Water splashed against the enclosure from any direction is to have no harmful effect
5	Protected against water jets	Water projected by a nozzle against the enclosure from any direction is to have no harmful effect
6	Protected against heavy seas	Water from heavy seas or water projected in powerful jets is not to enter the enclosure in harmful quantities
7	Protected against effects of immersion	Ingress of water in a harmful quantity is not be possible when the enclosure is immersed in water under defined conditions of pressure and time
8	Protected against submersion	The equipment is suitable for continuous submersion in water under conditions to be specified by manufacturer. Note: Normally, the equipment is to be hermetically sealed. For certain types of equipment, however, water is allowed to enter in such a manner that it produces no harmful effects.

1.3.2.2 The type of protective enclosures selected for electrical equipment is to be appropriate to the conditions of the location at which such equipment is installed. The lowest degree of protection is to comply with Table 1.3.2.2.

Minimum Requirements for the Degree of Protection Table 1.3.2.2

(1)	(2)	(3)	(4) Equipment							
Location	Condition in location	Degree of protection	Switchboards, control gears, starter	Generators	Motors	Transformers, semiconductor converters	Luminaries	Heating appliances	Cooking appliances	Accessories (e.g. switch, junction box)
Dry accommodation spaces	Danger of touching live parts only	IP20	X	—	X	X	X	X	X	X
Dry control rooms			X	—	X	X	X	X	X	X
Control room (navigation bridge)	Danger of dripping water and/or moderate mechanical damage	IP22	X	—	X	X	X	X	X	X
Engine and boiler rooms above floor			X	X	X	X	X	X	X	IP44
Steering gear rooms			X	X	X	X	X	X	—	IP44
Refrigerating machinery rooms (excluding ammonia plants)			X	—	X	X	X	X	—	IP44
Emergency machinery rooms			X	X	X	X	X	X	—	IP44
General storage rooms			X	—	X	X	X	X	—	X
Pantries			X	—	X	X	X	X	X	IP44
Provision rooms			X	—	X	X	X	X	—	X
Bathrooms and showers	Increased danger of water and/or mechanical damage	IP34	—	—	—	—	X	IP44	—	IP55
Engine and boiler rooms below floor			—	—	IP44	—	X	IP44	—	IP55
Closed fuel oil separator rooms			IP44	—	IP44	—	X	IP44	—	IP55
Closed lub-oil separator rooms			IP44	—	IP44	—	X	IP44	—	IP55
Ballast pump rooms	Increased danger of water and/or mechanical damage	IP44	X	—	X	X	X	X	—	IP55
Refrigerated rooms			—	—	X	—	X	X	—	IP55
Refrigerated rooms			X	—	X	X	X	X	X	X
Shaft or pipe tunnels in double bottom	Danger of water spraying, serious mechanical damage, aggressive fumes	IP55	X	—	X	X	X	X	—	IP56
Production platform	Danger of rainwater and flushing	—	—	—	—	—	X	—	—	X
Main deck	Danger of sea wave and immersion	IP56	X	—	X	—	—	X	—	X

Note: ① "X" means that the requirements of column (3) are to be complied with, or if impossible, the requirements of note are to be satisfied. "—" means that the requirements of column (3) are generally not recommended.

② Where the protection is not achieved by the equipment itself, other means or the improvement of installation condition is to ensure the degree of protection required in the Table.

③ Where the electrical equipment is installed in the hazardous areas, provisions specified in Section 4 of this Chapter are to be satisfied.

1.3.2.3 In the engine room, the electrical and electronic equipment located within areas (see Fig. 1.3.2.3) protected by FWBLAFFS and those within adjacent areas exposed to direct spray are to have a degree of protection not less than IP44. Where the suitability of application in this area can be proved and approved by CCS, a lower degree of protection is permitted.

1.3.2.4 In the engine room, electrical and electronic equipment within adjacent areas (see Fig. 1.3.2.3) not exposed to direct spray may have a lower degree of protection provided evidence of suitability for use in these areas is submitted taking into account the design and equipment layout, e.g. position of inlet ventilation openings, current direction of cooling air, etc. to prevent or restrict the ingress of water mist/spray into the equipment.

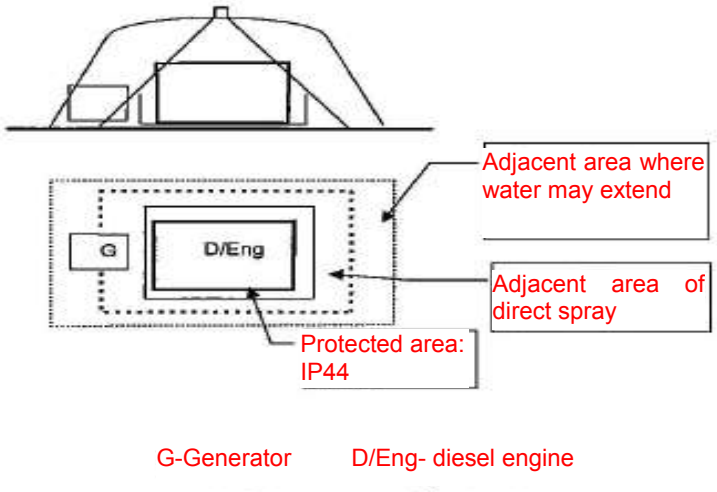

Fig. 1.3.2.3 Areas Protected by Fixed Water-Based Local Application Fire-Fighting Systems

1.3.3 Electromagnetic compatibility

1.3.3.1 Appropriate measures are to be taken to reduce the interference due to electromagnetic energy, so that all electrical and electronic installation can operate normally in an installation's electromagnetic environment.

1.3.3.2 The allowable value of the voltage (current) of the interference induced by electrical and electronic installation and the means of interference suppression are to comply with the relevant standards[2] acceptable to CCS.

1.3.4 Visual and audible signal

1.3.4.1 Except those required in 1.3.4.2 of the Section, the color code for visual signal is to comply with the requirements of Table 1.3.4.1.

[2] Refer to IEC Publication 60533: Electromagnetic Compatibility of Electrical and Electronic Installation in Ships, or the general requirements for electromagnetic compatibility of all electrical and electronic installation adopted by IMO Resolution A.813 (19);

Color Code of Visual Signal Table 1.3.4.1

Color	Meaning	Explanation	Example
Red	Danger or alarm	Warning of danger or a situation which requires immediate action	Operation failure of essential equipment; temperature or pressure of water, oil, etc. to a critical value; power failure of essential circuits
Yellow	Caution	Change or impending change of conditions	Temperature or pressure is abnormal but not to a critical value;
Green	Safety (normal operating or working conditions)	Indication of a safe situation	Normal operation of machinery; normal circulation of liquids; temperature, pressure, current, etc. within the limited value
Blue	Instruction/information (specific meaning assigned as needed in the case considered)	Blue may be given a meaning which is not covered by the three above colors: red, yellow and green	Motor begins to start; unloading generator begins to switch on; heating circuit of stopping motor is connected.
White	Meaningless	Any meaning, to be used if red, yellow or green is considered not applicable	Earthing insulation indication; synchroscope; telephone calling; equipment by automatic control

1.3.4.2 Except those required above, the visual and audible signals are to comply with the relevant regulations or standards[3] acceptable to CCS.

1.3.5 Harmonic distortion in power systems with harmonic filters[4]

1.3.5.1 The requirements 1.3.5.2 to 1.3.5.6 shall be met when installing harmonic filters on the main bus of the power system of the floating installation. Harmonic filters used only for variable frequency speed regulation of single equipment (such as motor of pump) and harmonic filters used for improving electromagnetic compatibility of single equipment/system may not meet this requirement.

1.3.5.2 The total harmonic distortion (THD) of the power system shall not exceed 8%. If this distortion limit is exceeded, all equipment shall be selected for a design for a higher specific distortion limit, and the harmonic distortion calculation shall be provided and kept on board for verification by the surveyors during periodic surveys.

1.3.5.3 Equipment capable of continuously monitoring harmonics in the main bus shall be installed and an alarm shall be given if acceptable limits are exceeded. Continuously monitored harmonic values shall be stored in the engine room centralized monitoring system or recorded in the engine log for inspection by the surveyors.

1.3.5.4 The distribution system integrator of the floating installation shall determine the effect of harmonic distortion when the harmonic filter fails by calculation. The distribution system integrator shall provide the shipowner with guidance documents specifying the permissible power system operation modes during normal navigation and harmonic filter failure, so as to maintain within acceptable distortion limits. The correctness of the above calculation results and guidance documents shall be verified by the surveyors during the debugging test.

1.3.5.5 Three-phase harmonic filters shall be provided with independent protection for single phase. The trigger of single-phase protection device shall automatically cut off the whole filter and give an alarm. In addition, the three-phase harmonic filter shall also be equipped with a three-phase current imbalance detection device independent of the overcurrent protection equipment, and an alarm shall be given when the current is unbalanced. The above alarm shall be set on the spot and/or in the place where there are people on duty.

1.3.5.6 Additional protection shall be considered for individual capacitive components (e.g., safety valves or overvoltage cut-off switches) to prevent rupture. Protective measures shall be determined according to capacitor

[3] Refer to the IMO Resolution A.1021 (26) Regulations for Alarms and Indicators.

[4] In addition to new devices, it is also suitable for floating installation that have modified harmonic filters and have been applied for regular inspection or temporary inspection on or after July 1, 2017.

type.

Section 4 EARTHING

1.4.1 Protective earthing

One point or multi-point earthing is to be adopted for systems, devices or equipment for electrical safety.

1.4.1.1 All non-current-carrying accessible metal parts of electrical equipment are to be earthed. Except the following parts:

(1) lamp caps;

(2) shades, reflectors and guards supported on lampholders or lighting fittings constructed of, or shrouded in, non-conducting material;

(3) metal parts on, or screws in or through, non-conducting material, which are separated by such material from current-carrying parts, and from earthed non-current-carrying parts, in such a way that in normal use they cannot become live or come into contact with earthed parts;

(4) portable appliances having double and/or reinforced insulation, provided that the appliances conform with recognized safety requirements;

(5) bearing housings which are insulated in order to prevent circulation of current in the bearings;

(6) clips for fluorescent lighting tubes;

(7) apparatus supplied at a working voltage not more than 50 V. For alternating current, this voltage is a value of root mean square between conductors. Auto-transformers are not to be used for the purpose of achieving this voltage;

(8) cable clips.

1.4.1.2 When the electrical equipment is directly fixed on the installation's metallic constructions or securely fixed on bedplates (or supports) which have a good electrical contact with installation's metallic constructions, a special earthing conductor may not be required.

1.4.1.3 Whether the earthing is achieved through a special conductor or by the equipment bedplates (or supports), the surfaces in contact are to be bright and smooth so as to ensure an effective contact, and means are to be provided to prevent the connections from loosening and corrosion.

1.4.1.4 When special earthing conductors are used, they are to be of copper or other corrosion-resistant materials of good conductance, and are to be protected against mechanical damage and corrosion where necessary. The nominal cross-sectional area of different types of copper earthing conductors is not to be less than required in Table 1.4.1.4.

1.4.1.5 Non-current-carrying exposed metal parts of movable or portable appliances, other than the parts, are to be earthed by means of an earth-continuity conductor in the flexible cable or cord, which is earthed through the associated plug and socket outlet, and the cross-sectional area of the earth conductor is to comply with the requirements of Table 1.4.1.4.

Sizes of Earthing Conductors Table 1.4.1.4

Types of earthing conductor	Cross-sectional area of associated current-carrying conductor S (mm^2)	Minimum cross-sectional area of copper earthing conductor Q (mm^2)
Earthing-continuity conductor in flexible cable or cord	S≤16	Q=S
	S＞16	Q=S/2, but not less than 16
Earthing-continuity conductor incorporated in fixed cable	S≤16	Q＝S, but no less than 1.5
	S＞16	Q=S/2, but not less than 16
Separate fixed earthing conductor	S≤2.5	Q＝S, but no less than 1.5
	2.5＜S≤120	Q=S/2, but not less than 4
	S＞120	Q＝70

1.4.1.6 Metal sheathings or coverings of cables are to be effectively earthed at both ends of the cable, except in final sub-circuits where earthing at the supply end only will be considered adequate. This does not necessarily apply to control and instrumentation cables where single point earthing may be desirable for technical reasons.

1.4.1.7 The metal sheathings or coverings of cables are to be earthed by one of the means described below:

(1) gripped by metal clamps and connected to the metal hull of the installation by copper earthing conductors. The relationship between the cross-sectional area Q of the copper earthing conductors and the cross-sectional area of the current-carrying conductors of the cables is to be as follows:

$Q \geq 1.5$ mm^2, when $S \leq 25$ mm^2;

$Q \geq 4$ mm^2, when $S > 25$ mm^2;

(2) by means of glands intended for this purpose and so designed as to ensure an effective earth connection;

(3) to be earthed by means of clamps or clips of corrosion-resistant metal making effective contact with the sheathings or coverings of cables and earthed metal.

1.4.1.8 The electrical continuity of all metal sheathings or coverings of cables throughout the length of the cable, particularly at joints and tappings, is to be ensured.

1.4.1.9 The lead sheath of lead-sheathed cables is not to be used as the sole means of earthing the non-current carrying parts of items of equipment.

1.4.1.10 The service earthing conductors used in the floating installation structure are to be of the same cross-sectional area as the conductors in the insulated pole (or phase).

1.4.1.11 The cross-sectional area of service earthing conductors which do not normally carry current is to be 50% of that of current-carrying conductors, but not less than 1.5 mm^2.

1.4.1.12 The system earthing of earthed distribution systems is to be effected by means independent of any earthing arrangement of normally non-current-carrying parts of the electrical equipment.

1.4.1.13 Every connection of an earth-continuity conductor or a special earthing conductor to floating installation structure is to be made in an accessible position, and is to be secured by a screw of brass or other corrosion-resistant material of a diameter not less than 4 mm which is to be used for this purpose only.

1.4.1.14 Metallic constructions, masts, helicopter decks and movable members of all derricks are to be effectively earthed and where this cannot be achieved through normal construction, special arrangements are to be provided for this purpose.

1.4.1.15 Where insulation mode is used to fasten the aluminum superstructure to the steel units to prevent electrolytic corrosion, separate jumper is to be set between superstructure and installation and the connection mode is to prevent electrolytic corrosion. The connection point is set where it is easy for inspection.

1.4.1.16 The rotating part of hoisting machinery is to be connected and earthed with fixed part reliable electricity.

1.4.2 Lightning protection

Earthing set for lightning protection equipment (lightning rod, lightning wire and arrester) to discharge lightning current to the ground.

1.4.2.1 Direct structure damage prevention

(1) Lighting protection system pursuant to the following requirements is to be set when electrical equipment is installed on the metallic construction of prominent high or there may be personnel in case of lightning:

① the resistance between air terminal and earth termination is not to be over 0.02 Ω;

② air terminal is composed of copper or copper alloy conductor rod with a diameter not less than 12 mm and 300 mm higher than the masthead. Other materials in accordance with 1.4.2.1 (1) ① may be used such as stainless steel, aluminium alloy and iron pole via anti-rust treatment. All materials are to be of seawater corrosion resistance.

③ air terminal is to be set to protect the vent of combustible gas at the top of mast or nearby; air terminal is at least to be higher than 2 m of vent. The metal mast may be used as the air terminal if it is 2 m higher than the vent.

④ copper strip with a cross-sectional area not less than 70 mm^2 is to be firmly connected with steel structure of floating installation when necessary; copper strip is to be insulated and round in order to prevent surface discharge. Other materials in accordance with 1.4.2.1 (1) ① may be used. The laying of downlead is to be straight line as much as possible. The bending radius is at least to be 10 times of conductor's equivalent diameter when bending is required. The connection of downlead is to be carried out by means of copper rivet or clamp without soft soldering connection.

(2) Effective electrical connection is to be carried out between various jackstays and steel structure of floating installation.

1.4.2.2 Indirect damage prevention

(1) On all floating installation, equipment is to be so installed as to minimize the effect of secondary damage caused by lightning to the electrical system.
(2) Metallic enclosures are to be reliably earthed. Particular attention is to be paid to navigation lights and other equipment at the top of masts and on other elevated structures.
(3) Cable screens or armour, though normally earthed for signal interference suppression, are not to provide the sole lightning path to earth for equipment. Separate earthing, as required in (2), is to be provided.
(4) The formation of cable loops, or metallic loops such as pipework, in proximity to down conductors of the protective system required in (2) is to be avoided. Cables in close proximity to down conductors are to be installed in metal pipes.
(5) Cables along decks are to be installed close to the deck and advantage is to be taken of the screening effect of earthed metallic structures near to or above the cable runs, for examples handrails, pipes, etc.
(6) Means are to be provided for the discharging to earth of any lightning energy that may be induced in for example radio and navigational equipment antennas. Consideration is to be given to installing devices such as spark gaps or surge diverters to provide protection from voltage transients.

1.4.3 Anti-static

Grounding is set to prevent inflammable oil, natural gas storage tank and pipeline from dangerous effect of static electricity.

1.4.3.1 Measures are to be taken to avoid the hazards caused by the electrostatic discharge of the flowing of liquid/gas/steam and to make the resistance among oil compartment, slop tank, piping system, any surface of equipment and hull no more than 1 MΩ.

1.4.3.2 Bonding straps are required for cargo tanks (cabinet), process plant and piping systems, where the resistance between them and the hull exceeds 1 MΩ.

1.4.3.3 Special earthing metal bonding strap connected with hull is to be set if oil compartment, slop tank, piping system and equipment are not connected with hull permanently or the resistance among hulls is more than 1 MΩ. For example:

(1) Independent oil compartment;

(2) Oil compartment and piping separated with hull electricity;

(3) Pipeline connector of movable pipeline.

