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INTERNATIONAL STANDARD

Mobile and fixed offshore units – Electrical installations – Part 6: Installation

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 6: Installation

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61892-6 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units.

This second edition cancels and replaces the first edition published in 1999. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) clauses regarding installation of cables have been added;
b) the clause regarding secondary cells and batteries have been modified to give requirements also to installation of valve regulated (VRLA) type batteries;
c) an informative annex regarding testing of installation has been added.

The text of this standard is based on the following documents:

FDIS	Report on voting
18/1065/FDIS	18/1071/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61892 series, under the general title *Mobile and fixed offshore units – Electrical installations*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

IEC 61892 forms a series of International Standards intended to ensure safety in the design, selection, installation, maintenance and use of electrical equipment for the generation, storage, distribution and utilization of electrical energy for all purposes in offshore units which are used for the exploration or exploitation of petroleum resources.

This part of IEC 61892 also incorporates and co-ordinates, as far as possible, existing rules and forms a code of interpretation, where applicable, of the requirements laid down by the International Maritime Organization, and constitutes a guide for future regulations which may be prepared and a statement of practice for offshore unit owners, constructors and appropriate organizations.

This standard is based on equipment and practices which are in current use, but it is not intended in any way to impede development of new or improved techniques.

The ultimate aim has been to produce a set of International Standards exclusively for the offshore petroleum industry.

MOBILE AND FIXED OFFSHORE UNITS – ELECTRICAL INSTALLATIONS –

Part 6: Installation

1 Scope

This part of IEC 61892 contains provisions for electrical installation in mobile and fixed offshore units including pipeline, pumping or 'pigging' stations, compressor stations and exposed location single buoy moorings, used in the offshore petroleum industry for drilling, processing and for storage purposes.

It applies to all installations, whether permanent, temporary, transportable or hand-held, to a.c. installations up to and including 35 000 V and d.c. installations up to and including 750 V (a.c. and d.c. voltages are nominal values).

This standard does not apply to electrical installations in rooms used for medical purposes, or in tankers.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60079-14:2002, *Electrical apparatus for explosive gas atmospheres – Part 14: Electrical installations in hazardous areas (other than mines)*

IEC 60447:2004, *Basic and safety principles for man-machine interface – Actuating principles*

IEC 60502-1:2004, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m = 1,2 kV) up to 30 kV (U_m = 36 kV) – Part 1: Cables for rated voltages of 1 kV (U_m=1,2 kV) up to 3 kV (U_m = 3,6 kV)*

IEC 60502-2:2005, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m=1.2 kV) up to 30 kV (U_m = 36 kV) – Part 2: Cables for rated voltages from 6 kV (U_m = 7,2 kV) up to 30 kV (U_m = 36 kV)*

IEC 60623:2001, *Secondary cells and batteries containing alkaline or other non-acid electrolytes – Vented nickel-cadmium prismatic rechargeable single cells*

IEC 60825 (all parts), *Safety of laser products*

IEC 60896-11:2002, *Stationary lead-acid batteries – Part 11: Vented types – General requirements and methods of test*

IEC 61892-1, *Mobile and fixed offshore units – Electrical installations – Part 1: General requirements and conditions*

IEC 61892-2, *Mobile and fixed offshore units – Electrical installations – Part 2: System design*

IEC 61892-3, *Mobile and fixed offshore units – Electrical installations – Part 3: Equipment*

IEC 61892-4, *Mobile and fixed offshore units – Electrical installations – Part 4: Cables*

IEC 61892-7, *Mobile and fixed offshore units – Electrical installations – Part 7: Hazardous areas*

ISO 8468:1990, *Ship's bridge layout and associated equipment – Requirements and guidelines*

3 Terms and definitions

For the purposes of this document the terms and definitions given in IEC 61892-1 through IEC 61892-7 and the following apply.

3.1
appropriate authority
governmental body and/or classification society with whose rules a unit is required to comply

3.2
bonding
connection of non-current-carrying parts to ensure continuity of electrical connection, or to equalize the potential between parts

3.3
electric surface heating
heat generated in the surface layer of a body to be heated by electrical means in order to raise or maintain its temperature

3.4
electric surface heating system
system of electric surface heating devices together with any controls, thermal insulation and protective cladding designed to meet a specified electric surface heating requirement

3.5
emergency switchboard
switchgear and controlgear assembly which is normally supplied by the main switchboard but, 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 distribute and control electrical energy to the emergency services for all electrical consumers essential for the safety of the crew and the unit under emergency conditions

3.6
equipotential bonding
electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential

3.7
exposed conductive part
conductive part which can readily be touched and which is not normally alive, but which may become alive under fault conditions

NOTE Typical exposed conductive parts are walls of enclosures, operating handles, etc.

3.8
extraneous conductive part
conductive part not forming a part of the electrical installation and liable to propagate a potential, including earth potential

3.9
main switchboard
switchgear and controlgear assembly which is directly supplied by the main source of electrical power and is intended to distribute and control electrical energy to the unit's services

3.10
primary structural damage
damage which can result from lightning strike to units which do not provide a path of low resistance to earth for the passage of lightning currents, for example units of non-metallic construction or those having substantial non-metallic members

3.11
safety voltage (extra low voltage)
voltage which does not exceed 50 V a.c. r.m.s. between conductors, or between any conductor and earth, in a circuit isolated from the supply by means such as a safety isolating transformer, or converter with separate windings; a voltage which does not exceed 50 V d.c. between conductors, or between any conductor and earth, in a circuit which is isolated from higher voltage circuits

NOTE 1 Consideration should be given to the use of equipment operating at less than 50 V under certain conditions, such as wet surroundings, exposure to heavy seas or powerful water jets where direct contact with live parts is involved.

NOTE 2 The voltage limit should not be exceeded either at full load or no-load but it is assumed, for the purpose of this definition, that any transformer or converter is operated at its rated supply voltage.

3.12
secondary damage
damage to units or to their electrical installations, which can result as an indirect consequence of a lightning strike to a unit or to its immediate vicinity. A path to earth of low resistance may not prevent secondary damage, which may occur as a result of high values of induced, or resistance drop voltages produced by the passage of lightning currents

3.13
valve-regulated battery cell
a secondary cell which is closed under normal conditions but which has an arrangement which allows the escape of gas if the internal pressure exceeds a predetermined value. The cell cannot normally receive addition to the electrolyte

3.14
vented (secondary) battery cell (*Syn.* open (secondary) cell)
a secondary cell having a cover provided with an opening through which gaseous products may escape

NOTE The opening may be fitted with a venting system.

