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Utility connections in port

Part 3: Low-voltage shore connection (LVSC) systems — General requirements

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– IEC subcommittee 23H: Plugs, socket-outlets and couplers for industrial and similar applications, and for electric vehicles, of IEC technical committee 23: Electrical accessories;
– ISO Technical Committee 8: Ships and marine technology, subcommittee 3: Piping and machinery;
– IEEE IAS Petroleum and Chemical Industry Committee (PCIC) of the IEEE Industry Applications Society.

This document is published as a triple logo (IEC, ISO and IEEE) standard.

This first edition cancels and replaces IEC PAS 80005-3:2014. This edition constitutes a technical revision.

The text of this International Standard is based on the following IEC documents:

Draft	Report on voting
18/1970/FDIS	18/1993A/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 8 members out of 8 having a cast vote.

The language used for the development of this International Standard is English.

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A list of all the parts in the IEC 80005 series, published under the general title *Utility connections in port*, can be found on the IEC website.

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INTRODUCTION

For a variety of reasons, including environmental considerations, it is becoming an increasingly common requirement for ships to shut down ship generators and to connect to shore power for as long as practicable during stays in port.

The intention of this document is to define requirements that support, with the application of suitable operating practices, efficiency and safety of connections by compliant ships to compliant low-voltage shore power supplies through a compatible shore-to-ship connection.

With the support of sufficient planning, cooperation between ship and terminal facilities, and appropriate operating procedures and assessment, compliance with the requirements of this document is intended to allow different ships to connect to low-voltage shore connection (LVSC) systems at different berths. This provides the benefits of standard, straightforward connection without the need for adaptation and adjustment at different locations that can satisfy the requirement to connect for as long as practicable during stays in port.

Ships that do not apply this document can find it impossible to connect to compliant shore supplies.

In relation to the 1 MVA upper scope limitation of this document, ship types that fall under the annexes of IEC/IEEE 80005-1 and require less than 1 MVA when connected to shore power can be designed in accordance with IEC/IEEE 80005-1 with a high-voltage shore connection to ensure interoperability.

Where deviations from the requirements and recommendations in this document are considered for certain designs, it is important to highlight the potential effects on compatibility.

Where the requirements and recommendations of this document are complied with, low-voltage shore supplies arrangements are likely to be compatible for visiting ships for connection.

Clauses 1 to 12 are intended for application to all LVSC systems. They intend to address mainly the safety and effectiveness of LVSC systems with a minimum level of requirements that would standardize on one solution.

This document includes the requirements to complete a detailed compatibility assessment for ship and shore supply prior to a ship arriving to connect to a shore supply for the first time.

Annex A includes cabling recommendations that can be used in LVSC systems and contains performance-based requirements for shore connection cables. Annex A was developed by technical experts from several countries. IEC technical committee 18, subcommittee 18A and IEC technical committee 20 were consulted regarding the cable requirements.

Annex B describes ship to shore cable management and connector to be used in LVSC systems.

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1 Scope

This document specifies provisions for the design, installation and testing of low-voltage shore connection (LVSC) systems, onboard ships and on shore, to supply the ship with electrical power from shore.

This document is applicable to:

– ships requiring up to 1 MVA while at berth;
– three-phase shore connection systems rated 250 A and above, and with a nominal voltage rating of 400 V AC to 1 000 V AC;
– shore-side connection systems;
– shore-to-ship connection and interface equipment;
– transformers and reactors;
– semiconductor and rotating frequency convertors;
– ship-side connection systems;
– protection, control, monitoring, interlocking and power management systems.

This document does not apply to:

– inland navigation vessels;
– high-voltage shore connection systems, including ships built in accordance with the annexes of IEC/IEEE 80005-1;
– the electrical power supply during docking periods, for example dry docking and other out-of-service maintenance and repair;
– systems to be operated by ordinary persons as defined in 3.19.

NOTE 1 Other standards are available specifically for inland navigation vessels in Europe.

NOTE 2 IEC 60092-507 is applicable to small vessels.

NOTE 3 Additional or alternative requirements can be imposed by national administrations or the authorities within whose jurisdiction the ship is intended to operate and by the owners or authorities responsible for a shore power supply or distribution system.

NOTE 4 High-voltage shore connection systems are covered by IEC/IEEE 80005-1.