1.4.3.4 Jumper used for the anti-static electrical connection and earthing of equipment and piping system is to be designed and installed as follows:

(1) Clear to be seen and easy to find any defects;

(2) Made of copper conductor with a cross-sectional area not less than 10 mm^2 or other anti-corrosion metals with good conductivity;

(3) It is able to prevent mechanical damage and rust;

(4) Special screws made of brass with diameter not less than 4 mm or other anti-corrosion materials are to be used for tightening and the position is to be convenient for inspection and replacement.

1.4.3.5 Reliable electrical connection is to be set at every connector and at least two points of earthing of transmission or pipelines of oil and gas on the floating installation, compressed air, carbon dioxide and metal pipelines and equipment in the dry powder system.

1.4.3.6 Metal conductor must be used every 20 m to connect and earth the pipelines laid in parallel on the floating installation when the distance is less than 100 mm; Metal conductor must also be used to connect and earth when the crossing distance is less than 100 mm.

1.4.3.7 Reliable earthing is to be set for the head, end and branch piping of transmission piping of flammable liquids and gas.

1.4.3.8 Earthing is to be set for tanks storing flammable liquids and gas. For tanks with volume more than 50 m^3, at least two earthing is to be set along its diameter.

1.4.3.9 Earthing is to be set for the entrance of pipeline when the overhead pipelines on the floating installation enter the buildings. Earthing is to be repeated for at least once for the pipeline within 25 m from the pipeline entrance.

1.4.3.10 Anti-static earthing device across with shuttle tanker is to be set for floating installation. 35 mm^2 multistrand copper core cable is to be used to connect at 2 places to ensure equipotential connection under oil transmission.

1.4.3.11 Continuous electrical connection is to be kept between floating installation and hose, among hoses and between hose and shuttle tanker.

Section 5 ELECTRICAL EQUIPMENT IN HAZARDOUS AREAS

1.5.1 General requirements

1.5.1.1 Hazardous areas are divided as given in Chapter 7 of PART EIGHT. Electrical apparatus used in hazardous areas are to be manufactured, tested, marked and installed in accordance with international standards[5]。

1.5.1.2 Electrical equipment and wiring installed in hazardous areas is to be limited to that necessary for operational purposes. Only the cables and types of equipment described in this Chapter may be installed. Selection and installation of equipment and cables in hazardous areas is to be in accordance with international standards.

1.5.1.3 Cables are to be selected and laid in compliance with the relevant requirements of Section 11 of Chapter 2 of this PART in addition to 1.5.3 of this Section.

1.5.1.4 Socket outlets are in general not to be installed in areas or spaces subject to explosion hazard. Where it is necessary to do so, the sockets are to be selected in accordance with the relevant requirements 1.5.2 of this Section.

1.5.1.5 The socket outlets and plugs installed in the extended hazardous areas or spaces on the open deck are to be interlocked with a switch so that the plug can not be inserted or withdrawn when the switch is in the ON position, and the switch is to be capable of isolating all the poles or phases in the circuit.

1.5.1.6 When certified explosion-proof electrical equipment is permitted in hazardous areas, all switches and protective devices are to be capable of interrupting all poles or phases. Such equipment, switches and protective devices are to be clearly and permanently labeled for identification purpose.

1.5.1.7 Transmitting aerials and any associated riggings are to be sited well clear of flammable or explosive gas or vapor outlets.

1.5.1.8 Where lighting is necessary in a hazardous space, explosion-proof lighting points are to be arranged on at least two independent circuits with the lighting points distributed alternately so as to permit light from one circuit to be retained while maintenance is carried out on the other. The lighting in such spaces is to be controlled by a separate control box located in non-hazardous areas or spaces. Each sub-circuit is to be provided with an indicating lamp. The switches and protective devices are to be clearly and permanently labeled for identification purpose.

1.5.1.9 A device is to be installed to continuously monitor the insulation level, particularly of circuits (other than intrinsically safe circuits) which pass through hazardous areas or spaces or which are connected to apparatus installed in such areas or spaces. The device is to operate an alarm in the event of an abnormally low level of insulation.

[5] Refer to IEC Publication 60079: Electrical Apparatus for Explosive Gas Atmosphere or other equivalent standards, e.g.: GB3836 Explosion-proof Electrical Apparatus for Explosive gas Atmosphere, etc.

1.5.2 Explosion-proof electrical equipment

1.5.2.1 The explosion-proof electrical equipment is to be manufactured and tested in accordance with the relevant standards (same as 1.5.1.1 of this Section) acceptable to CCS and certified by a competent testing authority recognized by CCS.

In selection of electrical apparatus for use in hazardous areas, consideration is to be given to:

(1) The zone in which the apparatus will be used;

(2) The sensitivity to ignition of the gases or vapours likely to be present, expressed as a gas group;

(3) The sensitivity of the gases or vapours likely to be present to ignition by hot surfaces, expressed as a temperature classification.

1.5.2.2 The following types of explosion-proof electrical installation may be adopted on the floating installation:

(1) Intrinsically safe Ex "ia" or "ib"

(2) Explosion-proof Ex "d"

(3) Increased safety Ex "e"

(4) Overpressure ventilation Ex "p"

(5) Encapsulated Ex "m"

(6) Non-sparking v "n"

(7) Oil filling Ex "o"

(8) Powder filling Ex "q"

(9) Special Ex "s"

In addition, lamps of air-turbine-driven motors with pressurized enclosure are considered as pressurized explosion-proof.

1.5.2.3 The electrical equipment for hazardous areas is listed in Table 1.5.2.3.

1.5.2.4 All explosion-proof electrical equipment are to be of Group II suitable for use in flammable gas atmosphere.

1.5.2.5 When explosion-proof electrical installation of "i" or "d" type or some installation of "n" type are to be used, the appropriate Group is to be selected as appropriate according to the type of gas in the space, as shown in Table 1.5.2.5.

Explosive-proof electrical equipment applied in the danger area Table 1.5.2.3

Protection type	ia	ib	d	e	m	n	o	p	q	s
Zone 0	x									
Zone 1	x	x	x	x	x		x	x	x	
Zone 2	x	x	x	x	x	x	x	x	x	x

Categories of explosive-proof electrical installation Table 1.5.2.5

Group	IIA	IIB	IIC
Typical hazardous ambient gas	Petroleum vapor, ammonia	Volatilized paint	Acetylene gas, hydrogen gas

For the explosion-proof electrical installation, other than those of "i" and "d" types and some installation of "n" type, Group II is to be used without difference.

1.5.2.6 The explosion-proof electrical installation are divided into six classes with respect to their maximum surface temperatures during operation, and are to be properly selected according to the self-ignition point temperature, as shown in Table 1.5.2.6.

Temperature groups of the explosion-proof electrical installation Table 1.5.2.6

Temperature group	T1	T2	T3	T4	T5	T6
Surface maximum temperature °C	450	300	200	135	100	85

Note:① When a natural gas mixture composed mainly of methane is encountered in the space, Group II A and temperature class T3 may be taken.

② Electrical apparatus located in hazardous drilling well and mud processing areas is to meet at least Group II A and temperature class T3.

1.5.3 Cable types and runs in hazardous areas

1.5.3.1 All cables, other than those of intrinsically safe circuits, installed in hazard areas are to be protected with at least one of the following:

(1) A non-metallic impervious sheath in combination with braiding or other metallic covering;

(2) Copper or stainless sheath for mineral insulated cables only. Aluminium sheathed cables may be considered for special applications. Aluminium sheathed cables may be considered for special applications.

1.5.3.2 Cables of intrinsically safe circuits are to have a metallic shielding with at least a non-metallic external impervious sheath.

1.5.3.3 Electrical cables are to meet the following:

(1) In Zone-0 hazardous areas, only cables associated with "ia" equipment are allowed;

(2) Thermoplastic sheathed cables, thermosetting sheathed cables or elastomeric sheathed cables are to be used for fixed wiring in zone 2 areas;

(3) Flexible and portable cables, where necessary, used in zone 1 and zone 2 areas are to be to the satisfaction of the Administration;

(4) Permanently installed, fixed cable passing through zone 1 hazardous areas are to be fitted with conductive covering, braiding or sheathed for earth detection.

1.5.3.4 Where cables are immersed in the oil for a long period, the construction of the cables is to be such as to withstand the substances to which they can be exposed, or the cables are to be enclosed in casings (such as metallic pipes) capable of withstanding such substances.

1.5.3.5 Each intrinsically safe circuit is to have its own separate cable. Intrinsically safe circuits are to be laid separately with non-intrinsically safe circuits, e.g. neither lay these together in a cable bundle or pipe nor mount them under common clamps.

1.5.3.6 Where cables pass through gastight bulkheads or decks separating dangerous areas or spaces from non-dangerous areas or spaces, arrangements are to be such that gastight integrity of the bulkhead or deck is not impaired.

1.5.3.7 Cable runs are to be kept at an adequate distance from decks, bulkheads, oil tanks or pipes. When cables pass through bulkheads, the distance of the cables from steam pipe flanges is to be not less than 450 mm for steam pipes having a diameter greater than 75 mm, and not less than 300 mm for steam pipes having a diameter equal to or less than 75 mm.

1.5.3.8 Cables installed on deck or on gangways are to be protected against mechanical damage; Cables are to be installed so as to avoid strain or chafing and due allowance is to be made for expansion or working of the structure; Where expansion bends are fitted, they are to be accessible for maintenance, but it is not to be arranged within 3 meters from all the oil tank openings or gas or steam outlets.

1.5.3.9 Flexible cables or wires for portable electrical appliances are not to pass through hazardous areas or spaces.

1.5.3.10 Cables installed in crude oil pump rooms are to be suitably protected against mechanical damage.

1.5.3.11 Cables, other than those supplying lighting to crude oil pump rooms, are allowed only to pass through the pump room entrances, provided that they are to be installed in heavy gauge steel pipes with gastight joints or conduits.

1.5.3.12 Where corrosion may be expected, non-metallic impervious sheath is to be applied over the metal meshwork, metallic sheath or steel armour of the cable.

Chapter 2 ELECTRIC INSTALLATION

Section 1 MAIN SOURCE OF ELECTRICAL POWER

2.1.1 Main power supply

2.1.1.1 Every floating installation is to be provided with a main source of electrical power which is to include at least two generating sets.

2.1.1.2 The power of generators is to be such that in the event of any one generating set being stopped it will still be possible to supply the services referred to in 1.1.1.6 (1).

2.1.1.3 In alternating current systems with one generating set out of action, the remaining sets are to have sufficient reserve capacity to permit the starting of the largest motor in the unit without causing any motor to stall or any other devices to fail due to excessive voltage drop on the system.

2.1.1.4 The number, capacity and arrangement of power transformers or converters are to meet the following requirements if they constitute the necessary parts of the main electric power source system:

(1) The power transformers are to be such that with any one of them not in operation, the remaining transformer(s) is (are) sufficient to ensure the safe operation of equipment required for the normal propulsion and the safety of floating installation, and basic conditions of habitability are also to be ensured, which include at least adequate services for cooking, heating, domestic refrigeration, mechanical ventilation, sanitary and fresh water;

(2) Each transformer required is to be located as a separate unit with separate enclosure or equivalent, and is to be served by separate circuits on the primary and secondary sides;

(3) Each primary circuit is to be provided with switchgear and protection devices in each phase;

(4) Each of the secondary circuits is to be provided with a multi-pole isolating switch.

2.1.1.5 The busbar of main switchboard is to be subdivided into at least two parts which are normally to be connected by circuit breakers or other devices approved by CCS and so far as is practicable, the connection of generation sets and other duplicated equipment is to be equally divided between these parts;

2.1.1.6 When the main switchboard system of the floating installation is connected with battery and super capacitor as auxiliary power supply, it shall at least meet the following principles:

(1) Any failure of the battery and supercapacitor shall not affect the continuity and safety of the main power supply, and the operating conditions of the battery and super capacitor shall be clearly explained in the design specification of the floating installation;

(2) Charging and discharging conditions and isolation conditions of storage battery and super capacitor shall be included in coordinated protection analysis and short-circuit current calculation;

(3) Batteries and supercapacitors should be located in special compartments in principle;

(4) Hazard identification and analysis including ventilation, firefighting, alarm, release of combustible and toxic gases, etc. shall be carried out for batteries and super capacitors, and limit conditions including thermal runaway and possible secondary disasters of single independent batteries and super capacitors shall be analyzed;

(5) The power supply and cooling system of the battery cooling system shall be able to keep working continuously after thermal runaway and other faults of the battery, and the battery and cooling system shall not be arranged in the same place possible;

(6) The power supply of battery compartment ventilation system shall be independent of the battery itself;

(7) The power supply of the battery exhaust system shall be independent of the battery itself and work continuously to keep the negative pressure state in the pipeline;

(8) A combustible and toxic gas detector caused by thermal runaway of the battery shall be set in the pipeline of the battery exhaust system. Once it is confirmed that there is gas, the main switch of battery charging and discharging shall be cut off immediately, and an alarm shall be displayed in the central control room/cab.

2.1.1.7 Refer to CCS Guidelines for Survey of Hybrid Ships for specific performance and product inspection as

well as and inspection during and after construction of the system.

2.1.2 Installation of switchboard

2.1.2.1 The main switchboard is to be so placed relative to one main generating station that, as far as is practicable, the integrity of the normal electrical supply may be affected only by a fire or other casualty in one space. An environmental enclosure for the main switchboard, such as may be provided by a machinery control room situated within the main boundaries of the space, is not to be considered as separating the switchboards from the generators.

2.1.2.2 Water, oil or steam pipes, oil tanks or other liquid containers are not to be installed above or behind the switchboards, if they are unavoidable, suitable protection is to be provided in these positions.

2.1.2.3 In addition to main switchboards installed in machinery control room, a door with lock is to be provided at the access to the passageway behind switchboards maintained in the back. Where the length of switchboard is greater than 6 m, access doors are to be provided at both ends of the passageway behind switchboards.

2.1.2.4 Non-slipping and oil-proof non-conducting mats or grating of impregnated wood are to be fitted in front and at the rear of the main switchboard.

Section 2 Emergency Souse of Electrical Power

2.2.1 General requirements

2.2.1.1 Every floating installation is to be provided with a self-contained emergency source of electrical power.

2.2.1.2 The emergency source of electrical power is to be so arranged as to comply with the following:

(1) The emergency source of electrical power and associated transforming equipment (if any), transitional source of emergency power, emergency switchboard and emergency lighting switchboard are to be located above the worst damage waterline and in a space not within the assumed extent of damage specified in Chapter 2 of PART THREE, and be readily accessible from open deck. They are not to be located forward of the collision bulkhead (if any);

(2) The location of the emergency source of electrical power and associated transforming equipment (if any), transitional source of emergency power, emergency switchboard and emergency lighting switchboard in relation to the main source of electrical power is to be such as to ensure to the satisfaction of CCS that a fire or other casualty in the space containing the main source of electrical power or in any machinery space of category A will not interfere with the supply or distribution of emergency power. As far as practicable, the space containing the emergency source of electrical power, the transitional source of emergency electrical power and the emergency switchboard is not to be continuous to boundaries of machinery spaces of category A or those spaces containing the main source of electrical power. Where the space containing the emergency source of electrical power, the transitional source of emergency electrical power and the emergency switchboard is contiguous to boundaries of machinery spaces of category A or those spaces containing the main source of electrical power, or to hazardous areas of Zone 1 or 2, the contiguous boundaries are to be in compliance with the requirements of Chapter 7 of PART EIGHT.

2.2.1.3 The emergency source of electrical power may be a generator, which is to comply with the following requirements:

(1) Driven by a diesel engine with an independent supply of fuel and cooling, and with an accessory starting arrangements complying with the relevant requirements; the flash point (closed-cup test) of the oil fuel is not to be less than 43°C;

(2) Started automatically upon failure of the main source of electrical power supply and connected automatically to the emergency switchboard, unless a transitional source of emergency electrical power in accordance with 2.2.1.5 of this Section is provided, and those services referred to in 2.2.2.2 of this Section are then to be transferred automatically to the emergency generating set;

(3) Provided with a transitional source of emergency electrical power as specified in 2.2.1.5 of this Section unless the emergency generator is capable of supplying the services mentioned in 2.2.2 and of being automatically started and carrying the required load as quickly and safe as is practicable, subject to a maximum of 45 s.

2.2.1.4 The emergency source of electrical power may also be an accumulator battery, which is to be capable of:

(1) Carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12 percent above or below its nominal voltage;

(2) Automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power;

(3) Supplying immediately at least those services specified in 2.2.2.1 of this Section.

2.2.1.5 A transitional source of emergency electrical power which consists of an accumulator battery is to be provided, unless an automatically started emergency generator in accordance with 2.2.1.3 is provided. The transitional source of emergency electrical power is to comply with the following requirements:

(1) Carrying the emergency electrical load without recharging while maintaining the voltage of the battery throughout the discharge period within 12 percent above or below its nominal voltage;

(2) Supplying immediately those services specified in 2.2.2.2 of this Section in the event of failure of either the main or emergency source of electrical power.

2.2.1.6 Where emergency electrical power is necessary to restore propulsion, the capacity is to be sufficient to restore propulsion to the installation in conjunction with other machinery, as appropriate, from a dead condition of the installation within 30 min after blackout.

2.2.1.7 The emergency switchboard is to be installed as near as is practicable to the emergency source of electrical power and to comply with the following requirements:

(1) Where the emergency source of electrical power is a generator, the emergency switchboard is to be located preferably in the same space with the emergency generator;

(2) The accumulator batteries provided as the emergency source of electrical power or the transitional source of emergency electrical power are not to be installed in the same space with the emergency switchboard;

(3) Water, oil and steam pipes, oil tanks and other liquid containers shall not be provided behind or above the emergency switchboard. If it cannot be avoided, there shall be reliable protective measures;

(4) The front of the emergency switchboard shall be paved with anti-skid and oil-resistant insulating carpet or insulated wood grille.