3.15
gastight sealed (secondary) cell
a secondary cell which remains closed and does not release either gas or liquid when operated within the limits and temperature specified by the manufacturer. The cell may be equipped with a safety device to prevent dangerously high internal pressure. The cell does not require addition to the electrolyte and is designed to operate during its life in its original sealed state

4 Equipment earthing and bonding

4.1 General

4.1.1 This clause contains mainly provisions for earthing of exposed conductive parts and bonding of extraneous conductive parts, various other bonding connections and a table for sizes of earth-continuity conductors and earthing connections.

4.1.2 All metallic parts of a unit, that are not normally current-carrying parts, shall be designated as either an exposed conductive part or an extraneous conductive part.

a) Exposed conductive parts shall be connected to earth under the specific conditions for each type of system earthing:
   - for TT- and IT-systems, the exposed conductive parts shall be connected directly to earth;
   - for TN-S systems, the exposed conductive parts shall be connected to the protective conductor, which is connected to earth at the neutral point of the distribution system.

   NOTE 1 For the definition of TT-, IT- and TN-S-systems, see IEC 61892-2.

   NOTE 2 Earth or an equipotential bonding system may be the steel structure or the hull of a unit.

b) Extraneous conductive parts shall be connected to an equipotential bonding system.

   For units that have separate modules and/or concrete structures, equipotential bonding shall be installed between extraneous conductive parts.

   It shall be ensured that there is no detrimental mutual influence between the different protective measures applied in the same installation or in part of an installation.

NOTE 1 For earthing requirements of system neutral points, see IEC 61892-2.

NOTE 2 For earthing and bonding requirements in hazardous areas, see IEC 61892-7.

4.1.3 Earth bars, when provided, shall be located in front of equipment and junction boxes to allow for easy access for usage, inspection and maintenance. All earthing bars and terminals shall be visible and possible to be checked also after termination of cables. Separate connections shall be used for each individual earth conductor.

4.2 Earthing of exposed conductive parts

4.2.1 Unless specifically included in the following exemptions, all exposed conductive parts shall be earthed.

Exemption:

- lamp caps;
- shades, reflectors and guards, supported on lampholders or luminaires constructed of, or shrouded in, non-conducting material;
- 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;
- portable appliances which have a double and/or reinforced insulation (see IEC 61892-1) provided that the appliances conform with recognized safety requirements;
- bearing housings which are insulated in order to prevent the circulation of current in the bearings;
- clips for fluorescent lighting tubes;
- equipment supplied at extra-low voltage (safety voltage);
- cable clips;
- equipment of "all-insulated" construction in which the insulation enclosing the equipment is durable and continuous;
- fixed equipment or parts of equipment which, although not shrouded in insulation material, are nevertheless protected in such a way that they cannot be touched and cannot come into contact with exposed metal;
- equipment located in special earth-free rooms.

4.2.2 Metal parts of portable appliances, other than current-carrying parts and parts exempted in 4.2.1, shall be connected to earth by means of a conductor in the flexible cable or cord, which complies with Table 1 and which is connected, for example, through the associated plug and socket-outlet.

4.2.3 Secondary windings of instrument transformers shall be earthed.

4.2.4 The bonding shall be such as to give a substantially equal potential and a sufficiently low earth-fault loop impedance to ensure correct operation of protective devices.

4.3 Equipotential bonding

4.3.1 Extraneous conductive parts shall be connected to the equipotential bonding system as described in 4.4.

4.3.2 Metal frames or enclosures of equipment mounted in direct metallic contact with the unit structure need no supplementary bonding, provided that the surfaces in contact are clean and free from rust, scale or paint when installed and are firmly bolted together. Alternatively, they may be connected to the unit structure by a connection complying with 4.4.

4.3.3 Removable gland plates shall be separately bonded to the parent equipment, unless the connection between the gland plate and the parent equipment complies with the requirement of 4.3.2.

Enclosures of high-voltage equipment located in hazardous areas shall be connected to PE and bonded to the main structure.

4.4 Bonding connections

4.4.1 Every bonding connection to earth shall be of copper or other corrosion-resistant material and shall be securely installed and protected where necessary against damage and also against galvanic corrosion. Connections shall be secured against becoming loose due to vibration.

4.4.2 The nominal cross-sectional area of every copper bonding connection shall be not less than required in Table 1. Every other bonding connection shall have a conductance not less than that specified for a copper bonding connection.

4.4.3 Equipotential bonding connections for extraneous conductive parts shall have a cross-sectional area of at least 6 mm^2.

4.5 Connections to the unit structure

4.5.1 The bonding shall be achieved by means of a separate bonding conductor unless the parts under consideration are installed in accordance with 4.3.2.

4.5.2 Every connection of an earth conductor or a bonding conductor to the unit structure or hull shall be made in an accessible position, and shall be secured by a screw of brass or other corrosion resistant material, which shall be used for this purpose only. In all cases, care shall be taken to ensure clean metallic surfaces free from rust at the contact areas immediately before the screw is tightened.

4.5.3 Any electrical or instrumentation equipment attached, but not welded, to the structure steelwork, for example to hand rails, ladders and stairways, shall be bonded to the nearest structural steelwork.

4.5.4 To minimize shock from high-frequency voltage induced by the radio transmitter, handles, handrails, etc., made of metal shall be in good electrical connection with the hull or superstructure.

4.6 Protection against galvanic corrosion

Methods of securing dissimilar materials, for example aluminium to the structure or steel hull of a unit, often include insulation to prevent galvanic corrosion between the materials. In such cases, a separate bonding connection shall be provided between, for example, an aluminium superstructure and structure or hull, which shall be made in such a manner that galvanic corrosion is avoided and the points of connection may be readily inspected.

4.7 Metal coverings of cables

4.7.1 All metal coverings of cables shall be earthed at both ends, except in so far as the provisions given for single-core cables for a.c wiring apply (see 5.2). Single-point earthing is admitted for final subcircuits (at the supply end) and in those installations (control and instrumentation cables, intrinsically safe circuits, control circuits, etc.) where it is required for technical or security reasons, if any.

4.7.2 Earthing connections shall be carried out with conductors that have cross-sectional areas (see Table 1) related to the current rating of the cables, or by equivalent means, such as metal clamps gripping the metal covering of the cable and connected to earth.

The metal covering of cables may be earthed by means of glands intended for that purpose and so designed as to ensure an effective earth connection.

The glands shall be firmly attached to, and in effective contact with, a metal structure earthed in accordance with this standard.

4.7.3 The electrical continuity of all-metal coverings throughout the length of the cables, particularly at joints and tappings, shall be ensured.