NOTE 5 Some existing 380 V AC ship systems can be supplied by 400 V AC.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60034 (all parts), *Rotating electrical machines*

IEC 60079 (all parts), *Explosive atmospheres*

IEC 60092-101: *Electrical installations in ships - Part 101: Definitions and general requirements*

IEC 60092-201:2019, *Electrical installations in ships - Part 201: System design - General*

IEC 60092-301, *Electrical installations in ships - Part 301: Equipment - Generators and motors*

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IEC 60092-302-2, *Electrical installations in ships - Part 302-2: Low voltage switchgear and controlgear assemblies - Marine power*

IEC 60092-352, *Electrical installations in ships - Part 352: Choice and installation of electrical cables*

IEC 60092-401, *Electrical installations in ships - Part 401: Installation and test of completed installation*

IEC 60092-504:2016, *Electrical installations in ships - Part 504: Automation, control and instrumentation*

IEC 60146 (all parts), *Semiconductor convertors - General requirements and line commutated convertors*

IEC 60309-1, *Plugs, fixed or portable socket-outlets and appliance inlets for industrial purposes - Part 1: General requirements*

IEC 60309-5:2017, *Plugs, socket-outlets and couplers for industrial purposes - Part 5: Dimensional compatibility and interchangeability requirements for plugs, socket-outlets, ship connectors and ship inlets for low-voltage shore connection systems (LVSC)*

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame*

IEC 60364 (all parts), *Low-voltage electrical installations*

IEC 60364-6, *Low-voltage electrical installations - Part 6: Verification*

IEC 60909 (all parts), *Short-circuit currents in three-phase AC systems*

IEC 60947-2, *Low-voltage switchgear and controlgear - Part 2: Circuit-breakers*

IEC 60947-5-1, *Low-voltage switchgear and controlgear - Part 5-1: Control circuit devices and switching elements - Electromechanical control circuit devices*

IEC 61363-1, *Electrical installations of ships and mobile and fixed offshore units - Part 1: Procedures for calculating short-circuit currents in three-phase a.c.*

IEC 62477-1, *Safety requirements for power electronic converter systems and equipment - Part 1: General*

International Convention for the Safety of Life at Sea (SOLAS):1974, *Consolidated edition 2009, Ch. II-1/D, Regulations 42, 43 and 45*

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3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO, IEC and IEEE maintain terminology databases for use in standardization at the following addresses:

– IEC Electropedia: available at https://www.electropedia.org/
– ISO Online browsing platform: available at https://www.iso.org/obp
– IEEE Standards Dictionary Online: available at http://dictionary.ieee.org

3.1
cable management system
CMS
all equipment designed to control, monitor and deliver the flexible cables, for power and control, and their connection devices

3.2
shore plug and socket-outlet
means enabling the connection of a flexible cable to fixed wiring, consisting of a shore socket-outlet and a shore plug

Note 1 to entry For use of shore plugs, shore socket-outlets, and ship couplers, see Figure 4.

3.3
shore socket-outlet
part intended to be installed with the fixed wiring (shore side) or incorporated in equipment

Note 1 to entry: See Figure 4.

3.4
shore plug
part intended to be attached directly to one flexible cable, and to be connected to the shore socket-outlet

Note 1 to entry: See Figure 4.

3.5
ship coupler
means enabling the connection of a flexible cable to the ship, consisting of two parts: a ship connector and ship inlet

Note 1 to entry: See Figure 4.

3.6
ship connector
part intended to be attached to one flexible cable connected to the supply, and to be connected to the ship inlet

Note 1 to entry: See Figure 4.

3.7
ship inlet
part incorporated in, or fixed to, the ship

Note 1 to entry: See Figure 4.

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3.8
equipotential bonding
set of electric connections intended to achieve equipotentiality between conductive parts

[SOURCE: IEC 60050-195:2021, 195-01-10]

3.9
low-voltage
LV
set of voltage levels used for the distribution of electricity and whose upper limit is generally accepted to be 1 000 V AC

[SOURCE: IEC 60050-601:1985, 601-01-26, modified – In the definition, "for alternating current" has been replaced with "AC".]

3.10
person in charge
PIC
person or persons responsible for LVSC system operation

3.11
pilot contact
contact of the shore plug, ship inlet, shore socket-outlet and ship connector which signals correct connection, and which is a safety-related component

3.12
receiving point
connection point of the flexible cable on the ship

3.13
safe
condition in which safety risks are minimized to an acceptable level

[SOURCE: IEC/IEEE 80005-1:2019, 3.12]

3.14
fail-safe
able to enter or remain in a safe state in the event of a failure

[SOURCE: IEC 60050-821:2017, 821-01-10]

3.15
isolated system
system in which no live part is intentionally earthed, except for high impedance connections for protection or measurement purposes

[SOURCE: IEC 60050-195:2021, 195-04-07]

3.16
safety relay
device that will open the circuit even under single fault conditions

Note 1 to entry: This can be achieved by the series connection of two relays from different manufacturers or the application of similar technology.

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3.17
safety circuit
normally closed interlocking circuit with pilot contacts and safety devices that shuts down the LVSC system in response to specific initiating events

3.18
load
power consumed by the ship while connected to shore power supply

3.19
ordinary person
person who is neither a skilled person nor an instructed person

[SOURCE: IEC 60050-195:2021, 195-04-03]

3.20
system earthing
system grounding, US
functional earthing and protective earthing of an electric system

[SOURCE: IEC 60050-195:2021, 195-01-14]

3.21
alarm
prioritized system of notification

Note 1 to entry: For IMO definitions, see IMO Resolution A.1021(26) Code of Alarms and Indicators.