2.2.1.8 An indicator is to be mounted in a suitable place on the main switchboard or in the machinery control room to indicate when the batteries constituting either the emergency source of electrical power or transitional source of emergency electrical power are being discharged.

2.2.1.9 The emergency switchboard is to be supplied during normal operation from the main switchboard by an interconnector feeder which is to be adequately protected at the main switchboard against overload and short circuit and which is to be disconnected automatically at the emergency switchboard upon failure of the main source of electrical power.

2.2.1.10 In order to ensure ready availability of the emergency source of electrical power, arrangements are to be made where necessary to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that electrical power is to be available to the emergency circuits.

2.2.1.11 Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances, the emergency switchboard and the emergency generator may be used exceptionally, and for short periods, to supply non-emergency circuits.

2.2.1.12 Provision is to be made for the periodic testing of the complete emergency system, including the testing of automatic starting arrangements.

2.2.2 Scope and period of supply of the emergency source

2.2.2.1 The emergency source of electrical power available is to be sufficient to supply all essential services, with due regard being paid to such services as may have to be operated simultaneously. The emergency source of electrical power is to be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:

(1) For a period of 18 hours, emergency lighting:

① at every survival craft embarkation station on deck and outboard;

② in all services and accommodation alleyways, stairways and exits, personnel lift cars, and personnel lift trunks;

③ in the machinery spaces and main generating stations including their control positions;

④ in all control stations and in all machinery control rooms;

⑤ in all operation spaces and spaces for machinery control devices, generating equipment and emergency shutdown devices required for controlling the above working;

⑥ at stowage positions for firemen’s outfits;

⑦ on helicopter decks, including status lights for perimeter and helideck , illumination for wind direction indicator and related obstacle lights, if any;

(2) For a period of 96 hours, any signaling lights, or the sound signals which may be required for marking of offshore structures;

(3) For a period of 18 hours:

① navigation lights, other signaling lights and sound signals, required by the International Regulations for Preventing Collisions at Sea in force;

② the VHF radio installation, the MF radio installation (if any), the ship earth station (if any) and the MF/HF radio installation (if any) required by the Code for the Construction and Equipment of Mobile Offshore Drilling Installation in force;

③ Signaling lights for landing of helicopters and equipment for communication with helicopters;

(4) For a period of 18 hours:

① all internal communication equipment that required in an emergency;

② fire and gas detection and their alarm systems;

③ intermittent operation of the manual fire alarms and all internal signals that are required in an emergency;

④ the capability of closing the blow-out preventer and of disconnecting the floating installation from wellhead device, if electrically controlled; emergent separating and closing system for crude oil input pipeline, important oil and gas processing equipment and instruments, and emergency cut-off device;

⑤ turret machines which are important for maintaining the safety of floating installation (if applicable).

Unless such services mentioned above in ①to ④ have an independent supply for the period of 18 hours from an accumulator battery suitably located for use in an emergency;

(5) For a period of 18 hours, one of the fire pumps including feed pumps, if dependent upon the emergency generator for its source of power;

(6) For a period of at least 18 hours, the permanently installed diving equipment, if dependent upon source of power supplied by the installation;

(7) For a period of 0.5 hours:

① power to operate the watertight doors as provided by 4.2.1 of PART THREE but not necessarily all of them simultaneously, unless an independent temporary source of stored emergency is provided;

② power to operate the controls and indicators required by 4.2.2 of PART THREE;

2.2.2.2 The transitional source of emergency electrical power required by 2.2.1.5 is to be of sufficient capacity to supply at least the following services, if they depend upon an electrical source for their operation, for half an hour:

(1) The lighting required by 2.2.2.1 (1) to (2). For this transitional phase, the required emergency lighting, in respect of the machinery space and accommodation and service areas, may be provided by permanently fixed, individual accumulator lamps which are automatically charged and operated;

(2) All essential internal communication equipment required by 2.2.2.1 (4) ①and ②;

(3) Intermittent operation of the services referred to in 2.2.2.1 (4) ③ and ④;

Unless in respect of above (2) and (3), they have independent supply from an accumulator battery suitably located for use in an emergency and sufficient for the period specified.

2.2.3 Starting arrangements for emergency generators

2.2.3.1 Emergency generators are to be capable of being readily started in their cold condition down to a temperature of 0°C. If this is impracticable, or if lower temperatures are likely to be encountered, consideration is to be given to the provision and maintenance of heating arrangements, acceptable to the Administration, so that ready starting will be assured.

2.2.3.2 Each emergency generator which is arranged to be automatically started is to be equipped with starting arrangements acceptable to the Administration with a storage energy capability of at least three consecutive starts. A second source of energy is to be provided for an additional three starts within 30 min unless hand (manual) starting can be demonstrated to be effective.

2.2.3.3 Provision is to be made to maintain the stored energy at all times.

2.2.3.4 Electrical and hydraulic starting systems are to be maintained from the emergency switchboard.

2.2.3.5 Compressed air starting systems may be maintained by the main or auxiliary compressed air receivers, through a suitable non-return valve or by an emergency air compressor energized by the emergency switchboard.

2.2.3.6 All of these starting, charging and energy storing devices are to be located in the emergency generator room; these devices are to not be used for any purpose other than the operation of the emergency generator set. This does not preclude the supply to the air receiver of the emergency generator set from the main or auxiliary compressed air system through a non-return valve fitted in the emergency generator room.

2.2.3.7 When automatic starting is not required by these provisions and where it can be demonstrated as being effective, hand (manual) starting is permissible, such as manual cranking, inertia starters, manual hydraulic accumulators, or powder cartridges.

2.2.3.8 When hand (manual) starting is not practicable, the provisions in paragraphs 2.2.3.2 and 2.2.3.3 to 2.2.3.6 are to be complied with, except that starting may be manually initiated.

Section 3 EXTERNAL SUPPLY OF ELECTRICAL POWER

2.3.1 Shore power connections with rated voltage of 1kV and below

2.3.1.1 If the equipment on the floating installation is to be powered by shore power or other external power sources, a shore power box shall be provided on the floating installation at an appropriate place where it is convenient to connect flexible cables from external power sources, and the shore power box shall conform to the provisions of 3.3.2.11 of Chapter 3 of Part Four of Rules for Classification of Sea-Going Steel Ships. The shore power box shall be connected with the main switchboard or emergency switchboard by fixed cables with sufficient quota.

2.3.1.2 When the shore power and/or ship power system is an AC three-phase system with neutral grounding, facilities shall be provided to connect the hull with shore and ground. When the ship power system is a DC system with the hull as the loop, the negative electrode of shore power shall be connected to the hull.

2.3.1.3 Shore power indicators shall be provided on the main switchboard or emergency switchboard to indicate that shore power cables have been electrified.

2.3.1.4 If automatic control equipment is used to connect and disconnect shore power, the automatic control equipment shall meet the applicable requirements of Chapter 2 of Part Six of the Rules.

2.3.1.5 Except as specified in 2.3.1.6, interlocking devices shall be provided between all main and emergency generators and shore power to avoid simultaneous power supply.

2.3.1.6 If the system has the function of short-term parallel load transfer between shore power and floating installation power station, it shall meet the requirements of 19.2.5.3,19.2.5.4 and 19.2.6 of Chapter 19 of Part Eight of Rules for Classification of Sea-Going Steel Ships.

2.3.2 Shore power connections with rated voltage above 1kV

2.3.2.1 Shore power connection systems that transfer loads between shore power and floating installation power stations only by means of power failure shall at least meet the requirements of 19.2.1.2, 19.2.2, 19.2.3, 19.2.4, 19.2.5.2 and 19.2.6 of Chapter 19 of Part Eight of Rules for Classification of Sea-Going Steel Ships.

2.3.2.2 Shore power connection systems with short-term parallel load transfer between shore power and floating installation power unit shall at least meet the requirements of 19.2.1.2, 19.2.2, 19.2.3, 19.2.4, 19.2.5.3, 19.2.5.4 and 19.2.6 of Chapter 19 of Part Eight of Rules for Classification of Sea-Going Steel Ships.

2.3.2.3 Shore power equipment installed on the floating installation shall meet the requirements of Section 3 of Chapter 19 of Part Eight of Rules for Classification of Sea-Going Steel Ships.

Section 4 POWER SUPPLY AND DISTRIBUTION

2.4.1 Distribution systems

2.4.1.1 The following systems of distribution may be used:

(1) D.C.: two-wire insulated system;

(2) A.C.: single phase two-wire insulated system;

(3) A.C.: three phase three-wire insulated system;

(4) Three phase four-wire insulated system not using steel structure of the floating installation as middle point of circuit for earthing (including direct, high and low resistance earthing).

Subject to special approval by CCS, distribution systems other than those listed above may be used.

2.4.1.2 The floating installation structure is not to be used for power distribution, except that the current flowing through the floating installation structure may be acceptable:

(1) Impressed current cathodic protective systems;

(2) Limited and locally earthed systems, provided that any possible resulting current does not flow directly through any hazardous areas;

(3) Insulation level monitoring devices, provided the circulation current does not exceed 30 mA under the most unfavorable condition;

(4) Intrinsically safe circuits;

(5) Power supply, control and instrumentation circuits where technical or safety reasons preclude the use of a system with no connection to earth, provided the current in the hull is limited to not more than 5 A in both normal and fault conditions;

(6) Alternating current power networks of 1000 V root mean square (line to line) and over, provided that any possible resulting current does not flow directly through any hazardous spaces.

2.4.1.3 For power supply and distribution systems for high-voltage system, refer to the requirements of 2.12 of this PART.

2.4.2 Voltage and frequency

2.4.2.1 The maximum voltages of D.C. or A.C. distribution systems are not to exceed the values given in Table 2.4.2.1. The voltage levels above the values specified in 2.4.2.1 are to be approved by CCS, and comply with the relevant standards of IEC.

Maximum Voltages of Distribution System Table 2.4.2.1

No.	Application	Max. voltage (V)
1	For power equipment permanently installed, connected to fixed wiring	15,000
2	(1) For power, heating and cooking equipment permanently installed, connected to fixed wiring, except space heater in accommodation spaces; (2) For power and heating equipment (other than space heater in accommodation spaces) permanently installed where connection by flexible cable is necessary because of the application, e.g. movable cranes, etc.; (3) For portable equipment, which is not hand held during operation, connected by socket outlet and flexible cable which incorporates an earth continuity conductor, e.g. welding transformer.	1,000
3	(1) For lighting and heaters in accommodation and public spaces; (2) For socket outlets supplying the following types of portable apparatus: ① with double insulation earthed by means of an earth; ② equipment earthed with continuous conductor.	250
4	For socket outlets supplying portable apparatus used in spaces where particular risks due to conductivity may exit, e.g. exceptionally damp or confined spaces: (1) supplied or not supplied from an isolating transformer; (2) supplied from a safety isolating transformer supplying one consuming apparatus only, the two wires of those socket out lets are to be insulated to earth.	50 250

Note: ① For the control voltage of distribution systems above 500 V, see 2.4.2.2 of this Section.

2.4.2.2 For distribution systems above 500 V the control voltage is to be limited to 250 V, except when all control devices of the distribution system are enclosed in the related control box and the distribution voltage is not higher than 1,000 V.

2.4.2.3 The standard frequency for A.C. distribution systems is to be 50 Hz or 60 Hz.

2.4.3 Balance of loads

2.4.3.1 For A.C. three-wire or four-wire systems, the current-consuming units are to be so grouped in the final sub-circuits that the load on each phase will, under normal conditions, be balanced as far as possible within 15% of their respective rated load at the individual distribution and section boards as well as the main switchboard.

2.4.4 Insulated distribution systems

2.4.4.1 The neutral of generating sets are not to be connected together in the insulation distribution system.

2.4.4.2 The insulated distribution systems for power, heating and lighting, whether primary or secondary, are to be provided with a device capable of continuously monitoring the insulation level to earth and of giving an audible or visual indication of abnormally low insulation values.

2.4.5 Diversity factors

2.4.5.1 Circuits supplying two or more final sub-circuits are to be rated in accordance with the total connected load subject, where justified, to the application of a diversity factor. Where spare ways are provided on a section or distribution board, an allowance for future increase of load is to be added to the total connected load before application of any diversity factor.

2.4.5.2 The diversity factor may be applied to the calculation of the cross sectional area of conductors and rating of switchgear and fuse gear.

2.4.6 Power supply to essential equipment

2.4.6.1 Unless expressly provided otherwise, the essential equipment is to be supplied directly from the main or emergency switchboard (if required), except for the total discrimination.

2.4.7 Power supply to radio equipment and navigation equipment

2.4.7.1 The power supply to the radio equipment as required in Chapter IV (hereinafter referred to as the radio equipment) and the electrical/electronic navigation equipment as required in Chapter V (hereinafter referred to as the navigation equipment) of the SOLAS Convention are to comply with the requirements of 2.4.7.2 to 2.4.7.5.

2.4.7.2 The distribution board of supplies to the radio equipment is to be independent of that of supplies to the navigation equipment.

2.4.7.3 The distribution board of the radio equipment and that of the navigation equipment supplied by the emergency source of electrical power are to be supplied by separate feeders from main and emergency switchboards, and each distribution board is to be provided with a device for changing over between main and emergency sources of electrical power, which is in general to be initiated automatically.

2.4.7.4 Each consumer is to be supplied by an independent final sub-circuit from its distribution board.

2.4.7.5 One or more reserve power sources independent from the installation’s propulsion and electric systems are to be provided to supply the radio equipment for the purpose of distress and safety radio communications in the event of failure of the installation’s main and emergency sources of electrical power. The capacity of the reserve source or sources is to be sufficient to supply the following equipment simultaneously for 1 h:

(1) VHF radio installation;

(2) MF radio installation or ship earth station or MF/HF radio installation;

(3) Adequate illumination of radio control console for operating the radio equipment.

2.4.8 Power supply to auxiliary machinery motors, etc.

2.4.8.1 In addition to the above-mentioned requirements, the power supply to auxiliary machinery motors, illumination, navigation lights, internal communication systems and safety system for floating installation and persons on board is to comply with the relevant requirements of this PART.

2.4.9 Sockets

2.4.9.1 The sockets for general portable appliances are to be in compliance with the requirements of No.3 and No.4 in Table 2.4.2.1 of this Section.

2.4.9.2 For the sockets of distribution systems operating at different voltages and/or frequencies, non-interchangeable plugs are to be used for connection.

2.4.9.3 No socket outlets are to be provided below floor plates in machinery spaces, or in enclosed fuel and lubrication oil separator rooms.

2.4.9.4 Where sockets are necessary in cargo holds, they are to be fitted in positions with sufficient protection against mechanical damage.

2.4.9.5 Socket outlets for power circuits rated over 16A (AC) or 10A (DC) are to be interlocked in such a way that the plug can be neither inserted nor withdrawn when the socket contacts are live.

2.4.10 Power supply with transformers operating in parallel

2.4.10.1 Transformers arranged for parallel operation are to comply with the following requirements:

(1) Their winding connections are to be compatible;

(2) Their rated voltage ratios are to be equal (with tolerances within permissible limits);

(3) Their short-circuit impedance values are to be equal (if expressed in percentage, a ratio within 0.9 to 1.1 may be allowed);

(4) When transformers are intended for operation in parallel, the rated output of the smallest transformer in the group is not to be less than 50% of the rated output of the largest transformer in the group.

2.4.11 Power supply for safety, control and alarm systems of prime mover

2.4.11.1 The prime movers referred to in this paragraph means the prime movers drive the diesel engines, gas turbines and steam turbines which are composed of the generators of the main power supply.

2.4.11.2 The safety, control and alarm systems of prime movers are to be supplied by two independent sources of electrical power of which power supply and wiring are to be ensured to comply with 2.1.1.2 of this Chapter in event of single fault.

2.4.12 Power supply for electric control system of diesel engine

2.4.12.1 The power supply for electric control system of diesel engine is to meet the requirements of 2.2.4 in Appendix 2, Chapter 9 in PART THREE of CCS Rules for Classification of Sea-going Steel Ships.

Section 5 PROTECTION

2.5.1 General requirements

2.5.1.1 Electrical installation are to be suitably protected against overcurrent including short circuits, and other electric faults. The performance and arrangement of the protective devices are to provide complete and coordinated automatic protection to ensure the continuity of supply to available essential services through the discriminative action of the protective devices in the event of a fault elsewhere, and to ensure the elimination of the effects of the fault to reduce damage to the system and hazard of fire.

Coordination is to be provided:

(1) Between main generator protective device, main bus-bar section breakers (if provided with trip), protective devices (if fitted) of feeders connected to the main bus-bar, and protective devices of feeders from the main bus-bar;

(2) between protective devices of feeders and branch circuits of the distribution board containing essential services, unless otherwise specified in 2.5.3.6 of this Section;

(3) Between protective devices of feeders from the emergency generator and the emergency bus-bar, and between protective devices of feeders interconnecting main and emergency switchboards and feeders from the emergency bus-bar.

2.5.1.2 Short-circuit protection is to be provided in each non-earthed pole or phase of distribution systems.

2.5.1.3 Overload protection is to be provided in:

(1) Insulated two-wire DC or single-phase AC systems: at least one pole or phase;

(2) Insulated three-phase AC systems: at least two phases;

(3) earthed systems: each non-earthed pole or phase.