4.7.4 Metal casings, pipes and conduits or trunking shall be effectively earthed.

4.7.5 Conduits may be earthed by being screwed into a metal enclosure, or by nuts on both sides of the wall of a metal enclosure, provided the surfaces in contact are clean and free from rust, scale or paint and that the enclosure is in accordance with these provisions on earthing. The connections shall be painted immediately after assembly in order to prevent corrosion.

4.7.6 Cable sheaths and armour, and conduits, may be earthed by means of clamps or clips of corrosion-resistant and galvanically compatible metal, making effective contact with sheath or armour and earthed metal.

4.7.7 All joints in metal conduits and ducts and in metallic sheaths of cables used for earth continuity shall be soundly made and protected, where necessary, against corrosion.

4.7.8 Instrument cables without armour shall normally have screens earthed at the control equipment.

NOTE An evaluation must be made regarding the need for earthing in one or both ends of the armour/screen in relation to the required suppression of the frequency band.

4.7.9 Instrument cables with armour shall have screen and armour insulated from each other with the screen earthed at the control equipment only and the armour earthed at both ends, unless it is required for functional reasons to be earthed at one end only, in which case it shall normally be earthed at the equipment or, in the case of intrinsically safe circuits, in accordance with 4.7.10.

NOTE An evaluation must be made regarding the need for earthing in one or both ends of the armour/screen in relation to the required suppression of the frequency band.

4.7.10 Intrinsically safe (IS) cables shall normally have a screen connected to the IS earth bar.

4.7.11 Spare cores of glanded multi-core or multi-pair electrical and instrumentation cables shall be connected to terminal blocks and be collectively earthed.

NOTE Due to the lack of international provisions covering the use of cable armours, metal sheaths or shields as protective earthing conductors for connected equipment, reference is made to national codes.

4.7.12 Earthing facility with a local earth bus shall be provided for connection of phase connections as personnel protection.

4.8 Cable racks and cable tray

Electrical continuity shall be maintained at splices between sections of cable ladder, rack or tray by the use of splice plates. Additional bonding is not required, unless cable ladder, rack or tray is insulated from the steel structure or hull to prevent galvanic corrosion. In these cases bonding shall be carried out as required in 4.4.

4.9 Ductings of heating, ventilation, air-condition (HVAC) and vessels

Vessels and equipment skids, which are not seam-welded to the structural steel, shall be bonded to earth using the integral earthing bosses supplied with the equipment.

Electrical continuity shall be maintained between HVAC ducting sections and between ducting and the main structure.

Table 1 – Sizes of protective-earthing (PE) conductors and earthing connections

Type of earthing connection	Cross-sectional area of associated current-carrying conductor	Minimum cross-sectional area of copper earthing connection
1 PE conductor in flexible cable or flexible cord	Any	Same as current-carrying conductor up to and including 16 mm^2, or one-half above 16 mm^2 but at least 16 mm^2
2 PE conductor incorporated in fixed cable	Up to and including 16 mm^2	Same as current-carrying conductor up to and including 16 mm^2 but at least 1,5 mm^2
a) insulated PE conductor	Over 16 mm^2	50 % of the current-carrying conductor but at least 16 mm^2
b) bare PE conductor in contact with metallic covering	1 mm^2 to 2,5 mm^2	1 mm^2
	4 mm^2 to 6 mm^2	1,5 mm^2
3 Separate fixed earthing conductor	Not exceeding 2,5 mm^2	Same as current-carrying conductor subject to minimum of 1,5 mm^2 for stranded earth conductor, or 2,5 mm^2 for solid earth conductor
	Exceeding 2,5 mm^2 but not exceeding 120 mm^2	One-half of the cross-sectional area of the current-carrying conductor, subject to a minimum of 2,5 mm^2
	Exceeding 120 mm^2	70 mm^2

5 Cables and wiring

5.1 General

This clause contains provisions for the installation of cables and wiring, while IEC 61892-4 contains provisions for the construction, rating and selection of cables.

5.2 Installation

Cables for high voltage, low voltage, control and instrumentation shall not be installed on the same cable ladders or trays. Where insufficient space makes this impossible, cables for low voltage, control and instrumentation may be installed on the same tray, but not in the same cable bunch.

NOTE 1 A partition separator made of the same material as the cable tray should be installed on the tray or ladder if different types of cables are installed on the same tray or ladder.

Cable ladders installed horizontally shall have sufficient space to facilitate cable pulling and cleating/strapping, minimum 300 mm free space between top of one ladder edge to bottom of next ladder edge, and from top ladder edge to roof.

NOTE 2 All cables should be routed on cable ladders or trays. This does not preclude single cables fixed by cable clips and installation of cables on the underside of ladders or trays.

Trunking or conduits may be used for special mechanical protection of single field routed cables for shorter distances (approximately 5 m). Where conduits are used, they shall be installed with open ends.

Access for maintenance and an orderly layout shall be ensured. This is also valid when cables are installed below raised floor.

Once a cable has been cut, a protective cap/sealing shall be applied on the end, when being exposed to humid atmosphere.

All cable entries to equipment located outdoors and in wash down areas shall be from below. Top entry is not allowed.

NOTE 3 Side entry may be used provided it is installed with a drip nose.

Sufficient cable spare length shall be provided for equipment that needs future adjustments (floodlights, loudspeakers, etc.) or where equipment has to be dismounted for maintenance and calibration without disconnecting the cable.

Single core cables for three-phase AC shall run in trefoil formation. The braided armour shall be earthed in one end only. For equipment installed in hazardous areas, the braid shall be earthed at the hazardous end. When using single core cables, additional cables for earthing have to be installed.

Single core cables shall not be installed separately through openings surrounded by magnetic materials. Non-magnetic stainless steel separation walls and stay plates shall be used in multi cable transits utilised for single core cables.

All cables shall be marked for easy identification, at least in each end.

NOTE 4 The marking should indicate type of cable, i.e. high voltage, low voltage, control/instrumentation and consumer.

The minimum permissible bending radius shall be as specified by the cable manufacturer.

5.3 Cable-runs

Cable-runs shall be selected so as to avoid action from condensed moisture or dripping water. Cables shall, as far as possible, be remote from sources of heat and protected from avoidable risks of mechanical damage.

In the case of essential electrical equipment for which it is mandatory to have at least two supplies, the supply and any associated control cables shall follow different routes, which shall be separated both vertically and horizontally as far as practical.

5.4 Cable cleating and strapping

Stainless steel straps shall be used for all runs outside and in non ventilated areas. When cut no sharp ends shall be left in cutting end.

Ultra violet resistant plastic straps may be used for horizontal runs indoors.

Where cables are run on the underside of ladders or trays, or otherwise such that the cables could be released in a fire, stainless steel straps shall be used.