3.22
exposed conductive part
conductive part of equipment that can be touched and that is not live under normal conditions, but that can become live when basic insulation fails

[SOURCE: IEC 60050-195:2021, 195-06-10]

4 General requirements

4.1 System description

A typical LVSC system in accordance with this document consists of hardware components as shown in Figure 1.

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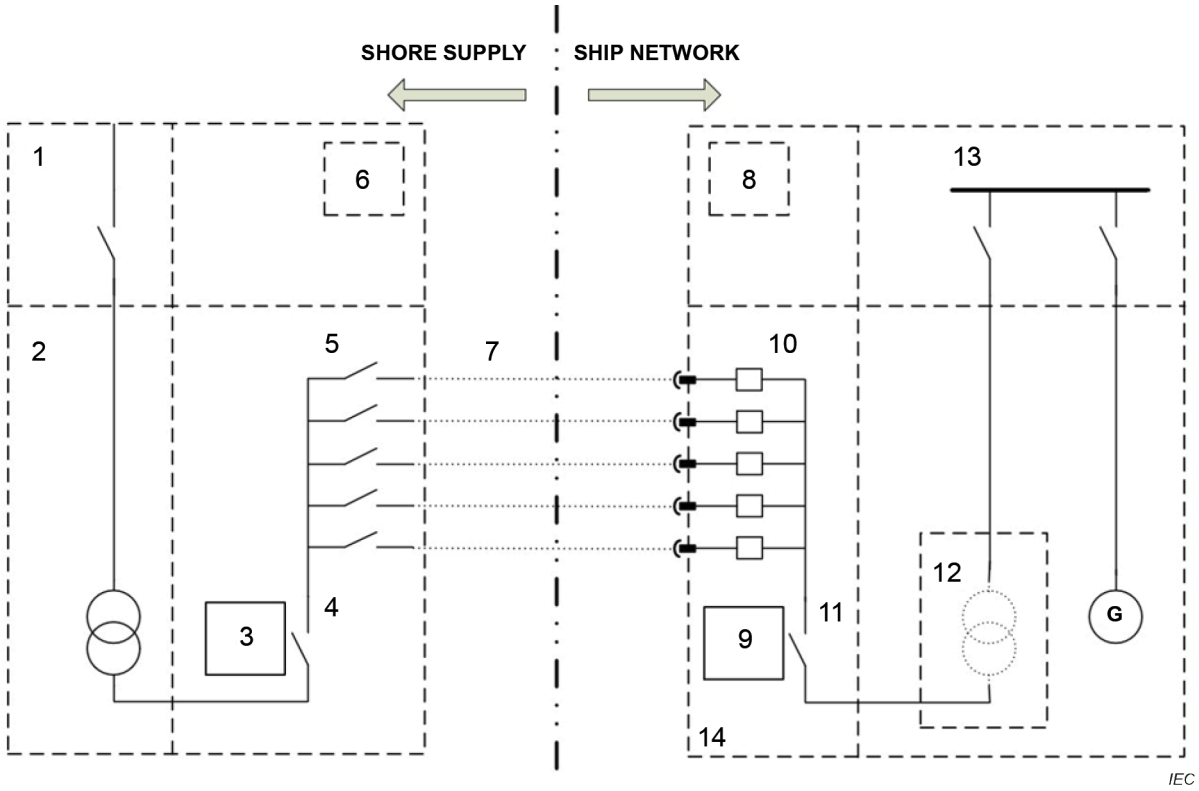

Key

1	shore supply system	8	control ship
2	shore-side transformer	9	ship protection relaying for ship-side main circuit-breaker
3	shore-side protection relaying for shore-side main circuit-breaker	10	ship-side shore connection switchboard with individual short-circuit current protection and limiting device of each branch (see 4.8 and 8.3.3) to be interlocked with ship-side main circuit-breaker
4	shore-side main circuit-breaker, see 6.2.1	11	ship-side main circuit-breaker.
5	shore-side current limiting branch circuit-breakers	12	onboard transformer (where applicable)
6	control shore	13	onboard main switchboard
7	shore-to-ship connection and interface equipment	14	shore connection switchboard

Figure 1 – Block diagram of a typical LVSC system

A device shown in the typical LVSC system block diagram may be omitted if its operational and protective functions are provided by other devices (shown in Figure 1) and proven by documentation and testing.

4.2 Distribution system

4.2.1 General

Typical distribution system requirements used on shore are given in IEC 60364-1. Typical ship distribution systems requirements are given in IEC 60092-201.

NOTE IEEE Std 45™ provides additional information on typical ship distribution systems.

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