2.5.1.4 No fuse or non-linked switch is to be inserted in an earthed conductor of distribution systems.

2.5.2 Calculations of short-circuit current

2.5.2.1 In the calculation of the maximum prospective short-circuit current, consideration is to be given to:

(1) All generators which are possibly connected in parallel to reach the maximum required power;

(2) All motors which are normally simultaneously connected in the system.

2.5.2.2 When necessary, the prospective short-circuit power factor of the AC system is to be calculated. If the power factor so obtained is less than the specified one corresponding to the rated short-circuit making or breaking capacity of the selected switch gear, then the breaking capacity of such switch gear is to be reduced accordingly.

2.5.2.3 Short-circuit calculations are to be referred to PART FOUR: Short-Circuit Current Calculations with Regard to Electrical Installation in CCS Rules for Classification of Sea-going Steel Ships, or performed by other methods acceptable to CCS.

2.5.2.4 In general, short-circuit calculations are to be carried out for the following:

(1) Short circuit at the output terminal of generators;

(2) Short circuit at the main bus-bar;

(3) Short circuit at the bus-bars of the emergency switchboard, section switchboards and distribution switchboards;

(4) Short circuit at the secondary side of power and lighting transformers.

For the determination of the discriminative action of protective devices, short-circuit calculations are, if necessary, to be additionally performed for short-circuit at terminals of the protected circuit, when only the smallest generator is in supply.

2.5.3 Choice of protective devices against short-circuit

2.5.3.1 Protection against short-circuit currents is to be provided by circuit breakers or fuses.

2.5.3.2 Unless stated otherwise in 2.5.3.3 and 2.5.3.5, the breaking capacity of protective devices against short circuit is to comply with the following requirements:

(1) The rated short-circuit breaking capacity of circuit breakers and general fuses is not to be less than the maximum prospective short-circuit current at the point of installation. For the A.C. systems, the rated short-circuit breaking capacity is not to be less than the prospective symmetrical short-circuit current (root-mean-square value) at the point of installation;

(2) The rated operating short-circuit breaking capacity of circuit breakers for relevant circuit of essential equipment is not to be less than the maximum prospective short-circuit current at the point of installation. For the A.C. systems, the rated operating short-circuit breaking capacity is not to be less than the prospective symmetrical short-circuit current (root-mean-square value) at the point of installation.

2.5.3.3 The rated short-time withstanding current of category B circuit breakers (with short time-lag) is not to be less than the maximum prospective short-circuit current at the contact breaking time at the point of installation. For the A.C. systems, the rated short-time withstanding current is not to be less than the prospective symmetrical short-circuit current (root-mean-square) at the contact breaking time at the point of installation.

2.5.3.4 Unless stated otherwise in 2.5.3.5, the rated short-circuit making capacity of every circuit breaker or switch intended to be closed on a short circuit is to be not less than the maximum peak value of the prospective short-circuit current at the point of installation.

2.5.3.5 The use of a circuit breaker having a short-circuit breaking and/or making capacity less than the maximum prospective short-circuit current at the point where it is installed is permitted, provided that it is backed up by a fuse or by a circuit breaker on the generator side having at least the necessary short-circuit rating and not being the generator circuit breaker.

The short-circuit performance of the arrangement is to be at least equal to the requirements of the standards[6] accepted by CCS for a single circuit breaker having the same short circuit performance category as the backed-up circuit breaker and rated for the maximum prospective short-circuit level at the supply terminals of the arrangement.

[6] Refer to IEC Publication 60947-2: Low-Voltage Switch Gear and Control Gear – Part 2: Circuit-Breakers.

2.5.3.6 The back-up protection complying with the requirements of 2.5.3.5 may be used for non-essential services and essential service with automatic changing functions. The same fuse or circuit breaker may be used to back up more than one circuit breaker when essential services are not involved.

2.5.3.7 Circuit breakers with fuses connected to the load side may be used, provided the backup fuses and the circuit breakers are of coordinated design, in order to ensure that the operation of the fuse takes place in due time so as to prevent arcing between poles or against metal parts of the circuit breakers when they are submitted to overcurrent involving the operation of the fuse.

2.5.3.8 When determining the performance requirements for the above-mentioned back-up protection arrangement, it is permitted to take into account the impedance of the various circuit elements of the arrangement, such as the impedance of a cable connection when the backed-up circuit breaker is located away from the backup circuit breaker or fuse.

2.5.4 Selective protection for short circuit

2.5.4.1 Unless stated otherwise in 2.5.3.6, the short-circuit protection of essential equipment is to be selective and comply with the following:

(1) To ensure that only the switching device nearest to the fault initiates disconnection of the effective circuit in the case of short circuit;

(2) The tripping time of the protective devices connected in series is to be carefully coordinated;

(3) During the required time of selective protection, the switching device is to be capable of carrying the short-circuit current not breaking at the point of installation.

2.5.5 Choice of protective devices against overload

2.5.5.1 Circuit breakers provided for overload protection are to have a tripping characteristic overcorrect – trip time) adequate for the overload ability of the elements of the system to be protected and for any discrimination requirements.

2.5.5.2 The use of fuses for overload protection is permissible up to 320 A, provided they have suitable characteristics, but the use of circuit breakers or similar devices for overload protection is recommended above 200 A.

2.5.6 Protection of generators

2.5.6.1 Except as otherwise provided in 2.5.6.8 of this Section, circuit breakers capable of breaking all insulating poles at the same time shall be used for overload and short circuit protection of generators, and the overload protection shall be suitable for the heat capacity of generators. The overload protection shall meet the following requirements:

(1) For overloads between 10% and 50%, the circuit breaker is to be tripped with a time delay of less than 2 min. It is recommended that the circuit breaker be set within the limits of 125% to 135% of the rated current of the generator and with a time delay of 15 to 30 seconds;

(2) For overcurrent in excess of 50% but less than the steady short-circuit current of the generator, instantaneous tripping after a short-time delay is to be coordinated with the discriminative protection of the system. It is recommended that the pick-up current of the circuit breaker be set at 200% to 250% of the rated current of the generator and with a maximum time delay of 0.2 seconds (D.C.) or 0.6 seconds (A.C.);

(3) Circuit breakers for three or more than three generators connected in parallel are also to be provided with short-circuit instantaneous release which are to be set slightly greater than the maximum short-circuit current of the generators protected so that the circuit breaker may break instantaneously.

2.5.6.2 For generators rated at less than 50 kW (kVA) and not arranged to operate in parallel, a multi-pole linked switch with a fuse in each insulated pole may be fitted for protection.

2.5.6.3 Generators with a capacity of 1,500kVA or above shall be equipped with a suitable protection device or system to demagnetize the generator and break its circuit breaker in the event of a short circuit in the generator or in the supply cable between the generator and its circuit breaker. This requirement does not apply to emergency generators.

2.5.6.4 A.C. generators arranged to operate in parallel are to be provided with a reverse power protection, with a time delay set within 3 to 10 seconds. D.C. generators arranged for parallel operation are to be provided with instantaneous or short-time delayed (less than one second) reverse current protection. The setting of reverse power (or reverse current) protection of generators arranged for parallel operation, dependent on the types of prime mover used, is to be as follows:

(1) For diesel engines: 8% to 15% of the rated power (or current) of the generator;

(2) For steam turbines: 2% to 6% of the rated power (or current) of the generator.

A fall of 50% in the applied voltage is not to render the reverse power (or reverse current) protection inoperative, although it may alter the amount of reverse power required to open the breaker.

The reverse current protection is to be adequate to deal with the reverse current conditions emanating from the installation's network (e.g. cargo winches). When an equalizer connection is provided, the reverse current device is to be connected on the positive pole of D.C. generators.

2.5.6.5 Generators arranged to operate in parallel are to be provided with undervoltage protection which is to be as follows:

(1) The operation of undervoltage release is to be instantaneous, if used to prevent the circuit-breaker from closing when the generator is not generating electrical energy;

(2) When the voltage drops down to 70% ~ 35% of the rated voltage, the undervoltage release is to operate with a time delay for discrimination purpose.

2.5.6.6 Where turbine-driven D.C. generating sets are arranged to operate in parallel, means are to be provided for the purpose of opening simultaneously all circuit breakers of the generators when the over-speed tripping device of the driving turbine functions.

2.5.6.7 The protective arrangements associated with generators are to comply with the following requirements:

(1) They will remain to be effective even in the case of substantial reduction of speed of generators;

(2) They will permit the power to be restored immediately after the overload protective device operates.

2.5.6.8 Emergency generators shall be provided with short circuit protection. When the emergency generator is overloaded, it shall be able to send out auditory and visual alarm signals, without causing its circuit breaker to break.

2.5.7 Automatic load shedding

2.5.7.1 Proper load shedding arrangements are to be provided in order to disconnect automatically the excess non-essential load when any one of the generators is overload. This load shedding may be carried out in one or more stages according to the overload ability of the generating set.

2.5.8 Protection of power and lighting transformers

2.5.8.1 The primary windings of power and lighting transformers are to be protected against short circuit and overload by multi-pole circuit breakers or fuses. Overload protection may also be provided in the secondary windings.

2.5.8.2 When transformers are arranged to operate in parallel, means of isolation are to be provided on the secondary windings. Switches or circuit breakers used for this purpose are to be capable of withstanding surge currents.

2.5.9 Protection of feeder circuits

2.5.9.1 Each distribution circuit is to be protected against overload and short circuit by means of multi-pole circuit breakers arranged to open simultaneously all insulating poles, or a multi-pole switch and fuses.

2.5.9.2 When a multi-pole switch and fuses are used, the following requirements are to be complied with:

(1) The fuses in the distribution circuits from the main switchboard are to be installed between the busbar and the switch;

(2) For final sub-circuit from the distribution board, having a rated current not exceeding 60 A, and the consumers supplied by such sub-circuit and capable of being cut out at a nearby position, the switch may be omitted.

2.5.9.3 Circuits supplying consuming devices having individual overload protection (e.g. motors) may be provided with short-circuit protection only.

2.5.9.4 Permanently fixed cables between the shore connection box and the main switchboard are to be protected by a circuit breaker or an isolating switch and fuses. Such protection devices are to be fitted in the shore connection box.

2.5.9.5 In general, the interconnector feeder supplying the emergency switchboard from the main switchboard is to be protected at the main switchboard against overload and short circuit. Where the system is arranged for feed-back operation, the interconnector feeder is also to be protected at the emergency switchboard at least against short circuit.

2.5.9.6 The protection of the steering gear circuits is to comply with the relevant requirements of Section 1, Chapter 5 of PART FOUR of the Rules.

2.5.10 Protection of motors

2.5.10.1 Motors of rating exceeding 0.5 kW and all motors for essential services are to be protected individually against overload and short circuit, and also protected against undervoltage as required by 2.5.10.5 below.

The short-circuit protection may be provided by the same protective device for the motor and its supply cable.

2.5.10.2 The protective devices are to be designed to allow current to pass during the normal accelerating period of motors according to the conditions corresponding to normal use. When the time-current characteristics of the overload protective device of a motor are not adequate for the starting period of the motor, the overload protecting device may be rendered inoperative during the accelerating period provided that the protection against short circuit remains operative and that the suppression of the overload protection is only temporary.

2.5.10.3 For continuous duty motors, protective devices are to have a time delay characteristic which ensures reliable thermal protection of the motors for overload conditions. The maximum continuous current of the protective device is not to exceed 125% of the rated current.

2.5.10.4 For intermittent duty motors, the current setting and the delay characteristics for protective devices are to be chosen after considering the actual service conditions.

2.5.10.5 Motors are to be provided with either:

(1) Undervoltage protection, operative on the reduction or failure of voltage, to cause and maintain the interruption of power in the circuit until the motor is deliberately restarted; or

(2) Undervoltage release, operative on the reduction or failure of voltage, but so arranged that the motor restarts automatically and without excessive starting current on restoration of voltage.

The protective devices are to allow the motor to start when the voltage is above 85% of the rated voltage, and are without fail to intervene when the voltage is lower than approximately 20% of the rated voltage, at rated frequency, and with time delay when necessary.

2.5.10.6 When fuses are used to protect poly-phase motor circuits, consideration is to be given to protection against single phasing.

2.5.11 Protection of lighting circuits

2.5.11.1 Each lighting circuit is to be protected against overload and short circuit.

2.5.12 Protection of storage batteries

2.5.12.1 Storage batteries, other than engine starting batteries, are to be protected against short circuit with devices placed as near as practicable to the batteries.

2.5.12.2 Charging facilities are to be protected against reversal of current due to the reduction or loss of charging voltage.

2.5.13 Protection of meters, pilot lamps and control circuits

2.5.13.1 Voltmeters, voltage coils of measuring instruments, earth indicating devices and pilot lamps, together with their connecting leads are to be protected by fuses. A pilot lamp need not be individually protected provided the following conditions are satisfied:

(1) The pilot lamp is installed in the same enclosure and as an integral part of another item of the equipment;

(2) The pilot lamp is supplied from the interior circuit of the enclosure of the equipment;

(3) The protection device in the circuit is rated less than 25 A;

(4) A fault in a pilot lamp will not jeopardize the supply to essential equipment.

2.5.13.2 The voltage coils of control and protective devices and equipment are to be protected by fuses. The coils need not be individually protected provided the following conditions are satisfied:

(1) Coils are installed in the same enclosure and as an integral part of another item of the equipment, and are protected by a main protective device;

(2) Coils are supplied from circuits of the equipment and the protective device of such circuits is rated less than 25 A.

2.5.14 Protection of semiconductor equipment

2.5.14.1 Semiconductor equipment is to be protected against overload and short circuit.

Section 6 AUXILIARY MACHINERIES

2.6.1 General requirements

2.6.1.1 Motors rated at 1 kW or above and motors required for essential services are to be supplied from distribution boards by separate final sub-circuits.

2.6.1.2 Every electrical motor is to be provided with efficient means of starting and stopping which are, in general, placed near the motor, so as to be easily operated by the person controlling the motor.

2.6.1.3 Means are to be provided for the disconnection of the full load from all live poles of supply of every motor rated at 0.5 kW or above and its control gear. Where the control gear is mounted on or adjacent to a main or another distribution switchboard, a disconnecting switch in the switchboard may be used for this purpose. Otherwise, a disconnecting switch within the control gear enclosure or a separate enclosed disconnecting switch is to be provided.

2.6.1.4 When the starter or any other apparatus for disconnecting the motor is remote from the motor, it is required that either:

(1) Provision be made for locking the circuit disconnecting in the OFF position; or

(2) An additional disconnecting switch be fitted near the motor; or

(3) The fuses in each live pole or phase be so arranged that they can be readily removed and retained by persons authorized to have access to the motor.

2.6.1.5 Where a single master-starter system (i.e. a starter used for controlling a number of motors successively) is used, the apparatus is to provide undervoltage and overcurrent protection, and means of isolation and a running indicator for each motor not less effective than that required for systems using a separate starter for each motor. When the starter is of the automatic type, suitable alternative means are to be provided for manual operation. Where the starter is used for motors for essential services, the starting portion is to be duplicated, and means are to be provided for the transfer of the starting duties in the event of failure of one of the starters.

2.6.1.6 All motors with field adjustment speed control are to be provided with a device which renders the motors to be started only when the field is fully excited.

2.6.1.7 The undervoltage, overload and short-circuit protection for motors are to comply with the relevant requirements of Section 5 of this Chapter.

2.6.2 Permanently installed submersible bilge pumps

2.6.2.1 The motors of permanently installed submersible bilge pumps are to be connected to the installation's service emergency switchboard. The cables are to be installed in continuous lengths from above the bulkhead deck to the motor terminals. The cables are to be impervious-sheathed and armoured. Cables and their connections to such pumps are to be capable of operating under a head of water equal to their distance below the bulkhead deck.

2.6.2.2 Under all circumstances it is to be possible to start the motor of a permanently installed submersible bilge pump from a position above the bulkhead deck. If an additional start – stop push button is provided near the motor, the circuits are to be so arranged as to ensure that all control circuits of the start – stop push button may be disconnected from the position above the bulkhead deck.

2.6.3 Deck machinery

2.6.3.1 Electromagnetic brakes for electrical deck machinery are to have, in addition, a hand release device.

2.6.3.2 If not otherwise specially required by the specifications, the duty of windlass motors and warping winch motors is not to be less than 30 minutes rating.

2.6.3.3 Boat winch motors are to be provided with limit switches for cutting off the power supply upon the returning of boat to its original position.

2.6.3.4 The control device of boat winch motors is to be interlocked with the manual drive and manual brake.

2.6.4 Emergency shutdown of fans and oil pumps

2.6.4.1 Power ventilation of accommodation spaces, service spaces, control stations and machinery spaces is to be capable of being shutdown from an easily accessible position outside the space being served. This position is not to be readily cut off in the event of a fire in the space served.

The means provided to shutdown the power ventilation of the machinery spaces are to be entirely separate from the means provided for stopping ventilation of other spaces.

2.6.4.2 The exhaust fans of galley exhaust pipes are to be capable of being stopped in the galley.

2.6.4.3 Emergency shutdown device of various oil pump motor used for power plant is to be provided outside the spaces.

2.6.4.4 Motors of oil gas processing plant and oil gas transfer pump and their control equipment are to be provided with emergency shutdown (stopping) devices which may be arranged adjacent to the access to the spaces and inside the control rooms isolated from the spaces or other readily accessible locations even in the event of fire of such spaces.

2.6.4.5 Suitable means are to be provided to automatically shutdown all ventilation in protected spaces before CO_2 and other extinguishing agents are released.

2.6.5 Emergency shutdown and closing due to construction operations

2.6.5.1 Emergency shutdown and closing due to construction operations are to comply with relevant requirements in Chapter 4 of PART SEVEN.