Stainless steel straps shall be used for vertical runs and for horizontal runs in the vertical plane both indoor and outdoor. For strapping of fibre-optical and coaxial cables, supplier guidelines shall be adhered to.

The distance between supports shall be chosen according to the type of cable and the probability of vibration. It shall not exceed 400 mm for a horizontal cable run where the cables are laid on cable supports in the form of tray plates, separate brackets or hanger ladders. The spacing may be up to 900 mm, provided that there are supports with maximum spacing as specified above.

Trefoil cable cleats for single core power cables shall be approved for the potential short circuit stress. The cleats shall be outdoors, in naturally ventilated areas and wash down areas be made of stainless steel, AISI 316.

The distance between trefoil cleats for single core cables shall be as specified by the cable manufacturer based on the calculated short circuit level.

NOTE 1 For fire resistant cables the distance between the strapping is to be in line with the distance adopted during the fire resisting test in the relevant standard of the IEC 60331 series.

NOTE 2 Cables with class 5 conductors may require additional support to prevent sagging.

5.5 Joints and tappings

Cable runs shall not normally include joints (splices). If, in the case of repair or sectional construction of the unit, a joint is necessary, the joint shall be of such a type that electrical continuity, insulation, mechanical strength and protection earthing and fire-resisting or flame-retardant characteristics are not less than those required for the cables.

Tappings (branch circuits) shall be made in suitable boxes, of such a design that the conductors remain suitable insulated and protected from atmospheric action, and fitted with terminals or busbars of dimensions appropriate to the current rating.

Joints and tappings shall be clearly marked to identify the cable(s) and core(s).

5.6 Cable ends

Cable glands/blanking and drain plugs shall be of a material which is compatible with the material used in the enclosure.

Recommended types of cable glands are given in Table 2.

Table 2 – Enclosure-gland type

Type of enclosure	Type of gland
Plastic enclosures (relevant for field cables)	Plastic for size below M32
Plastic enclosures, reinforced with a metal gland plate for support of large supply- and multi-core cables	Brass
Metal enclosures (except aluminium)	Brass/stainless steel
Aluminium enclosures	Stainless steel/nickel plated brass
Only sea water resistant Aluminium shall be used. Plastic glands shall not be used for armoured cables. For cable glands for explosion protected equipment, see IEC 61892-7. Shrouds and similar should not be used on cable glands.	

5.7 Cable termination

Cables with braid armour shall have outer heat shrink sleeve, which is fitted over the complete cable make-off.

NOTE 1 Instrument and telecommunication cables with both braid armour and screen shall have inner and outer heat shrink sleeves.

The inner sleeve shall be drawn over the inner bedding, i.e. passed under the braiding providing insulation between braiding and screen.

The outer sleeve shall be fitted over the complete cable make-off.

The inner sleeve may be excluded at terminations providing a minimum of 50 mm inner bedding.

Where the screen shall be left disconnected (applicable for field instrument) it shall be sealed and isolated with an isolating cap, which allows for insulation testing without any disconnecting.

To minimize the extent of hot work sleeves of type self vulcanizing-tape may be used on units in operation.

High-voltage cables shall be fitted with compression lugs, unless another termination type is specified.

All cable conductors shall be terminated by use of compression lugs or ferrules dependent upon the type of termination, unless the terminal is of a type designed to be used without ferrules.

NOTE 2 The compression ferrule should be the type where the conductor strands are inserted through the whole ferrule and reach the bottom of the terminal.

NOTE 3 Support for cleating of cables when entering panels should be provided.

In switchboards and distribution boards, adequate space shall be provided for the use of a clip-on ampere meter without causing undue stress on the cable conductors or connections.

The braid armour and the screen shall be separated from each other as well as from the conductors and fitted as required. This shall be done without any reduction of the cross sectional area.

NOTE 4 The connection should, by preference, be with a 360° connection. Pigtails should be avoided.

Only one conductor shall be connected to each terminal of a terminal block/row for external connections. This is not related to terminals approved for two conductors for internal components (e.g. relays, contactors).

NOTE 5 Two conductors may in certain cases be used in one approved type ferrule connected to one terminal.

Spare conductors in instrument and telecom cables shall be terminated and left floating at the field end.

In cabinets all spare conductors shall be marked with a terminal number and connected to terminals linked together by solid terminal links, which shall be connected to the relevant earth bar.

Spare cores in instrument and telecom cables shall be connected to IE (intrinsically safe) earth in supply end only.

If there are no spare terminals left in the cabinet, all spare conductors shall be covered with yellow/green sleeves and marked with relevant cable number and connected directly to the relevant earth bar.

5.8 Cable ladders and trays

Cable support systems located outdoors, in natural ventilated areas and wash down areas shall be made of stainless steel, AISI 316. For indoor ventilated areas cable support systems made of galvanized carbon steel may be used. Cable supports shall be of the same material as the cable ladder/tray.

NOTE 1 Aluminium or fibreglass cable support system can be considered with the necessary precautions regarding mechanical strength and requirement for installation in hazardous area.

Cable protection shields shall be made in the same material as the cable support system in the area.

Maximum distance between the supports for cable ladders and trays shall be as specified by the supplier.

NOTE 2 Typical support distance is every 3 m.

Cable ladders installed horizontally shall have sufficient space to facilitate cable pulling and fixing.

NOTE 3 Minimum free space on top of ladder should be 300 mm.

All surfaces shall be cleaned prior to bolting together.

Cable support systems shall be located to leave sufficient space for surface protection of adjacent structure.

NOTE 4 In offices and living quarters where multidiscipline socket outlets are grouped together, multipurpose cable channels designed for recessed installed outlets should be used.

Kick plate shall be fitted around penetrations in floor where cables/tubing are exposed to mechanical damages.

Protection shield shall be installed where cables can be exposed to physical damages, minimum 500 mm above the floor.

Cable ladder systems shall be protected from danger of dropped object due to crane handling or similar.

5.9 Cables and wiring for interconnection of equipment

External cables and wiring shall comply with the requirements of IEC 61892-4.

Consideration shall only be given to cables and interconnecting wiring of smaller sizes than allowed for in IEC 61892-4 when they are adapted for equipment requiring currents of very small value. The mechanical strength and insulation qualities of such cables and wiring shall not affect the reliability of the system of which they form a part.

6 Generators and motors

6.1 General

This clause contains provisions for the installation of all types of electrical rotating machines on offshore units. Regarding location of generators, see IEC 61892-2.

6.2 Installation

6.2.1 Generators and motors shall, where practicable, be installed to minimise the effect of motion of the unit.

NOTE Regarding requirements for lubrication, see IEC 61892-3.