2.6.6 Position mooring equipment

2.6.6.1 The control, alarm and safety systems of the position mooring equipment are to be designed, constructed and installed in accordance with the relevant requirements of PART EIGHT of the Rules.

2.6.6.2 Control stations

(1) The operation of winches, windlasses and associated brakes, chain stoppers and pawls is to be controlled locally from weather-protected control stations which provide good visibility of the equipment and associated anchor handling operations.

(2) A centralized control station, which may be located on the bridge or a separate manned control room, is to be provided from which brakes, chain stoppers and pawls can be remotely released.

(3) For each winch, anchor windlass, the respective local control station is to be provided with a means of indicating the following:

① Line tension;

② Length of line paid out;

③ Line releasing speed.

(4) The indication required by 2.6.6.2 (3) ① and ②, is to be repeated to the centralized control station and in addition a means of indicating the following is to be provided at this position:

① Mooring patterns and anchor line catenaries;

② Status of winch operation;

③ Position and heading;

④ Gangway angle and extension, if applicable;

⑤ Riser angle, if applicable;

⑥ Wind velocity and direction.

(5) Means of voice communication are to be provided between the centralized control station, each local control station and anchor handling vessels, if applicable.

2.6.6.3 Alarms

(1) Alarms are to be provided at the local and centralized control stations for the following fault conditions;

① Excessive line tension;

② Loss of line tension;

③ Excessive gangway angle and extension, if applicable;

④ Excessive riser angle, if applicable.

(2) Alarms are to be provided adjacent to the winches and windlasses to warn personnel prior to and during any remote operation.

(3) Alarms are to be provided at the centralized control station for the following fault conditions;

① When the installation deviates from its predetermined area of operation;

② When the installation deviates from its predetermined heading limits.

These alarms are to be adjustable but could not exceed specified limits. Arrangements are to be provided to fix and identify their set points.

2.6.6.4 Controls

(1) Adequate controls are to be provided at the local control station for satisfactory operation of the winch(es).

(2) The braking system is to be arranged so that the brakes, when applied, are not released in the event of a failure of the normal power supply.

(3) Emergency power is to be provided to enable winch brakes to be released within 15 seconds in an emergency. The release arrangements are to be operable locally at each winch and from the centralized control position, and are to be such that the entire anchor line can be lowered in a controlled manner.

(4) The emergency power is to be such that during lowering of the anchor line it is possible to apply the brakes once and then release them again in a controlled manner.

(5) Emergency power is to be provided so that any anchor line stoppers or pawl mechanisms may be released from either the local or centralized control stations up to a line tension equal to the minimum rated break strength of the anchor line. These mechanisms are to be capable of release at the maximum angles of heel and trim under the damage stability and flooding conditions for which the unit is designed.

(6) At least one position reference system and one gyrocompass or equivalent is to be provided, if applicable, to ensure the specified area of operation and heading deviation can be effectively monitored.

(7) Position reference systems are to incorporate suitable position measurement techniques which may be by means of acoustic devices, radio, radar, taut wire, riser angle, gangway extension and angle or other acceptable means depending on the service conditions for which the unit is intended.

(8) A vertical reference sensor is to be provided, if applicable, to measure the pitch and roll of the installation.

(9) Means are to be provided to ascertain the wind velocity and direction acting on the installation.

2.6.6.5 General requirements for control system of thruster-assisted position mooring system

(1) Suitable processing and comparative techniques are to be provided at the centralized control station to validate the control system inputs, thereby ensuring optimum performance of the thruster-assisted position mooring system.

(2) Abnormal signal errors revealed by the validity checks required by (1) above are to initiate alarms.

(3) The control system is to be stable throughout its operational range and is to meet the specified performance and accuracy criteria.

(4) An alarm is to be provided for a control computer system fault.

(5) Sufficient instrumentation is to be fitted at the centralized control station to ensure effective control and monitoring of the system.

(6) The deviation from the desired heading and/or position is to be adjustable but could not exceed the specified limits. Arrangements are to be provided to fix and identify the set points for the desired heading and/or position.

Section 7 LIGHTING

2.7.1 General requirements

2.7.1.1 The lighting fittings fitted in exterior passageways, or other spaces where they are liable to mechanical damage, are to be provided with robust protective grids.

The lighting fittings located in such spaces where they are liable to considerable vibration are to be provided with means for damping the vibration.

Where lighting fittings are directly fixed on wooden paneling or other inflammable materials, precautions are to be taken against overheating and fire.

2.7.1.2 The lighting switches for fire control stations, provisions rooms, refrigerated spaces and other similar spaces are not to be fitted inside such spaces.

Switches for the lighting used in wet spaces and in other spaces where risk of explosion might arise are to be capable of isolating all insulating poles.

The lighting fittings used in provisions rooms and refrigerated spaces are to be provided with a pilot lamp at the switch.

2.7.1.3 Warning notices showing the inscription “DANGER! HIGH VOLTAGE!” are to be provided at points of access to discharge lamps operating at voltages above 250 V and where otherwise necessary.

2.7.2 Power supply, control and arrangement

2.7.2.1 The number of lighting points supplied by each final sub-circuit of rating of more than 16 A at the lighting distribution boards is not to exceed one. The number of lighting points supplied by each final sub-circuit of rating 16 A or less at the lighting distribution boards is not to exceed:

For 50 V circuits or less 10 points;

For 51~120 V circuits 14 points;

For 121~250 V circuits 24 points;

2.7.2.2 Except that in final sub-circuits for cornice lighting, panel lighting and safety (escape) signs where lamp holders are closely grouped, the number of points supplied is unrestricted provided that maximum operating current in the sub-circuit does not exceed 10 A.

2.7.2.3 Final sub-circuits for lighting are not to supply appliances for heating and power, except small galley equipment (e.g. toasters, mixers, coffee makers), small miscellaneous motors (e.g. desk and cabin fans, refrigerators), wardrobe heaters and similar items.

2.7.2.4 In the important spaces listed below the lighting is to be supplied by at least two final sub-circuits, so that in the event of failure of any one of the circuits the remaining circuit(s) will maintain the necessary lighting for such spaces:

(1) Machinery spaces of category A;

(2) Large galleys;

(3) Public spaces;

(4) Passageways and stairways leading to boat deck and helicopter deck;

Where an emergency generator set is installed, one of the circuits is to be supplied from the main switchboard and the other circuit supplied from the emergency switchboard.

2.7.2.5 Each main vertical fire zone is to be provided with at least two separate lighting feeders, one of which may be an emergency lighting feeder.

2.7.2.6 The degree of protection of lighting fittings located in various spaces is to comply with the requirements of Table 1.3.2.2 of this PART. Lighting switches for special spaces are to be installed in accordance with 2.7.1.2 of this Section.

2.7.2.7 Lighting circuits are to be provided with protection in accordance with 2.5.11.1 of this Chapter.

2.7.2.8 The main electrical lighting system which provides illumination throughout those parts of the installation normally accessible to and used by crew is to be supplied from the main source of electrical power.

2.7.2.9 In addition to the emergency lighting, the lighting in liquid cargo pump rooms is to be interlocked with ventilation, so as to ventilate when the lighting is available. When the ventilation system is out of order, the lighting is still available.

2.7.3 Special requirements for the emergency lighting system

2.7.3.1 The emergency lighting points are to be provided in accordance with the relevant requirements of 2.2.2 of this Chapter.

2.7.3.2 All emergency lighting fittings are to be provided with a prominent mark or structurally different from other luminaries.

2.7.3.3 No switch is to be installed in the transitional emergency lighting feeders.

2.7.3.4 No local switch is to be installed in the emergency lighting circuits as required in 2.2.2.1 (1) in this Chapter, except for the emergency lighting in the navigation bridge, at stowage positions of survival craft over sides and the emergency lighting serving as the main lighting.

2.7.3.5 The sources of electrical power for main and emergency lighting systems, associated transforming equipment (if any), main or emergency switchboard and the lighting switchboard (excluding section boards and distribution boards) are not to be arranged in the same spaces so that the two sets of systems will not be failed simultaneously in the event of a fire or other casualties in any spaces.

2.7.3.6 Emergency lighting is to provide sufficient illumination to allow safe evacuation of personnel in an emergency and possibly under smoke.

2.7.3.7 The safe exit of each main accommodation space for personnel or crew at sea is to be provided with fixed continuous lighting.

2.7.3.8 Where emergency lights are fitted with light dimmers, means are to be provided to automatically restore the normal illumination of such lights in the event of failure of main lighting.

2.7.3.9 The emergency electric lighting system is to be so arranged that the main lighting system as required in this Section will not be failed in the event of a fire or other casualties in spaces containing the emergency source of electrical power, including transformers or converters, if any.

2.7.4 General requirements for heating appliances

2.7.4.1 All space-heating appliances are to be installed permanently in positions.

2.7.4.2 Except that the certified explosive-proof equipment complying with Section 5 of Chapter 1 of this PART are permitted to be installed in Zone 1 and 2 hazardous areas specified in PART 8, heating appliances are not to be installed in any hazardous areas or places where combustible gases and dusts are likely to accumulate.

2.7.4.3 Heating appliances are to be so mounted that there will be no risk of excessive heating of adjacent decks, bulkheads or other surroundings.

2.7.4.4 Where oil is electrically heated, high temperature and low level alarm and protection are to be provided for the heated media. Where the alarm is located in an unmanned space, it is to be capable of giving audible and visual alarm signals to a manned space.

2.7.4.5 Each heating or cooking appliance is to be controlled as a complete unit by a multi-pole linked switch mounted in the vicinity of the equipment.

2.7.4.6 Each heater is to be connected to a separate final sub-circuit for heating except that up to ten small heaters of total connected current rating not exceeding 16 A may be connected to a single final sub-circuit for heating.

2.7.5 LED lamps for lighting

2.7.5.1 The LED lamps mentioned in this article are only applicable to lighting purposes, excluding navigation lights, signal lights and color lamps for decorative purposes.

2.7.5.2 LED lamps shall comply with IEC 60598-1 publication Luminaires - Part 1: General provisions and Tests and IEC 62722-2-1 publication Lamp Performance Part 2-1: Special Requirements for LED Lamps.

Section 8 NAVIGATION AND SIGNAL LIGHTS

2.8.1 Supply and control of navigation lights

2.8.1.1 Each navigation light is to be separately connected to a control box for this purpose, placed in an accessible position on the bridge (control room), and is to be controlled and protected in each insulated pole by a switch and fuse or by circuit breaker mounted in the control box.

2.8.1.2 The control box for navigation lights is to be connected directly to the emergency switchboard and transitional emergency charging and discharging board (where the transitional source of emergency power is required according to Section 2 of this Chapter), or directly to the main or emergency switchboard.

2.8.1.3 The change-over switch for the supply circuits required by 2.8.1.2 of this Section is to be installed in the control box or at a suitable location on the bridge.

2.8.1.4 Each navigation light is to be provided with an automatic indicator giving an audible and visual indication of failure of the light. If a visual signal is used and connected in series with the navigation light, means are to be provided to prevent extinction of the navigation light due to failure of the signal, and the audible and visual alarms for failure of the source of electrical power of the control box are to be provided.

2.8.1.5 The provisions of the Administration of the State in which the floating installation is to be registered for supply and control of navigation lights are also to be considered.

2.8.1.6 Navigation lights are not to be installed in hazardous areas and where this is not avoidable, explosion-proof lights, suitable for the spaces in which they are to be installed, are to be used.

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2.8.2 Supply and control of other signal lights

2.8.2.1 Signal lights for marking of offshore structures and helicopter landing deck are to be supplied from the main or emergency source of electrical power.

2.8.2.2 Signal lights for helicopter landing deck are to be supplied by at least two final separate sub-circuits.

Section 9 ELECTRIC HEAT TRACING

2.9.1 Definition

Electric heat tracing is an electric heating system set up to supplement the lost heat of object heated with electric heat tracing band or other electrical heating devices during use, so as to maintain the media temperature within the limited range, and prevent liquid in various process pipelines and containers of craft production and living facilities on the platform from congealing.

2.9.2 General requirements of electric heat tracing facility:

2.9.2.1 There are normal and emergent electric heating tracing systems, which are to be distinguished on nameplates and signs.

2.9.2.2 In the case of corrosive gas and media, the insulating layer of electric heating tracing is to be of corrosion resistance which is suitable for the area.

2.9.2.3 The detection, control and protection units for overload, short circuit and electric leakage are available for the electric heat tracing band and supporting electric control equipment.

2.9.2.4 The electric heat tracing band is laid according to the process requirements of manufacturer. Besides, the overhauling of electric heat tracing band, and the maintenance and replacement of valve body, liquidometer and other removable components are to be considered. The actual direction of electric heat tracing band on the insulating layer and the actual location of junction box are to be marked in the main pipe network diagram, so as to minimize the removal number of insulating layer and maintenance work during maintenance.

2.9.3 General requirements of electric heating device:

(1) Electric heating device is to be provided with the anticorrosive casing required for heated media suitable for the device;

(2) Electric heating device is to be provided with control and protection devices which can cut off power supply automatically when the temperature exceeds the limited value;

(3) The insulation resistance of electric heating device with voltage below 380 V is not to be less than 0.5 MΩ;

(4) Electric heating device is not to overheat surrounding buildings, equipment and goods.

2.9.4 The protection requirements and anti-hazard classification of electric heat tracing and electric heating device comply with the requirements of such space.

Section 10 BATTERY PACKS AND UNINTERRUPTIBLE POWER SUPPLY (UPS) DEVICES

2.10.1 General requirements

2.10.1.1 Adequate charging facilities are to be provided for all batteries.

2.10.1.2 In direct current systems means are to be provided to isolate the batteries from the low voltage system when being charged from a higher voltage system.

2.10.1.3 The automatic discharging device for emergency batteries is to be so arranged that automatic emergency supply is available whether the battery is on charge or not.

2.10.1.4 Where the accumulator batteries charging/discharging units or UPS and the distribution boards associated with charging/discharging are used as auxiliary, emergency or transitional sources of power, it is to comply with the relevant requirements of this Section.

2.10.2 Definitions

2.10.2.1 Uninterruptible power system (UPS) is a combination of converters, switches and energy storage means, for example batteries, constituting a power system for maintaining continuity of load power in case of input power failure.

2.10.2.2 Off-line UPS unit is a UPS unit where under normal operation the output load is powered from the bypass line (raw mains) and only transferred to the inverter if the bypass supply fails or goes outside preset limits. This transition will invariably result in a brief (typically 2 to 10 ms) break in the load supply. See Fig. 2.10.2.2.

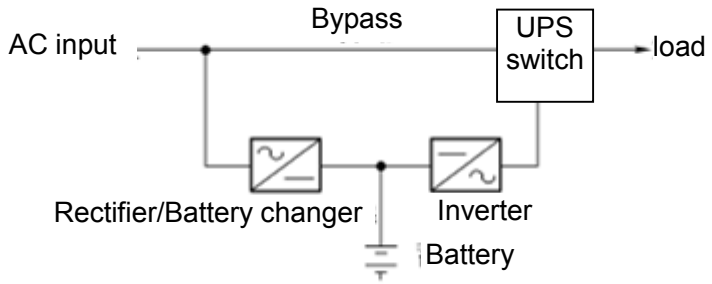

Fig. 2.10.2.2 Off-line UPS unit

2.10.2.3 Line interactive UPS unit is an off-line UPS unit where under normal operation the output load is powered from the UPS inverter or the power interface and when the input power goes outside the preset voltage and frequency limits, the load is transferred to stored energy power and the input power is disconnected from the power interface. See Fig. 2.10.2.3.

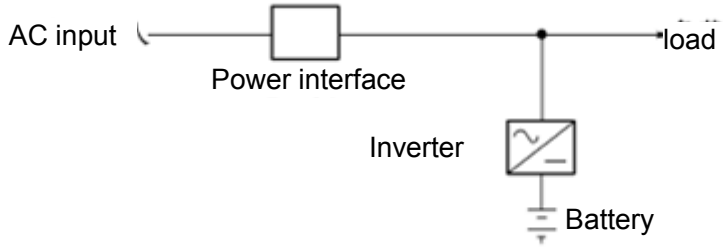

Fig. 2.10.2.3 Line Interactive UPS Unit

2.10.2.4 On-line UPS unit is a UPS unit where under normal operation the output load is powered from the inverter, and will therefore continue to operate without break in the event of the supply input failing or going outside preset limits. See Fig. 2.10.2.4.

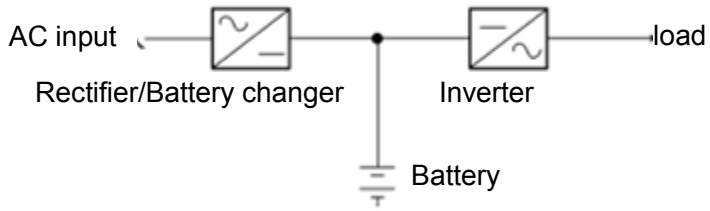

Fig. 2.10.2.4 On-line UPS Unit

2.10.3 Arrangement

2.10.3.1 Batteries and UPS unit are not to be installed in positions where they are exposed to excessively high or low temperatures, water spray, steam or other factors liable to impair their serviceability or shorten their service life. They are to be installed in such a way that persons can not be endangered and equipment can not be damaged by exhausted gases or leaked-out electrolytes.

2.10.3.2 Batteries are to be so installed as to ensure accessibility for changing cells, inspection, testing, topping-up and cleaning. UPS is to be so located as to be readily for emergency use, and to be arranged as closely as possible to the consumers of the power supply and to meet the arrangement requirements for the other electrical equipment.

2.10.3.3 Batteries are not to be installed in the accommodation area. An exception may be granted for gastight cells, where charging does not result in the development of harmful gases.

2.10.3.4 Where batteries may be exposed to the risk of mechanical damage or dropping objects, they are to be suitably protected.

2.10.3.5 Batteries connected to a charging device with a power output of more than 2 kW[①] are to be housed in a room assigned to batteries only, or in a box or locker on open deck.

Note: ① Power output of the charging device is to be calculated as the maximum charging current multiplied by the nominal voltage of battery.

2.10.3.6 Batteries connected to a charging device with a power output within the range 0.2 kW to 2 kW may be installed in a box or locker in any suitable place, or in an open position within a well ventilated machinery space.

2.10.3.7 Batteries connected to a charging device with a power output of less than 0.2 kW may be installed in an open position or in a battery box in any suitable place.

2.10.3.8 Supports made of non-absorbent, electrolyte-resistant insulating material are to be provided below each crate of cells to a height more than 20 mm, and an air gap of more than 20 mm wide is to be provided around each crate of cells by means of spacers made of the same material. Suitable measures are to be taken to prevent any electrolyte from lodging in contact with the installation's structure.

2.10.3.9 The interior surface of battery rooms, boxes, lockers or ventilation ducts, etc. liable to corrosion by the electrolyte or by the gas emitted from the electrolyte, are to be protected against corrosion by suitable means.

2.10.3.10 Engine starter batteries are to be installed as close as practicable to the engine served.

2.10.3.11 Storage batteries for emergency electrical power source and temporary electrical power source are to be installed in accordance with the relevant requirements of Section 2 of this Chapter.

2.10.3.12 Warning notice of "NO SMOKING AND NAKED LIGHTS" are to be fitted to the door of battery rooms, covers of boxes or lockers.

2.10.3.13 Acid batteries and alkaline batteries are prohibited to be housed in the same place or box (locker).

2.10.3.14 Hazard identification analysis shall be carried out for batteries with hazardous gas emission and capacity greater than 20kW during operation.

2.10.4 Ventilation

2.10.4.1 All battery rooms, boxes and lockers are to be ventilated, and the battery rooms are to be mechanically ventilated to avoid accumulation of dangerous concentrations of flammable gas.

2.10.4.2 Mechanical ventilators are to be provided in the special battery rooms, boxes or lockers where gas-permeability storage batteries are installed, if the total charging power exceeds:

——3 kW for lead-acid storage batteries, or;

——2 kW for nickel-cadmium storage batteries.

2.10.4.3 The ventilation system for battery rooms, boxes and lockers, other than boxes and lockers located on open deck or in spaces required in 2.10.3.6 and 2.10.3.7, is to be separate from other ventilation systems. The exhaust ducting is to be led to a location in the open air where any gases can be safely diluted, away from possible sources of ignition, and openings are to be into spaces where gases may accumulate. The outlet is to be located at the top of the room and the inlet near the floor, with the means to prevent the entrance of water and flame.

2.10.4.4 Mechanical ventilators for battery rooms, boxes or lockers are to be provided with means to prevent sparking in the event of the impeller accidentally touching the casing. The non-metallic-impellers are to be of an anti-static material.

2.10.4.5 All openings to battery rooms, other than ventilation openings, are to be effectively sealed to prevent the explosive gas from entering the adjacent compartments.

2.10.4.6 The quantity Q of air expelled of the rooms, boxes and lockers containing vented batteries is not to be less than:

$$Q = 0.11\ In \qquad \mathrm{m}^3/\mathrm{h}$$

where: I ——maximum current delivered by the charging equipment during gas formation, but not less than 25% of the maximum obtainable charging current, in amperes;

n ——number of cells in series.

2.10.4.7 The ventilation rate of the rooms, boxes and lockers containing valve-regulated sealed batteries may be reduced to 25% of that required in 2.10.4.7.

2.10.5 Charging facilities

2.10.5.1 Charging facilities are to be provided for all storage batteries such that the completely discharged battery can be recharged to the rated capacity in not more than 10 h, having regard to the service requirements.

2.10.5.2 Suitable means are to be provided for controlling and monitoring charging of batteries, and to protect them in accordance with the requirements of this PART.

2.10.5.3 For floating circuits or any other conditions where the load is connected to the battery whilst it is on charge, the maximum battery voltage is not to exceed the safe value for any connected apparatus.

2.10.5.4 Fast charging facilities, where provided, are to be arranged such that they are automatically disconnected if mechanical ventilators in the battery room fail.

2.10.6 Electrical equipment

2.10.6.1 Electrical equipment is to be avoided to install in the battery rooms. Where this is necessary, explosive-proof electrical equipment complying with the relevant requirements of this PART is to be used.

2.10.7 Recording of the type, location and maintenance cycle of batteries

2.10.7.1 Where batteries are fitted for use for essential and emergency services, a maintenance schedule of such batteries is to be compiled, maintained and updated. The schedule, which is to be reviewed by CCS, is to include at least the following information regarding the battery(ies):

— Type and manufacturer’s type designation;

— Voltage and ampere-hour rating;

— Location;

— Equipment and/or system(s) served;

— Maintenance/replacement cycle dates;

— Date(s) of last maintenance and/or replacement cycle;

— For replacement batteries in storage, the date of manufacture and shelf life.

2.10.7.2 Procedures are to be put in place to ensure that where batteries are replaced, they are of an equivalent performance type.

2.10.7.3 Where vented type batteries replace valve-regulated sealed types, it is to be ensured that there is adequate ventilation as required by 2.10.4 and that the requirements of this Section relevant to the location and installation are complied with.

2.10.7.4 Details of the schedule and of the procedures are to be integrated into the installation’s operational maintenance routine to be verified by the CCS Surveyor.

2.10.8 Alarms for charging and discharging units of batteries and UPS

2.10.8.1 The charging and discharging units of batteries and UPS are to be monitored. The audible and visual alarms are to be displayed in the normally attended spaces:

(1) Load supply failure (voltage and frequency);

(2) Earthing failure;

(3) Operation of battery protection equipment;

(4) Battery discharging;

(5) Operation of on-line UPS bypass.

Section 11 CABLES

2.11.1 General provisions

2.11.1.1 Cables are to be selected according to the environmental conditions of the location, methods of installation, rated current, duty, diversity factor, permissible voltage drop, etc.

2.11.1.2 The rated voltage of any cable is not to be lower than the nominal voltage of the circuit for which it is used.

2.11.1.3 Portable electrical equipment is to be provided with movable flexible cables.

2.11.1.4 Cables used in the non-earthing system are to be provided with suitable rating so as to sustain the additional stress of the cable insulation in the event of failure

2.11.1.5 Where the busway system is used for cables, reference is to be made to the related IEC standards and relevant requirements of IACS Resolution No. 67.

2.11.2 Selection of insulating material and voltage rating

2.11.2.1 The rated maximum operating temperature of the insulating material is to be at least 10°C higher than the maximum ambient temperature liable to be produced in the space where the cable is installed.

2.12.2.2 The insulating material of cables is generally to be selected in accordance with Table 2.11.2.2 The selection of other insulating materials is subject to IEC publication 60092.

Insulating Materials and Their Maximum Operating Temperature Table 2.11.2.2

Insulating material	Abbreviation	Maximum operating temperature of conductor (℃)	
		Normal work	Short circuit
Ethylene propylene rubber	EPR	90	250
High modulus or rigid ethylene-propylene rubber	HEPR	90	250
Crosslinked polyethylene	XLPE	90	250
Silicone rubber	S95	95②	350①
Crosslinked polyolefin for halogen-free cable	HF 95	90	250

Note: ① Not applicable to tinned copper conductors, only applicable to power cables.

② The maximum operating temperature of silicon rubber conductor is 180℃, but the actual maximum operating temperature is limited by the sheath material.

2.11.2.3 The rated voltage of a cable is expressed in U0/U, where U0 is the voltage between conductor and earth (metallic screen or surrounding medium of cables) and U is the voltage between any two conductors. In AC insulation systems, or in AC systems with high-resistance earthed neutral without automatic disconnection of circuits having insulation faults, the rated voltage of the cables is not to be lower than that given in Table 2.11.2.3.

Selection of Cables for AC Systems Table 2.11.2.3

Rated (between phases) voltage (kV) of Systems	Rated voltage U_0/U (kV) of cables
≤0.25	0.15/0.25
≤1.0	0.6/1.0
≤3.0	3.6/6.0
≤6.0	6.0/10.0
≤10.0	8.7/15.0

2.11.3 Selection of protective covering

2.11.3.1 Cables permanently fitted on decks exposed to the weather, in bathrooms, refrigerated spaces, machinery spaces or in any other location where water condensation or harmful vapour (e.g. oil vapour) may be present are to have a metallic impervious sheath (copper or lead alloy) or a non-metallic impervious sheath (polyvinyl chloride, polychloroprene, chlorosulphonated polyethylene, etc.). The character of the impervious sheath is to satisfy the requirements for environmental conditions.

2.11.3.2 In permanently wet situations, metallic sheaths are to be used for cables with hygroscopic insulation.

2.11.3.3 All cables and wiring external to electrical equipment are to be at least of a flame-retardant type. Where cables bunches are individually flame-retardant and shall be laid in bundling, the standards[7] accepted by CCS shall be followed.

2.11.3.4 Cables for services that are required to be operable under fire conditions, including those for their power supplies, are to be of a fire resistant type accepted by CCS (the same as 2.11.3.3 of this Section), where they pass through high fire risk areas, fire zones or decks, other than those which they serve. The following may be exempted:

(1) Systems that are self-monitoring;

(2) Systems designed in accordance with the fail-safe principle;

(3) Duplicated systems with cable runs as widely separated as practicable.

2.11.3.5 Where cables for services, required to be operable under fire conditions, including their supply cables, pass through high fire risk areas[8], other than those which they serve, they are to be so arranged that a fire in any of these areas or zones does not affect the operation of the service in any other area or zone. This may be achieved by either of the following:

(1) Cables being of a fire resistant type complying with the requirements of 3.5.1.1 in Chapter 3 of PART FOUR of CCS Rules for Classification of Sea-going Steel Ships are installed and run continuously to keep the fire integrity within the high fire risk area, as shown in Fig. 2.11.3.5;

(2) At least two-loops/radial distributions run as widely apart as is practicable and so arranged that in the event of damage by fire at least one of the loops/radial distributions remains operational.

[7] Refer to IEC60092 Publication and IEC60331 Publication: Fire-Resisting Characteristics of Electric Cables other equivalent standards

[8] The —high fire risk areas are defined as follows:
(1) machinery spaces as defined in Reg. II-2/3.20 of SOLAS; (2) spaces containing fuel treatment equipment or other highly flammable substances; (3) galley and pantries containing cooking appliances; (4) laundry containing drying equipment.

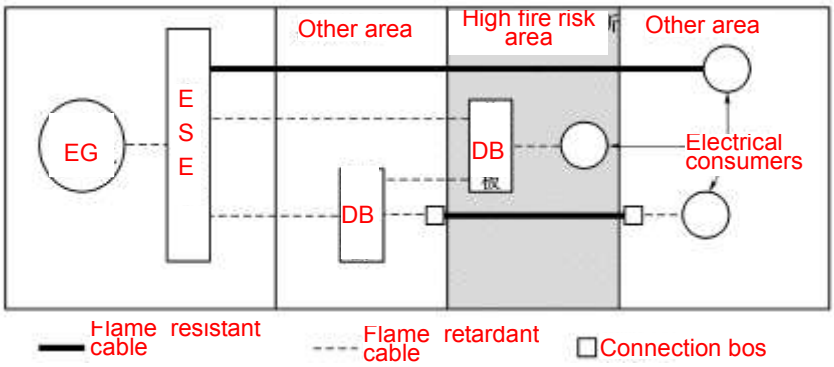

Fig. 2.11.3.5 Cables for Services under Fire Conditions

2.11.3.6 Services required to be operable under fire conditions include:

(1) General emergency alarm system;

(2) Fire detection and alarm system;

(3) Fire extinguishing system and alarm system for release of fire-extinguishing media;

(4) Public address system;

(5) Emergency lighting;

(6) Low location lighting;

(7) Control and power systems to power-operated fire doors and status indication for all fire doors;

(8) Control and power systems to power-operated watertight doors and their status indication;

(9) Remote emergency stop/shutdown arrangements for systems which may support the propagation of fire and/or explosion;

(10) Emergency fire pump.

2.11.3.7 So far as is reasonably practicable, the electrical cables to the emergency fire pumps are not to pass through the machinery spaces containing the main fire pumps and their source(s) of power and/or prime mover(s). Where the installation's arrangements are such that the cables have to pass through these spaces, the cables are to be of a fire resistant type and specially protected against mechanical damage (e.g. run in heavy gauge pipe).

2.11.3.8 Where necessary for particular applications, CCS may permit the use of special types of cables which do not comply with the requirements of 2.11.3.3 of this Section, such as radio frequency cables or digital computer information transmission system cables.

2.11.3.9 In choosing different types of protective coverings, due consideration is to be given to the mechanical actions to which each cable may be subjected during installation and in service. If the mechanical strength of the protective covering is considered insufficient, the cable is to be fitted in pipes or conduits or trunking or be otherwise protected.

2.11.4 Determination of the cross-sectional area of conductors

2.11.4.1 The highest continuous load carried by a cable is not to exceed its current rating after the application of correction factors. The diversity factor of the individual loads and the duration of the maximum demand may be allowed in estimating the maximum continuous load.

2.11.4.2 The voltage drop from the main switchboard or emergency switchboard busbars to any point in the installation when the cable are carrying maximum current under normal conditions of service, is not to exceed 6% of the nominal voltage. Where the supply is from batteries with a voltage not exceeding 50 V, this voltage drop may be increased to 10%.

For navigation lights it is necessary to limit voltage drops to lower values in order to maintain required lighting output and colour.

2.11.4.3 In assessing the current rating of lighting circuits, every lamp holder is to be assessed at the maximum load likely to be connected to it, with a minimum of 60 W, unless the fitting is so connected as to take only a lamp rated at less than 60 W.

Two lamp holders are to be counted for each lighting socket.

2.11.4.4 Cables supplying cargo winches or cranes, and capstans are to be suitably rated for their duty.

2.11.4.5 The cross-sectional area of the conductors of equalizer cables for D.C. generators is not to be less than 50% of that of the main circuit cables, and the cross-sectional area of the conductors of neutral wires of three-phase four-wire system is to be 50% of that of the phase wires. If the cross-sectional area of phase conductors is 16 mm^2 or less, the cross-sectional area of the neutral conductors is to be the same.

2.11.4.6 The minimum cross-sectional area of the electrical and lighting cables laid in hazardous areas is to be 1.5 mm^2.

2.11.5 Continuous service current rating

2.11.5.1 The maximum continuous load carried by a cable is not to exceed the values as given in Table 2.11.5.1.

The current ratings given in such tables are based on maximum operating conductor temperatures given in Table 2.11.2.2. Where a more precise evaluation of current rating has been carried out based on experimental or calculated data, details may be submitted to CCS for approval.

Current Ratings for Cables During Continuous Working Time
(Based on Ambient Temperature 45°C) Table 2.11.5.1

Insulation	Thermoplastic compound			Thermosetting compound			Silicon rubber and mineral insulation		
Maximum rated conductor temperature	70°C			90°C			95°C		
mm^2	Single core	2-core	3-or 4-core	Single core	2-core	3-or 4-core	Single core	2-core	3-or 4-core
1	12	10	8	16	14	11	20	17	14
1.5	15	13	11	23	20	16	26	22	18
2.5	21	18	15	40	26	21	32	27	22
4	29	25	20	51	34	28	43	37	30
6	37	31	26	52	44	36	55	47	39
10	51	43	36	72	61	50	76	65	53
16	68	58	48	96	82	67	102	87	71
25	90	77	63	127	108	89	135	115	95
35	111	94	78	157	133	110	166	141	116
50	138	117	97	196	167	137	208	177	146
70	171	145	120	242	206	169	256	218	179
95	207	176	145	293	249	205	310	264	217
120	239	203	167	339	288	237	359	305	251
150	275	234	193	389	331	272	412	350	288
185	313	266	219	444	377	311	470	400	329
240	369	314	258	522	444	365	553	470	387
300	424	360	297	601	511	421	636	541	445

2.11.6 Correction factors for current rating

2.11.6.1 Correction factors for different ambient temperatures

When it is known that the ambient temperature is different from 45°C, correction factors given in Table 2.11.6.1 are to be applied.

Correction Factors for Current Rating Table 2.11.6.1

Ambient temperature (°C) / Maximum rated Conductor temperature(°C)	35	40	45	50	55	60	65	70	75	80	85
60	1.29	1.15	1.00	0.82	—	—	—	—	—	—	—
65	1.22	1.12	1.00	0.87	0.71	—	—	—	—	—	—
70	1.18	1.10	1.00	0.89	0.77	0.63	—	—	—	—	—
75	1.15	1.08	1.00	0.91	0.82	0.71	0.58	—	—	—	—
80	1.13	1.07	1.00	0.93	0.85	0.76	0.65	0.53	—	—	—
85	1.12	1.06	1.00	0.94	0.87	0.79	0.71	0.61	0.50	—	—
90	1.10	1.05	1.00	0.94	0.88	0.82	0.74	0.67	0.58	0.47	—
95	1.10	1.05	1.00	0.95	0.89	0.84	0.77	0.71	0.63	0.55	0.45

2.11.6.2 Correction factors for bunched cables

(1) For cables laid in one of the following manners and so arranged as to ensure free cool air circulation around each bunch, the current ratings may be directly taken from Tables 2.11.5.1:

① Not more than six cables bunched together on cable trays, or in cable conduits, pipes or trunking;

② more than six cables arranged in the following manners:

Distances between any two sextuplets is equal to at least one diameter of the thickest cable

○○○○○○ ○○○○○○ ○○○○○○

or distance between any two triplets horizontally and vertically equal to at least one diameter of the thickest cable

○○○ ○○○ ○○○

○○○ ○○○ ○○○

(2) Where more than six cables, which may be expected to operate simultaneously at their full rated capacity, are laid close together in a cable bunch in such a way that there is an absence of free air circulation around them, a correction factor of 0.85 is to be applied.