6.2.2 Generators shall be located in well-ventilated spaces where combustible gases cannot accumulate.

NOTE This requirement does not preclude the installation of generators and prime movers in zone 2, provided sufficient precautions are taken with regard to ventilation and to explosion protection of equipment. For additional requirements for installations in hazardous areas, see IEC 61892-7.

7 Transformers

7.1 General

This clause contains provisions for the installation of all types of transformers used for power and lighting on offshore units.

7.2 Installation and location

7.2.1 Transformers shall be installed in sufficiently ventilated compartments, accessible only to authorized personnel. The one exception to this rule is that air-cooled transformers provided with means of protection against accidental contact with live parts need not be installed in special compartments.

Transformers may be installed outdoor provided the transformer has a suitable IP degree of protection.

7.2.2 Liquid-immersed transformers shall be installed in an area with provisions for containment and drainage of liquid leakage. When flammable liquid such as oil is used, consideration shall be given to the need for fire detection and extinguishing equipment and thermal and structural class A subdivision.

7.2.3 Suitable arrangements shall be provided for cooling and containing all the liquid which might escape from a damaged tank. Contamination of bilges shall be avoided by the provision of suitable drip-trays or save-alls.

7.2.4 Transformers and their connections shall be protected against such mechanical damage, condensation and corrosion as may reasonably be expected.

7.2.5 Where liquid cooling is used, consideration shall be given to the provision of a device capable of detecting leakage into the enclosure and provision of an alarm signal in either

primary or secondary cooling circuit, as relevant. In addition, the flow of coolant shall be monitored in order to operate an alarm in the event of a loss of flow.

7.2.6 Where provision is made for breathing, a suitable desiccator shall be provided.

7.2.7 Where forced cooling is used, it shall be possible to operate the transformer at reduced power on failure of a pump or fan. Consideration shall be given to the provision of a suitable temperature indicator and alarm facilities.

7.3 Isolation of windings

Means shall be provided for the isolation of secondary windings which can be connected to a source of voltage.

Where transformers are arranged to operate in parallel, means shall be provided for the isolation of the primary and secondary windings.

A suitable warning label indicating the points of isolation shall be provided near the point of access.

8 Switchgear and controlgear assemblies

8.1 General

This clause contains provisions for the installation of low-voltage switchgear and controlgear assemblies.

8.2 Location

8.2.1 Switchgear and controlgear assemblies shall be installed in easily accessible and well-ventilated locations where combustible gases, acid vapours or similar do not occur, and shall be located well clear of heat sources such as boilers, heated oil tanks, steam exhaust pipes or other heated pipes.

In addition to complying with the appropriate requirements of IEC 61892-1, all switchgear and controlgear assemblies shall be so installed that no pipes or tanks are above them within the same space or at their rear. Where this is unavoidable, pipes shall be continuous and without openings in such locations. In addition a drip pan shall be installed for protection of the switchgear and controlgear.

8.2.2 Where switchgear and controlgear assemblies are located in dedicated rooms, pipes or conduits for water, steam, gas, oil, etc., which are not related to the electrical equipment, are not permitted.

8.2.3 Doors to rooms containing high-voltage switchboards shall be marked with suitable warning signs.

8.3 Insulating mats

When the voltage exceeds the safety voltage (extra-low voltage) as defined in clause 3, an insulating mat or grating shall be provided in front of switchgear and controlgear assemblies and also at the rear, if access from the rear is required. The insulating mat or grating shall be oil-resistant and non-slip.

NOTE 1 If an assembly contains withdrawable equipment, the insulating mat or grating should be provided in front of and on both sides of the equipment in its fully withdrawn position.

NOTE 2 Removable mats for use only during repair and maintenance should be considered.

NOTE 3 See IEC 61111 (see bibliography).

NOTE 4 This requirement does not apply when the floor is made of an insulating layer.

8.4 Passageways in front of switchgear and controlgear assemblies

An unobstructed passageway extending not less than 1 m wide from the furthest projection shall be provided in front of any assemblies.

When an assembly contains withdrawable equipment, for example circuit-breaker and starter chassis, the unobstructed passageway shall not be less than 0,4 m wide with this equipment in its fully withdrawn position.

For small units, the unobstructed passageway may be reduced subject to agreement by the appropriate authority.

8.5 Space at the rear and passageways

When a space is provided at the rear of switchgear and controlgear assemblies, it shall be ample to permit maintenance and, in general, shall be not less than 0,6 m in the clear, except that the width may be reduced to 0,5 m where there are stiffeners and frames.

NOTE For nominal voltages exceeding 600 V, it is recommended to increase this space.

Passageways behind main and emergency switchboards with open rear shall be of ample height and shall, where practicable, be provided at each end with an access door fitted with an external lock which can at all times be opened from the interior. The access doors shall carry a permanent and prominent indication of the maximum voltage.

8.6 Positions of section and distribution boards

In accommodation spaces where open-type assemblies are surrounded by combustible material, a fire barrier of incombustible material shall be provided.

9 Semiconductor converters

9.1 Where semiconductor converter stacks or equipment are air-cooled, they shall be installed in such a manner that the circulation of air to and from the stacks, associated equipment or enclosures (if any) is not impeded, and that the temperature of the cooling inlet air to converter stacks does not exceed the ambient temperature for which the stacks are specified.

9.2 Converter stacks and associated equipment shall not be mounted near sources of radiant heat energy, such as resistors, steam pipes and engine exhaust pipes.

9.3 For liquid cooled type converters, the same installation precautions as specified in clause 7 for liquid-cooled transformers apply.

10 Secondary cells and batteries

10.1 Location

10.1.1 Secondary cells and batteries shall be arranged to permit ready access for replacing, inspection, testing replenishing and cleaning. They shall be located where they are not exposed to excessive heat, extreme cold, spray, steam or other conditions which would impair performance or accelerate deterioration.

The secondary cells and batteries shall be grouped in crates or tray of rigid construction and suitable material equipped with handles to facilitate handling. Lead shall not be used.

NOTE 1 The number of cells in a crate will depend on the weight and on the space available in the installation. The mass of crates or trays should preferably not exceed 100 kg. This requirement does not apply to cells whose mass is such that grouping in crates or trays is impracticable.

Batteries for emergency service, including emergency diesel-engine starting, shall be located where they are protected as far as is practicable from damage caused by collision, fire, flooding, spillage or any other casualty (in accordance with the International Convention for Safety of Life at Sea).

Battery shall not be installed in hazardous areas locations, except in rooms considered hazardous area solely by the presence of batteries itself. Batteries shall be located so that the vapours generated cannot harm surrounding appliances.

NOTE 2 The best operating conditions for a battery are obtained when the ambient temperature is within the range 15 °C to 20 °C. Sustained ambient temperature outside this range will affect secondary battery performance and will therefore require special consideration.