Notes: ① Cables are said to be bunched when two or more are contained within a single conduit, trunking or duct, or, if not enclosed, are not separated from each other.

② When a corrector factor of 0.85 is used, care is to be taken that there are in general not more than two layers in each cable bunch.

2.11.6.3 Correction factors for non-continuous services

(1) For half-hour or one-hour services, the corresponding correction factors given by Fig. 2.11.6.3 (1) may be applied.

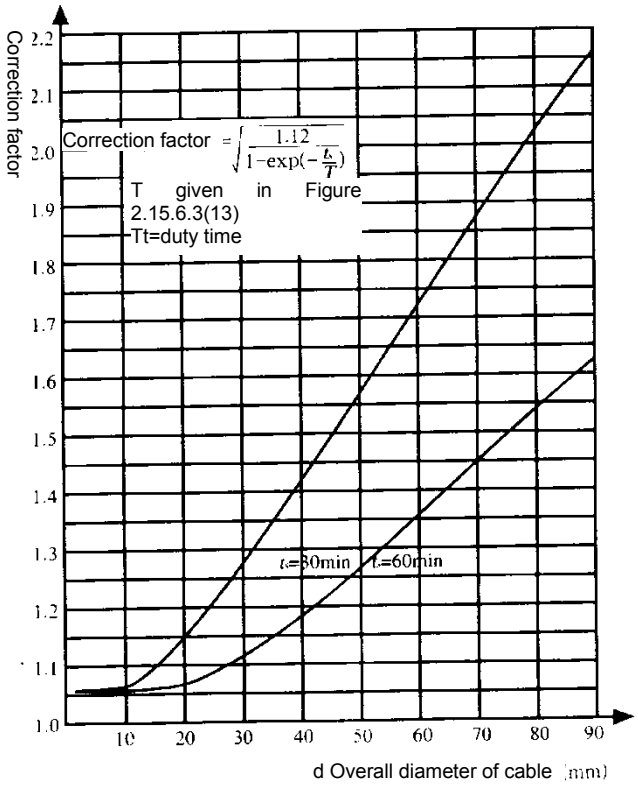

Fig. 2.11.6.3 (1) Correction Factors for Half-hour and One-hour Services

Note: Figure 2.11.6.3 (1) is applicable only when the intermediate periods of rest are longer than the critical duration (The critical duration is equal to 3 times the time constant).

(2) For intermittent service, the corresponding correction factors given in Fig. 2.11.6.3 (2) may be applied.

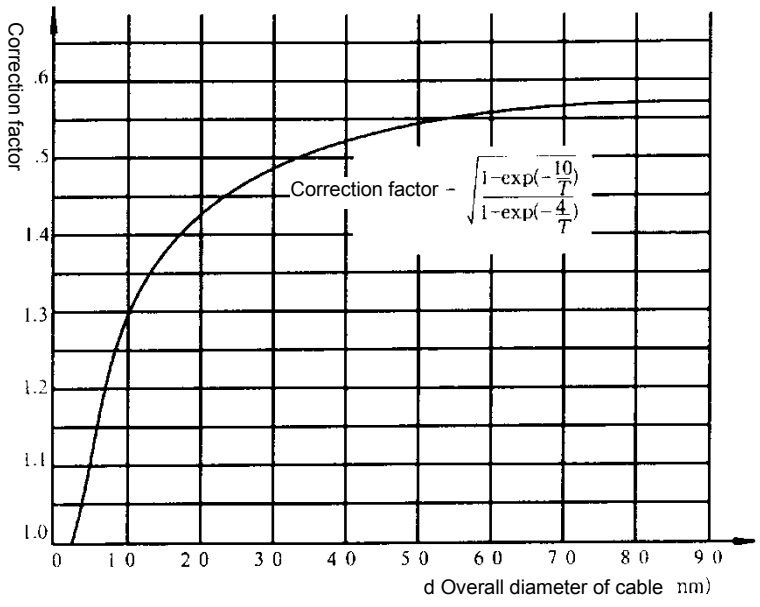

Fig. 2.11.6.3 (2) Correction Factor for Intermittent Service

Note: The correction factor given in Figure 2.11.6.3 (2) has been roughly calculated for periods of 10 minutes, of which 4 minutes are with a constant load and 6 minutes without load.

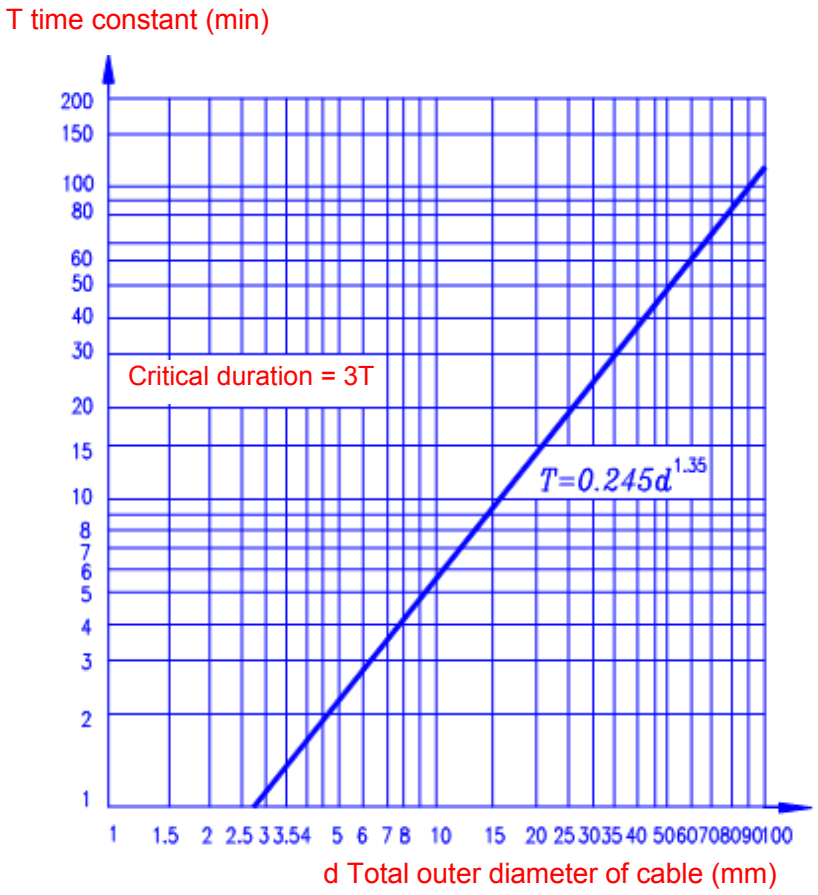

Fig. 2.11.6.3 (3) Time Constant of Cable

(3) The time constant of cable is given in Fig. 2.11.6.3 (3)

2.11.7 Parallel connection of cables

2.11.7.1 Parallel connection of cables will be permitted only for cables having a cross-section of 10 mm^2 or more. The current-carrying capacity of cables connected in parallel is the sum of the current ratings of all parallel conductors provided the cables have equal impedance, cross-section and rated maximum operating conductor temperatures.

2.11.8 Short-circuit capacity

2.11.8.1 Cables and their insulated conductors are to be capable of withstanding the mechanical and thermal effects of the maximum short-circuit current.

2.11.9 Cable routing

2.11.9.1 Cable runs are to be as far as practicable fixed in straight lines and in accessible positions.

2.11.9.2 Cable runs are to be so arranged as to avoid the harmful effects from moisture or condensed water.

2.11.9.3 Cable runs are to be, as far as possible, remote from the sources of heat such as boilers, hot pipes, resistors, etc., and are to be protected against mechanical damage.

2.11.9.4 Cables having insulating materials with different maximum-rated conductor temperatures are not to be bunched together, or, where this is unavoidable, the cables are to be so operated that no cable reaches a temperature higher than that permitted for the lowest temperature-rated cable in the group.

2.11.9.5 Cables having a protective covering or sheathing which may damage the covering or sheathing of other cables are not to be bunched with those other cables.

2.11.9.6 Important equipment requiring two-way power supply, such as two-way power supply for steering gear and its control cables, shall be laid as far away as possible in horizontal and vertical directions. When the main bus is divided into two or more separate sections in accordance with 2.1.1.5 of this Chapter, the cables from different main generators to the main switchboard shall be laid in at least two paths as far away as possible, for example from larboard and starboard or from different decks.

2.11.9.7 In the case of duplicated essential equipment, or systems which could operate as each other's stand-by for an essential function (such as an engine-room telegraph)[9], the supply and any associated control cables are to follow different ways, which are to be arranged as far apart as practicable, both vertically and horizontally.

2.11.9.8 Cables serving essential equipment or emergency power equipment, emergency lighting and internal communications or signals used in an emergency are to be as far as practicable routed clear of galleys, laundries, machinery spaces and their casings and other high fire risk areas, except for supplying equipment in those spaces.

Where possible, these cables are to be run in such a manner as to preclude their being rendered unserviceable by heating of the bulkheads that may be caused by a fire in an adjacent space.

2.11.9.9 Main cable runs and cables for the supply and control of essential services are to be kept away from the machinery, machinery parts having an increased fire risk unless:

(1) The cables have to be connected to the subject equipment;

(2) The cables are separated by a steel bulkhead or deck from the subject equipment;

(3) The cables are of a fire-resisting type.

Note: Machinery, machinery parts or equipment containing combustibles are considered to have an increased fire

2.11.9.10 Where cables are installed in bunches, one of the following precautions is to be taken to limit the propagation of fire:

(1) Cables of the bunch have been tested for fire retardation in accordance with the requirements of a standard[10] acceptable to CCS;

(2) Fire dampers are provided or fire-resisting coatings approved by CCS are applied at suitable positions in the bunched cable run.

2.11.9.11 Where trunk cables are laid in concealed manner, the paneling in way of which is to be arranged for easy removal.

[9] When the main switchboard is located in a separate and enclosed compartment, such as engine control room, the above requirement is not applicable to the equipment and cables installed in this compartment

[10] Refer to IEC Publication 332-3 Test on Electric Cables under Fire Conditions, Part 3 – Test on Bunched Wires or Cables or equivalent standards.

2.11.9.12 Cables are not to be directly embedded in the thermal and sound insulation lagging made of combustible material. Where the trunk cables are covered with non-combustible material for separation, they may be laid in the insulation lagging, but the load carried is to be reduced.

2.11.9.13 The arrangement and run of fire resistant cables are to be in compliance with the following:

(1) Cables are to be so arranged that the loss of the services supplied by them due to a localized fire in any one space or area referred to in 2.11.3.5 of this Section is minimized;

(2) Cables are to be run as directly as is practicable.

2.11.9.14 Power cables, signal cables and control cables are in general not to be installed in the same bunch.

2.11.9.15 Each intrinsically safe circuit is to have its own separate cable. Such cables are to be laid apart from those for non-intrinsically safe circuits, e.g. neither bundled together or placed in the same casing or conduit, nor fixed by common clamps. The outer sheath of the cable is to be coloured blue or alternatively black with clearly visible blue stripes.

2.11.10 Mechanical protection of cables

2.11.10.1 Cables exposed to risk of mechanical damage are to be protected by metal channels or casing or enclosed in steel conduit unless the protective covering of cables is sufficient to withstand the possible damage.

2.11.10.2 Metal casings for mechanical protection of cables are to be efficiently protected against corrosion.

2.11.10.3 Where cables are placed underneath the floor plates in machinery spaces, reliable precautions are to be taken to prevent such cables from being soaked in oil or water, or being exposed to mechanical damage.

2.11.11 Radius of bend

2.11.11.1 The minimum internal radius of bend of installed cables is to be generally in accordance with Table 2.11.11.1.

Minimum Internal Radii of Bends in Cables for Fixed Wiring Table 2.11.11.1

Cable construction		Overall diameter of Cable D, mm	Minimum internal radius of bend
Insulation	No armored or no braided		
Thermoplastic or thermoset material (copper conduit is in circle type)	No armored or no braided	≤25	4D
		＞25	6D
	Metal sheathed, braided or armored	Any	6D
	Metal thread armored, metal strip armored or metal sheathed	Any	6D
	Synthetic polyester/metal sheathed slice or combined sheathed	Any	8D
Thermoplastic or thermoset material (copper conduit is of specific type)	Any	Any	8D
Mineral	Hard metal sheathed	Any	6D

2.11.12 Securing of cables

2.11.12.1 Cables are to be effectively supported and secured with the exception of cables for portable appliances and of those installed in pipes, conduits, trunking or special casings.

2.11.12.2 Clips or straps are to be robust and are to have a sufficient surface area and an appropriate shape so that the cables may remain tight without their coverings or sheathing being damaged.

2.11.12.3 Clips, supports and accessories are to be made of corrosion-resistant material or suitably corrosion inhibited before erection.

2.11.12.4 The distances between the points at which the cable is supported are to be chosen according to the construction of cable and the probability of vibration and are to be generally in accordance with those given in Table 2.11.12.4.

2.11.12.5 When cables are fixed by means of non-metallic clips or straps, and are not laid on top of horizontal cable trays or supports, suitable metal cable clips or straps are to be added at regular distances not greater than 1 m in order that in the event of a fire, cables are prevented from falling and causing an injury to personnel or an obstruction to any escape route.

Maximum Spacing of Supports for Securing Cables Table 2.11.12.4

External diameter of cable (mm)		Distance between supports (mm)	
Exceeding	Not exceeding	Non-armored cables	Armored cables
—	8	200	250
8	13	250	300
13	20	300	350
20	30	350	400
30	—	400	450

2.11.13 Penetration of bulkheads and decks by cables

2.11.13.1 Penetration of watertight bulkheads or decks is to be carried out with either individual watertight glands or with packed watertight boxes carrying several cables. However, the watertight integrity of the bulkheads or decks is to be maintained.

2.11.13.2 Where cables pass through non-watertight bulkheads or structural steel, the holes are to be bushed with lead or other approved material. If the steel is 6 mm or more in thickness, adequately rounded edges may be accepted as the equivalent of bushing.

2.11.13.3 Penetration of bulkheads and decks which is required to have some degree of fire integrity is to be so effected as to ensure that the required degree of fire integrity is not impaired.

2.11.13.4 Cables passing through decks are to be protected by deck tubes or ducts.

2.11.13.5 Materials used for glands and bushings are to be such that there is no risk of corrosion to cables or structural members.

2.11.13.6 Where rectangular holes are cut in bulkheads or structural steel, the corners are to be radiused.

2.11.14 Installation of cables in pipes, conduits or trunking

2.11.14.1 When cables are installed in metal tubes, conduits or trunking, the following requirements are to be complied with:

(1) The pipes, conduits or trunking are to be smooth on the interior and protected against corrosion;

(2) Provision is to be made at the ends of pipes, conduits or trunking so as to protect the sheathing or covering of cables from being damaged;

(3) The pipes or conduits are to have such internal dimensions and radius of bends as will permit easy drawing in and out of the cables which they are to contain. The internal radius of bends is not to be less than that laid down for cables, provided that for pipes equal to or above 63 mm in external diameter, the internal radius of bends is not less than twice the external diameter of the pipe;

(4) The drawing-in factor (ratio of the sum of the cross-sectional areas of the cables to the internal cross-sectional area of the pipe or conduit or trunking) is not to exceed 0.4;

(5) Pipes, conduits or trunking are to be earthed and are to be mechanically and electrically continuous across joints;

(6) Pipes, conduits or trunking are to be so arranged that water cannot accumulate inside them (consideration being given to possible condensation);

(7) If necessary, ventilating openings are to be provided, preferably at the highest and lowest points, so as to permit air circulation and to prevent the accumulation of water at any part of the pipes, conduits or trunking.

This may be done only if the fire risk will not be increased thereby;

(8) Expansion joints are to be provided where necessary for long pipe run;

(9) Lead-sheathed cables without any coverings are not to be laid in pipes, conduits or trunking.

2.11.14.2 Where cables are laid in trunks, the trunks are to be so constructed as not to afford passage for fire from one tween-decks or compartment to another.

2.11.14.3 Cables used for cold cathode luminous discharge lamps are not to be installed in metal conduit unless protected by metal sheath or screen.

2.11.15 Installation of cables in refrigerated spaces

2.11.15.1 Cables not serving the refrigerated spaces are not to pass through such spaces. Cables installed in refrigerated spaces are to have a watertight or impervious sheath and are to be protected against mechanical damage. If an armoured cable is used, the armour, unless galvanized, is to be protected against corrosion by a further moisture-resisting covering.

2.11.15.2 Cables installed in refrigerated spaces are to be of open manner.

2.11.15.3 Where it is necessary for the cables to pass through the insulation lagging in the refrigerated spaces, they are to pass directly through at right angles and are to be protected by a metal tube sealed watertight at each end.

2.11.15.4 Metal supports used for securing the cables are to be galvanized or otherwise protected against corrosion.

2.11.15.5 Precautions are to be taken to prevent the placing of hooks round the cable as a casual means of suspension.

2.11.15.6 PVC insulated cables are generally not to be used in refrigerated spaces unless the PVC compounds are appropriate to low temperature service.

2.11.16 Relief of tension

2.11.16.1 Cables are to be so installed that the tension stress applied to them either by reason of their own weight or for any other reason is minimized. This is particularly important for cables of small cross sections and for cables laid vertically or in vertical pipes

2.11.17 Electrodynamic forces

2.12.17.1 In order to guard against the effects of electrodynamic forces in the event of short circuit, single-core cables are to be firmly fixed and the strength of supports is to be sufficient to withstand the electrodynamic forces corresponding to the prospective short-circuit currents.