NOTE 3 Battery bank assembly inside chargers or UPS enclosures should be avoided due to corrosive vapours and possible release of hydrogen.

NOTE 4 For ventilation of battery compartments, see IEC 61892-7.

10.1.2 Secondary cells and batteries connected to a charging device shall be installed dependent on the output power of the device (calculated from the maximum obtainable charging current and the nominal voltage of the battery), as given in Table 3.

Table 3 – Location of batteries versus charging current

Charging current		Location
Vented type	**VRLA or sealed type**	
Power above 2 kW	Power above 4 kW	Room assigned to batteries only or, if a room is not available, in a suitable well-ventilated locker on exposed deck
Power between 0,2 kW and 2 kW	Power below 4 kW	As above, but may also be installed in a box or locker in some suitable space, or, if protected from falling objects, in a machinery space or in a similar well-ventilated compartment
Power below 0,2 kW	–	As above, but may also be stored in the open air, if protected from falling objects, or in a battery box in any suitable space
NOTE 1 When two or more batteries are grouped in the same room, the sum of output power of all charging devices shall be considered.		
NOTE 2 See additional requirements for VRLA type batteries, see 10.7.		
NOTE 3 See ventilation requirements for battery rooms in the IEC 61892-7.		

10.1.3 Starter batteries shall be located as close as practicable to the engine or engines served in order to limit voltage drop in the cables.

10.1.4 Secondary cells and batteries (unless of the valve regulated type batteries with recharging power below 4 kW) shall not be placed in accommodation, office and control room areas.

10.1.5 Ventilated lead-acid batteries and alkaline secondary batteries shall not be placed in the same battery compartment. When different electrolyte type batteries are contained in the same room, precautions and warning labels shall be installed to avoid mixing of maintenance tools, electrolyte and topping up water.

10.1.6 A danger notice shall be permanently secured to doors or covers of battery compartments, lockers and boxes, indicating that any source of ignition in these rooms or in their vicinity is prohibited.

10.2 Access

Batteries shall be arranged to permit ready and ergonomic access for replacement, inspection, testing, replenishing and cleaning.

10.3 Electrical installation in secondary battery compartments

Cables, with the exception of those pertaining to the battery or the battery compartment lighting, shall, as far as possible, not be installed in the battery compartments. If, however, such an installation is necessary, the cables shall have a protective covering resistant to the vapours developed by the electrolyte or shall be otherwise protected against these vapours.

10.4 Protection against corrosion

The interior of battery compartments, including crates, trays, boxes, shelves and other structural parts therein, shall be protected against the deteriorating effect of the electrolyte by

– electrolyte-resistant coating, or

– lining of electrolyte-resistant material, for example glass fibre for lead-acid, steel for alkaline secondary batteries.

NOTE 1 Alternatively, the floor of battery compartments may be lined with impermeable and electrolyte-resistant material spanning the entire floor. The lining should be watertight and carried up to at least 150 mm on all sides. Walls and deck-heads of battery compartments should all be protected with electrolyte-resistant coating or ceramic floor.

NOTE 2 Interior surfaces of metal shelves for lead cells, whether or not grouped in crates or trays, or for alkaline secondary batteries, should be protected by a lining of electrolyte-resistant material. The lining should be watertight and carried up to at least 75 mm on all sides. Linings should have a minimum thickness of 0,8 mm if made of steel. Exterior surfaces of metal shelves should have at least an electrolyte-resistant coating.

NOTE 3 Materials used for coating and lining should not be likely to emit vapours detrimental to the batteries.

10.5 Fixing and supports

Where movement is possible, in floating installations for example, batteries shall be securely fixed. The trays shall be arranged to give them access to the air on all sides. Any isolating supports shall be non-absorbent to the electrolyte.

NOTE The distance between valve-regulated lead-acid cells or monobloc batteries should be not less than 5 mm.

10.6 Protection of circuits from secondary batteries

Devices shall be provided to disconnect the battery installation from all lines of incoming and outgoing circuits and from earth potential.

NOTE 1 These devices can be

– circuit breakers, switches,

– removable fuses,

– connecting links,

– specially designed clamps.

When conductors from the batteries are not protected against short-circuiting and overload, they shall be installed so as to be adequately protected against short-circuits and earth faults

and as short as possible, e.g., starting batteries for emergency generator or fire pumps engines in the same skid or very near.

NOTE 2 This requirement can be met by using for example single-core double-insulated cables.

10.7 Additional requirements for valve regulated lead acid (VRLA) type batteries

VRLA batteries shall be designed for operation in a nominal ambient temperature of 25 °C.

NOTE 1 VRLA type batteries should be installed in conditioned rooms with recommended average temperature between 20 °C to 25 °C, except for short periods of time operating in a different temperature range, to avoid lifetime shortening and thermal avalanche effect.

VRLA batteries shall have a charger with cell temperature compensation floating charge and shall not have boosting charge mode.

VRLA battery chargers shall have less than 1 % current ripple.

NOTE 2 Sealed or VRLA type batteries should not be used for diesel engine starting, like emergency generator or fire pumps.

10.8 Protection against electric shock

Measures shall be taken in stationary battery installations for protection against direct contact and indirect contact or both.

NOTE 1 Further guidance is given in IEC 61140.

NOTE 2 Protection by obstacles or by placing out of reach is expressly permitted in battery installations. It requires however that batteries with nominal voltages from DC 60 V to DC 120 V between terminals and/or with nominal voltages from DC 60 V to DC 120 V with respect to earth shall be located in box or cabinets with restricted access, and batteries with a nominal voltage above DC 120 V shall be located in locked cabinets or rooms with restricted access. Doors to battery rooms and cabinets are regarded as obstacles and shall be marked with the warning labels according to 10.9.

NOTE 3 If protection by barriers or enclosures is applied, a degree of protection IEC 60529 IP 2X or IPXXB should at least be used.

NOTE 4 A nominal touch voltage of DC 120 V should not be exceeded for direct and indirect contact (see IEC 61201).

NOTE 5 Batteries with nominal voltages up to or equal DC 60 V do not require protection against direct contact, as long as the whole installation corresponds to the conditions for SELV (safety extra low voltage) or PELV (protective extra low voltage).

10.9 Identification labels or marking

The identification label or marking shall be durably fixed on each battery assembly unit and shall include the information as required in IEC 60896 and IEC 60623.

Each crate or tray shall be provided with a durable nameplate securely attached, bearing the manufacturer's name, the ampere-hour rating at a specific rate of discharge (preferably the one corresponding to the duty for the specific application), the voltage and the specific gravity of the electrolyte (in the case of a lead-acid battery, the specific gravity when the battery is fully charged).