2.11.18 Installation of single-core cables for alternating current

2.11.18.1 For A.C. power systems, as far as practicable, two-core or multi-core cables are to be used. Where it is necessary to use single-core cables for circuits rated in excess of 20 A, the following requirements are to be complied with:

(1) Cables are to be either non-armoured or armoured with non-magnetic material;

(2) Cables belonging to the same circuit are to be contained in the same pipe, conduit or trunking. Cable clips are to include cables of all phases of a circuit unless the clips are of non-magnetic material;

(3) In the installation of two, three or four single-core cables forming respectively single-phase circuits, three-phase circuits, or three-phase four-wire circuits, the cables are to be as far as possible in contact with one another. In any event, the distance between adjacent cables is not to be greater than one diameter;

(4) When single-core cables of current rating greater than 250 A are run along a steel bulkhead, the clearance between the cables and the bulkhead is to be at least 50 mm unless the single-core cables belonging to different phases are installed in trefoil formation;

(5) Magnetic material is not to be used between single-core cables of a group of the same circuit. Where cables pass through steel plates, all the conductors of the same circuit are to pass through a plate or gland, so made that there is no magnetic material between the cables, and the clearance between the cables and the magnetic material is not to be less than 75 mm, unless single-core cables belonging to different phases are installed in trefoil formation;

(6) In order to equalize to some degree the impedance of three-phase circuits of considerable length consisting of single-core cables having a cross-sectional area of 185 mm^2 or over, the phases are to be transposed at regular intervals of not exceeding 15 m. Alternatively, the three single-core cables of different phases may be installed in a trefoil formation. The above precautions are, however, not necessary when the length of the run is less than 30 m;

(7) In circuits involving several single-core cables in parallel per phase, each cable is to follow the same route and have the same cross-sectional area;

Further, in order to avoid unequal division of the current, cables pertaining to the same phase are, as far as practicable, to be alternated with those of other phases. For instance, in case of six cables per phase, the correct dispositions are as shown in Table 2.11.18.1.

(8) The metal sheaths or coverings of single-core cables are to be earthed at one point only.

Dispositions of Cables Table 2.11.18.1

Cables in parallel per phase	1-layer disposition	2-layer disposition
2	ABC CBA	ABC ABC
3		ABCA BCABC
4		ABCABC CBACBA
5		ABCABCA BCABCABC
6		ABCABCABC CBACBACBA

2.11.19 Cable installation with respect to prevention of electromagnetic interference

2.11.19.1 In order to minimize the effects of unwanted electromagnetic interference, cables are to be installed in accordance with the relevant requirements of the standards[11] accepted by CCS.

2.11.20 Earthing of metal sheathings or coverings

2.11.20.1 Earthing of metal sheathings or coverings is to be in accordance with the relevant requirements of Section 4, Chapter 1 of this PART.

[11] Refer to IEC Publication 533: Electromagnetic Compatibility of Electrical and Electronic Installation in Ships.

2.11.21 Cable ends

2.11.21.1 The ends of all conductors of cross-sectional area greater than 4 mm^2 are to be fitted with soldered sockets, compression type sockets or mechanical clamps. Corrosive fluxes are not to be used.

2.11.21.2 The temperature of cable sockets and connecting terminals is, in general, not to exceed the maximum working temperature for the cable in relation to the insulation.

2.11.21.3 Cables with a supplementary insulating belt beneath the protective sheath are to have additional insulation at those points where the insulation of each core makes or may make contact with earthed metal.

2.11.21.4 The fixing of conductors in terminals at joints and at tappings is to be capable of withstanding the thermal and dynamic effects of short-circuit currents.

2.11.21.5 The ends of mineral insulated cables are to be prepared in accordance with the instructions issued by the manufacturers of these cables.

2.11.21.6 Cables having a hygroscopic insulation (e.g. mineral insulated) are to have their ends sealed against ingress of moisture.

2.11.22 Joints and tappings

2.11.22.1 Cable runs are normally not to include joints. If a joint is necessary for repair or sectional construction, it is to be of such a type that electrical continuity, insulation, mechanical strength and protection, earthing and fire-resisting or flame-retardant properties are not less than those required for the cables.

2.11.22.2 Joints and tappings are to be made in suitable boxes of such design that all conductors are adequately secured, insulated and protected from atmospheric action and fitted with terminals or busbars of dimensions appropriate to the current rating.

2.11.22.3 Joints and tappings are to be clearly marked.

2.11.23 Joint boxes

2.11.23.1 Joint boxes are to be made of flame-retardant material. Live parts are to be mounted on durable flame-retardant moisture-resistant material, of permanently high dielectric strength and high insulation resistance.

2.11.23.2 The live parts are to be so arranged by suitable spacing or shielding with flame-retardant insulating material that a short circuit cannot readily occur between conductors of different polarity or between conductors and earthed metal.

2.11.23.3 All joint boxes are to be provided with durable labels bearing clearly the purposes or circuit designations corresponding to the wiring diagrams. Where the joint boxes are installed in concealed manner, the paneling in way of the joint boxes is to be arranged for easy removal.

Section 12 SPECIAL REQUIREMENTS FOR HIGH VOLTAGE ELECTRICAL INSTALLATION

2.12.1 General requirements

2.12.1.1 This Section applies to A.C. three-phase systems with nominal voltage (voltage between phases) exceeding 1 kV. If not otherwise stated herein, construction and installation applicable to low voltage equipment generally apply to high voltage equipment.

2.12.1.2 The nominal system voltage is not to exceed 15 kV. Where necessary for special application, higher voltages may be accepted by CCS.

2.12.1.3 Equipment with voltage above about 1 kV is not to be installed in the same enclosure as low voltage equipment, unless segregation or other suitable measures are taken to ensure that access to low voltage equipment is obtained without danger.

2.12.2 System design

2.12.2.1 The distribution of high-voltage electrical installation is to comply with the following:

(1) It is to be possible to split the main switchboard into at least two independent sections, by means of at least one circuit breaker or other suitable disconnecting devices, each supplied by at least one generator. If two separate switchboards are provided and interconnected with cables, a circuit breaker is to be provided at each end of the cable.

Services which are duplicated are to be divided between the sections of the main switchboard or interconnected separate switchboards;

(2) For earthed neutral systems, in case of earth fault, the current is not to be greater than full load current of the largest generator on the switchboard or relevant switchboard section and not less than three times the minimum current required to operate any device against earth fault.

It is to be assured that at least one source neutral to ground connection is available whenever the system is in the energised mode. Electrical equipment in directly earthed neutral or other neutral earthed systems is to withstand the current due to a single phase fault against earth for the time necessary to trip the protection device;

(3) Means of disconnection are to be fitted in the neutral earthing connection of each generator so that the generator may be disconnected for maintenance and for insulation resistance measurement;

(4) All earthing impedances are to be connected to the main structure. The connection to the main structure is to be so arranged that any circulating currents in the earth connections do not interfere with radio, radar, communication and control equipment circuits;

(5) In the systems with neutral earthed, connection of the neutral to the main structure is to be provided for each section where the system is split into sections.

2.12.2.2 Each part of the electrical installation is to be provided with a degree of protection appropriate to the location and to satisfy the following:

(1) The degree of protection of enclosures of rotating electrical machines is to be at least IP23. The degree of protection of terminals is to be at least IP44. For motors installed in spaces accessible to unqualified personnel, a degree of protection against approaching or contact with live or moving parts of at least IP4X is required;

(2) The degree of protection of enclosures of transformers is to be at least IP23. For transformers installed in spaces accessible to unqualified personnel, a degree of protection of at least IP4X is required.

For transformers not contained in enclosures, 2.13.7.1 of this Section is to be complied with.

(3) The degree of protection of metal enclosed switchgear, controlgear assemblies and static convertors is to be at least IP32. For switchgear, control gear assemblies and static converters installed in spaces accessible to unqualified personnel, a degree of protection of at least IP4X is required.

2.12.2.3 The air clearances and creepage distances are to comply with the following:

(1) In general, for non-type-tested equipment phase-to-phase air clearances and phase-to-earth air clearances between non-insulated parts are to be not less than those specified in Table 2.12.2.3.

Minimum Air Clearance Table 2.12.2.3

Nominal voltage (kV)	Minimum air clearance (mm)
3 (3.3)	55
6 (6.6)	90
10 (11)	120
15	160

Note: Intermediate values may be accepted for nominal voltages provided that the next higher air clearance is observed. In the case of smaller clearances as specified in Table 2.12.2.3, appropriate voltage impulse test must be applied.

(2) Creepage distances between live parts and between live parts and earthed metal parts for standard components are to be in accordance with relevant IEC publications for the nominal voltage of the system, the nature of the insulation material and the transient overvoltage developed by switch and fault conditions.

For non-standardised parts within the busbar section of a switchgear assembly, the minimum creepage distance is to be at least 25 mm/kV and behind current limiting devices, 16 mm/kV.

2.12.2.4 For protection of the high-voltage electrical system, the following special requirements are to be complied with:

(1) Protective devices are to be provided against phase-to-phase faults in the cables connecting the generators to the main switchboard and against interwinding faults within the generators. The protective devices are to trip the generator circuit breaker and to automatically de-excite the generator. In distribution systems with a neutral earthed, phase to earth faults are also to be treated as above;

(2) Any earth fault in the system is to be indicated by means of a visual and audible alarm. In low impedance or direct earthed systems (a system is defined effectively earthed when earthing factor is[12] lower than 0.8), provision is to be made to automatically disconnect the faulty circuits. In high impedance earthed systems (a system is defined non-effectively earthed when earthing factor is higher than 0.8), where outgoing feeders will not be isolated in case of an earth fault, the insulation of the equipment is to be designed for the phase to phase voltage;

(3) Power transformers are to be provided with overload and short-circuit protection. When transformers are connected in parallel, tripping of the protective devices at the primary side has to automatically trip the switch connected at the secondary side;

(4) Voltage transformers are to be provided with overload and short-circuit protection on the secondary side;

(5) Fuses are not to be used for overload protection;

(6) Lower voltage systems supplied through transformers from high voltage systems are to be protected against overvoltages. This may be achieved by:

① direct earthing of the lower voltage system;

② appropriate neutral voltage limiters;

③ earthed screen between the primary and secondary windings of transformers.

2.12.3 Rotating machinery

2.12.3.1 Generator stator windings are to have all phase ends brought out for the installation of the differential protection.

2.12.3.2 Rotating machinery is to be provided with temperature detectors in their stator windings to actuate a visual and audible alarm in a normally attended position whenever the temperature exceeds the permissible limit.

If embedded temperature detectors are used, means are to be provided to protect the circuit against overvoltage.

2.12.3.3 In addition to the tests normally required for rotating machinery, a high frequency high voltage test in accordance with a standard acceptable to CCS[13] is to be carried out on the individual coils in order to demonstrate a satisfactory withstand level of the inter-turn insulation to steep fronted switching surges.

2.12.4 Power transformers

2.12.4.1 Dry-type transformers are to comply with a standard acceptable to CCS[14], and liquid-cooled transformers are also to comply with a standard acceptable to CCS[15].

[12] Earthing factor is defined as the ratio between the phase to earth voltage of the health phase and the phase to phase voltage. This factor may vary between (1/sqrt 3) and 1.

[13] Refer to IEC Publication 60034-15 Rotating electrical machines – Part 15: Impulse voltage withstand levels of rotating a.c. machines with form-wound stator coils or other equivalent standards.

[14] Refer to IEC Publication 60076-11 Dry-type power transformers or other equivalent standards.

[15] Refer to IEC Publication 60076 Power transformers or other equivalent standards.

2.12.4.2 Oil immersed transformers are to be provided with the following alarms and protections:

(1) Liquid level (Low) – alarm;

(2) Liquid temperature (High) – alarm;

(3) Liquid level (Low) - trip or load reduction;

(4) Liquid temperature (High) - trip or load reduction;

(5) Gas pressure relay (High) - trip.

2.12.5 Switchgear and controlgear assemblies

2.12.5.1 Switchgear and controlgear assemblies are to be manufactured in accordance with standard(s) acceptable to CCS[16].

2.12.5.2 Switchgear and controlgear assemblies are to be constructed in accordance with the following requirements:

(1) Switchgear is to be of metal - enclosed type or of the insulation - enclosed type in accordance with standard(s) acceptable to CCS[17];

(2) Withdrawable circuit breakers and switches are to be provided with mechanical locking facilities in both service and disconnected positions. For maintenance purposes, key locking of withdrawable circuit breakers and switches and fixed disconnectors is to be possible.

Withdrawable circuit breakers are to be located in the service position so that there is no relative motion between fixed and moving portions;

(3) The fixed contacts of withdrawable circuit breakers and switches are to be so arranged that in the withdrawable position the live contacts are automatically covered;

(4) For maintenance purposes an adequate number of earthing and short-circuiting devices is to be provided to enable circuits to be worked upon with safety.

2.12.5.3 Requirements for auxiliary systems:

(1) If electrical energy and/or physical energy is required for the operation of circuit breakers and switches, a store supply of such energy is to be provided for at least two operations of all the components.

However, the tripping due to overload or short circuit, and undervoltage is to be independent of any stored electrical energy sources. This does not preclude shunt tripping provided that alarms are activated upon lack of continuity in the release circuits and power supply failures;

(2) When external source of supply is necessary for auxiliary circuits, at least two external sources of supply are to be provided and so arranged that a failure or loss of one source will not cause the loss of more than one generator set and/or set of essential services.

Where necessary, one source of supply is to be from the emergency source of electrical power for the start up from dead ship condition;

[16] Refer to IEC Publication 60298: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 72.5 kV and IEC Publication 60466 A.C. insulation-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 38 kV.

[17] Refer to IEC Publication 60298: A.C. metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 72.5 kV or other equivalent standards.

(3) Auxiliary equipment (including various instruments and relays) are to be capable of withstanding any vibrations arising from switching on or off, without malfunction.

2.12.5.4 A power-frequency voltage test is to be carried out on any switchgear and controlgear assemblies. The test procedure and voltages are to be according to standard(s) acceptable to CCS③.

2.12.6 Cables

2.12.6.1 High voltage cables are to be manufactured in accordance with standard(s) acceptable to CCS[18].

2.12.7 Installation

2.12.7.1 Where equipment is not contained in an enclosure but a room forms the enclosure of the equipment, the access doors are to be so interlocked that they cannot be opened until the supply is isolated and the equipment earthed down.

At the entrance of the spaces where high-voltage electrical equipment is installed, a suitable marking is to be placed which indicates danger of high voltage. As regards the high-voltage electrical equipment installed outside a.m. spaces, the similar marking is to be provided.

2.12.7.2 Run and test of high-voltage cables is to comply with the following:

(1) In accommodation spaces, high voltage cables are to be run in enclosed cable transit systems;

(2) High voltage cables are to be segregated from cables operating at different voltage ratings each other; in particular, they are not to be run in the same cable bunch, nor in the same conduit or pipe, or, in the same box.

Where high voltage cables of different voltage ratings are installed on the same cable tray, the air clearance between cables is not to be less than the minimum air clearance for the higher voltage side in 2.13.2.3(1). However, high voltage cables are not to be installed on the same cable tray for the cables operating at the nominal system voltage of 1 kV and less;

(3) High voltage cables, in general, are to be installed on carrier plating when they are provided with a continuous metallic sheath or armour which is effectively bonded to earth; otherwise they are to be installed for their entire length in metallic castings effectively bonded to earth;

[18] Refer to IEC Publication 60092 Electrical installation in ships – Part 353: Single- and multi-core non-radial field power cables with extruded solid insulation for rated voltages 1 kV and 3 kV and IEC Publication 60092 Electrical installation in ships – Part 354: Single- and 3-core power cables with extruded solid insulation for rated voltages 6 kV, 10 kV and 15 kV or other equivalent standards.

(4) Terminations in all conductors of high voltage cables are to be, as far as practicable, effectively covered with suitable insulating material. In terminal boxes, if conductors are not insulated, phases are to be separated from earth and from each other by substantial barriers of suitable insulating materials. High voltage cables of the radial field type, i.e. having a conductive layer to control the electric field within the insulation, are to have terminations which provide electric stress control. Terminations are to be of a type compatible with the insulation and jacket material of the cable and are to be provided with means to ground all metallic shielding components (i.e. tapes, wires etc.);

(5) High voltage cables are to be readily identifiable by suitable marking;

(6) Before a new high voltage cable installation, or an addition to an existing installation, is put into service a voltage withstand test is to be satisfactorily carried out on each completed cable and its accessories. The test is to be carried out after an insulation resistance test and in accordance with standard(s) acceptable to CCS[19] or the following:

① When a d.c. voltage withstand test is carried out, the voltage is to be not less than:

1.6 (2.5 U_0 + 2 kV) for cables of rated voltage (U_0) up to and including 3.6 kV

4.2 U_0 for higher rated voltages

Note: where U_0 is the rated power frequency voltage between conductor and earth or metallic screen, for which the cable is designed.

The test voltage is to be maintained for a minimum of 15 minutes. After completion of the test the conductors are to be connected to earth for a sufficient period in order to remove any trapped electric charge. An insulation resistance test is then repeated.

② When an a.c. voltage withstand test is carried out, the voltage is to be not less than normal operating voltage of the cable and it is to be maintained for a minimum of 24 hours.

2.12.7.3 For high-voltage switchboard or control box with pressure releasing device, the cables are to be laid far away from such device.

[19] Refer to IEC Publication 60502 Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1.2 kV) up to 30 kV (Um = 36 kV) or other equivalent standards.