The nameplate shall also include reference to the systems supplied by the batteries, e.g. by using cell and battery number, tag number, identifying manufacturer and type, nominal battery voltage, capacity, electrolyte type and other relevant information.

At least the positive terminal shall be clearly identified, either by a red washer or by an indented or raised symbol.

11 Luminaires

11.1 General

This clause contains provisions for the installation of all types of luminaires, including discharge lamp luminaires with a voltage above 250 V.

11.2 Degree of protection and safety requirements

Depending on their location, luminaires shall as a minimum have the degree of protection and safety requirements given in IEC 61892-2.

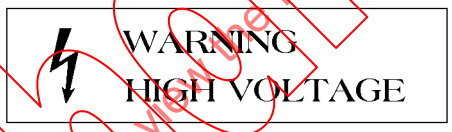
Luminaires likely to be exposed to more than the ordinary risk of mechanical damage shall be protected against such shock or be of specially robust construction.

Floodlights shall be provided with an extra safeguarding against falling down if the screwed connections loosen.

NOTE Particular attention should be paid to the mechanical protection of luminaires located in or near landing areas where cranes are operating.

11.3 Discharge lighting of voltage above 250 V

11.3.1 Discharge lamps operating at a voltage above 250 V shall be used only in fixed luminaires. Discharge lamp installations shall be provided with a durable and suitable notice bearing the inscription:



11.3.2 All live parts of discharge lamp luminaires shall be so placed and installed that they cannot be touched accidentally or inadvertently, the creepage distance along the surface of the glass tube being taken into consideration.

11.3.3 All non-current-carrying metallic parts of the installation shall be effectively earthed. It is, however, not always necessary to earth metallic clips or clamps used in positions remote from the terminals to support discharge lamps, but it may be found desirable to earth such clips or clamps in order to reduce interference with radio reception (see clause 4).

11.3.4 Each discharge lamp luminaire or installation shall be provided with a multipole (all pole) disconnecting switch in an accessible location. Such a switch shall be clearly marked and a warning notice shall be placed nearby.

Switches or other current-interrupting devices shall not be installed in the secondary circuit of transformers.

11.4 Emergency and escape lighting

Emergency lights and escape light fixtures shall be marked for easy identification. There shall be a clear difference between the two types.

11.5 Navigation aid system

Navigation aid system shall be installed as required by the appropriate authority.

NOTE Requirements to installation of navigation aid system can be found in recommendation AISM O-114, issued by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA).

12 Heating and cooking appliances

12.1 Guarding of combustible materials

All combustible materials in the vicinity of heating and cooking appliances shall be protected by suitable incombustible and thermal insulating materials.

12.2 Position of controlgear and switchgear

The position of fuses, switches and other control elements fitted in or near appliances shall be such that they will not be subject to temperatures above that for which they are designed and they shall be accessible for inspection, for example through separate covers.

12.3 Mounting of space-heating appliances

Space-heating appliances shall be so mounted that there will be no risk of dangerous heating of the deck, bulkhead or other surroundings.

13 Trace and surface heating

13.1 General

Trace and surface heating shall be installed in accordance with the system documentation. Special care shall be taken to ensure that any limits specified in the system documentation are not exceeded.

Systems installed in hazardous areas shall be installed in accordance with a standard acceptable to the appropriate authority.

13.2 Trace heating cables

Trace heating cables shall be strapped to equipment and pipes using glass fibre tape or another method in accordance with the manufacturer's documentation, and shall be spaced approximately at 300 mm intervals along pipes, and as required elsewhere.

Trace heating cables shall normally be installed along the lower semi-circle of the pipes.

Where practicable, cables shall pass through thermal insulation from below.

Trace heating cables shall be installed in such a way as to allow dismantling of joints, valves, instruments, etc. without cutting or damaging the cable.

For protection against condensation, the trace heating cable shall form a loop inside the junction box if not fitted with a drain plug.

Flexible conduits protecting trace heating cables shall be fixed to supports approximately every 200 mm.

For splicing of trace heating cables, manufacturer’s splicing kit, or instructions issued by the manufacturer shall be used.

13.3 Marking

The outside of the thermal insulation or protective cladding shall be clearly and durably marked at appropriate intervals to indicate the presence of electric trace and surface heating equipment.

13.4 Protection

The metallic covering of the heating cable shall be connected to the earthing system so as to provide an effective earth path.

13.5 Requirements for installation in hazardous areas

The electrical trace heating system shall be installed in hazardous locations in accordance with the requirements of IEC 60079-14 and IEC 61892-7.

13.6 Mechanical protection

In situations where the cable is liable to mechanical damage it shall be provided with suitable protection.

NOTE Where the trace heating cables are crossing flanges, thermal insulation covers or other sharp edges, protectors of stainless steel should be used.

13.7 Junction boxes

Where practicable, junction boxes shall be installed on steel supports, fixed directly to the heated pipes.

14 Control and instrumentation

14.1 General

The provisions of this clause are applicable to electrical, electronic and programmable equipment intended for control, monitoring, alarm and protection systems for use in offshore units.

NOTE If control and instrumentation aspects of closures in watertight bulkheads or shell plating, bilge pumping, fire protection and fire extinction are carried out by electrical methods, attention is drawn to additional requirements in SOLAS Chapter II-1, Regulations 15, 16, 17, 21 and Chapter II-2.

14.2 Layout

Control positions shall be ergonomically arranged for the convenience of the operator and hence the accuracy and safety of the operation.

Area or group identification shall be considered, especially in complex layouts, for example adequate spacing between display and control groups.

Equipment in the control room shall meet the requirements of ISO 8468.

14.3 Labelling

Each operator control panel, subpanel, indicating instrument, control handle, alarm, signal lamp, recording instrument, etc. shall be clearly and systematically identified by means of self-explanatory and unambiguous labels.

14.4 Labels

Labels shall be permanently secured, placed consistently relative to instruments, etc. and shall be made of durable material, bearing clear and indelible characters and numbers.

14.5 Display colours

Colours for the differentiation of operating conditions shall be readily distinguishable and identifiable.

14.6 Protection against fluid leakage

Electrical equipment, where practical, shall not be installed in the same panel or cabinet as equipment employing a hydraulic medium, or pipelines carrying water, oil or steam, unless effective means have been provided to protect the electrical equipment in case of leakage.

Through-runs of pipelines carrying hydraulic mediums, water, oil or steam, shall be avoided in Isolation of control rooms.

Deckheads and bulkheads of control rooms shall be made sufficiently waterproof to prevent seepage of water, oil, etc. into the compartment. All cable and pipe entries into control rooms shall be suitably sealed to prevent steam or oil-laden air from being drawn into the compartment.

14.7 Protection from condensation

As far as practicable, arrangements shall be made to prevent condensation in enclosures.

14.8 Protection during installation period

Electrical equipment shall be well protected during the installation period to prevent damage from welding, caulking, painting and similar injurious operations.

14.9 Sensors

14.9.1 Location of sensors

All sensors shall be located such that their output is a realistic measure of the parameter. Sensors shall be installed in places where there is minimal risk of damage during normal overhaul and maintenance.

14.9.2 Temperature sensors

Temperature sensors shall be installed in pockets of suitable material. Connections shall be arranged so as to permit withdrawal for testing purposes.

14.9.3 Pressure sensors

Pressure sensors exposed to shocks and strong vibration in their working medium shall be protected by damping chambers.

14.9.4 Enclosure

The enclosure of sensors and their terminal boxes shall be adequate for the expected place of installation (see IEC 61892-2) and for the type of cables installed.

14.9.5 Testing and calibration

Facilities shall be provided for testing and calibration of sensors which can not be tested during normal operational conditions.

14.10 Measurements and indications

14.10.1 Instrument similarity

Instruments measuring the same or similar quantities shall have the same or similar dial numbering and scale breakdown.

14.10.2 Direction of scale values

Scale values shall increase methodically from left to right, from bottom to top, or clockwise.

14.10.3 Scale division

Scales shall be divided to avoid the need for interpolation.

14.10.4 Automatic control sequence

Instruments for monitoring an automatic control sequence shall preferably display the sequential steps of operation and indicate if the sequential schedule is not being fulfilled.

14.10.5 Centralized control

Where centralized control can be performed from more than one control position, means shall be provided to indicate which control position is in operation.

14.11 Controls

14.11.1 Direction of motion

Where applicable, the motion of controls determined in relation to the person facing the control device shall be as follows:

For an increase in the value of the measured quantity, a direction of motion

– "to the right",
– "upwards",
– "forward", or
– "clockwise", when the movement is regarded chiefly as a rotation.

For more detailed instructions, see IEC 60447.

14.11.2 Control levers

Control levers, handles and push-buttons shall be easy to manipulate.

The need for extreme force shall be avoided.

Motions shall be limited by noticeable mechanical stops.

Where necessary, protection against inadvertent operation shall be fitted.

14.11.3 Identification

In addition to identification by labels, consideration shall be given to the use of different shapes of control levers and handles for the various functions, so that the operator will learn to associate a control function with a particular shape.

14.12 Alarm system

The acoustic and optical signals and indications used in alarm systems shall meet the requirements of IMO Resolution 867E Code on Alarms and Indicators, 1995, as far as applicable.

15 Communication

15.1 The radio equipment shall be so installed and such precautions taken in the installing of other equipment as to ensure the proper operation of these services.

15.2 The electrical installation of the equipment shall be carried out in accordance with IEC 61892-2 in order to achieve and maintain electromagnetic compatibility between systems.

15.3 Where several systems are grouped in close proximity, they shall be so installed as to be protected from physical damage and interference from adjacent systems during normal and fault conditions.

15.4 Laser systems shall be installed in accordance with IEC 60825.

16 Lightning protection

16.1 General

This clause contains provisions for the installation of lightning protection against primary structural damage and secondary damage to electrical systems.

NOTE Information regarding lightning protection can be found in IEC 62305.

16.2 Protection against primary structural damage

16.2.1 Measures shall be taken to minimise the risks of damage to a unit and its electrical installation due to lightning. An evaluation of the risk to the unit and personnel shall be made.

16.2.2 Where protective systems are required they shall include air terminals, down conductors and earth terminations so installed as to minimize the possibility of voltages being induced in electric cables due to the passage of electric currents.

16.2.3 A protective system need not be fitted to a unit of metallic construction, where a low resistance path to earth will be inherently provided by bolted and welded steelwork from the highest point of the unit to earth.

16.2.4 A protective system shall be fitted to any unit of non-metallic construction or having a substantial number of non-metallic members.

16.2.5 Metallic masts and metallic structural members may form part or all of any protective system.

16.2.6 Metal rigging, such as stays, etc., may act as fortuitous down conductors and shall be bonded to the protective system.

16.2.7 Joints in down conductors shall be accessible and be located or protected so as to minimize accidental damage. They shall be made using copper rivets or clamps. Clamps may be of copper or of copper alloy, and shall preferably be of the serrated contact type and effectively locked. No connection shall be dependent on a soldered joint.

16.2.8 Suitable means shall be provided to enable units, when in dry dock or on a slipway, to have their protective systems or metal hull connected to an efficient earth on shore.

16.3 Air terminals

An air terminal shall be fitted to each non-metallic mast.

Air terminals shall be made of copper or copper alloy conducting bar of not less than 12 mm diameter, and shall project at least 300 mm beyond the top of the mast. Other materials may be used, for example stainless steel or aluminium alloys, or steel bars effectively protected against corrosion, subject to the requirement of 16.4.2. The material shall be resistant to seawater.

16.4 Down conductors

16.4.1 Down conductors shall be made of copper or copper alloy, tapes or cables. Cable is preferred as both the insulation and circular shape inhibit surface discharge. Other materials may be used, for example, stainless steel or aluminium alloys, subject to the requirement of 16.4.2. The material shall be resistant to seawater.

16.4.2 The resistance between air terminals and earth terminals shall not exceed 0,02 Ω.

16.4.3 A flare boom, drilling rig or crane shall be bonded to the main structure. If satisfactory conductance through the structure is not achieved, additional earthing conductors shall be installed where necessary.

NOTE Special consideration must be observed for mobile units during dry docking where the normal connection to earth can be missing

16.4.4 Pipes and ventilation ducts shall be interconnected and connected to the main structure at the points where they penetrate it.

16.5 Protection against secondary damage

16.5.1 Equipment shall be so installed as to limit the effect of secondary damage to the electrical system.

16.5.2 Metallic enclosures shall be earthed to the metal structure or hull or to the protective system. Particular attention shall be paid to navigation lights and other equipment at the top of masts and other elevated structures.

16.5.3 Cable screens or armour, though normally earthed for reasons of signal interference, shall not provide the sole lightning path to earth for the equipment. Separate earthing, as required by 16.5.2, shall be provided.

16.5.4 Lightning earth connections to the protective system shall follow the most direct route.

16.5.5 The formation of cable loops, or metallic loops such as pipework, in proximity to down conductors shall be avoided. Cables in close proximity to down conductors shall be installed in metal pipes.

16.5.6 On metal units, cabling along decks shall be installed close to the deck to minimize the cross-sectional area of the loop existing between the cable and the deck. When choosing