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INTERNATIONAL STANDARD

Utility connections in port –
Part 1: High Voltage Shore Connection (HVSC) Systems – General requirements

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FOREWORD

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International Standard IEC/ISO/IEEE 80005-1 has been prepared by IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units, in cooperation with IEC subcommittee 23H: Industrial plugs and socket-outlets, of IEC technical committee 23: Electrical accessories; ISO technical committee 8: Ships and marine technology, subcommittee 3: Piping and machinery; and IEEE IAS Petroleum and Chemical Industry Committee (PCIC) of the Industry Applications Society of the IEEE[1].

This publication is published as an IEC/ISO/IEEE triple logo and prefix standard.

This document cancels and replaces IEC/PAS 60092-510 published in 2009.

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.

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

FDIS	Report on voting
18/1254/FDIS	18/1268/RVD

Full information on the voting for the approvals of this standard can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 9 members out of 9 having a cast vote.

International standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The IEC Technical Committee, the ISO Technical Committee and IEEE Technical Committee have decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC, ISO and IEEE web site in the data related to the specific publication. At this date, the publication will be

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- withdrawn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

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1 A list of IEEE participants can be found at the following URL:
http://standards.ieee.org/downloads/80005-1/80005-1-2012/80005-1-2012_wg-participants.pdf

INTRODUCTION

The following standard was developed jointly between IEC technical committee 18: Electrical installations of ships and of mobile and fixed offshore units, ISO technical committee 8: Ships and marine technology, subcommittee 3: Piping and machinery, and IEEE IAS PCIC Marine industry subcommittee.

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 scenario of receiving electrical power and other utilities from shore is historically known as “cold ironing”.

The intention of this standard is to define requirements that support, with the application of suitable operating practices, efficiency and safety of connections by compliant ships to compliant high-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 standard is intended to allow different ships to connect to high-voltage shore connections (HVSC) 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 standard may find it impossible to connect to compliant shore supplies.

Where deviations from the requirements and recommendations in this standard may be considered for certain designs, the potential effects on compatibility are highlighted.

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

Clauses 1 to 12 are intended for application to all HVSC systems. They intend to address mainly the safety and effectiveness of HVSC systems with a minimum level of requirements that would standardise on one solution. This standard includes the requirement to complete a detailed compatibility assessment for each combination of ship and shore supply prior to a given ship arriving to connect to a given shore supply for the first time

Annex A includes cabling recommendations that should be used in HVSC systems.

The other annexes in this standard are ship specific annexes that include additional requirements related to agreed standardisation of solutions to achieve compatibility for compliant ships at different compliant berths and to address safety issues that are considered to be particular to that ship type. These annexes use the same numbering as Clauses 1 to 12 with an annex letter prefix. Hence, the numbering is not necessarily continuous. Where no additional requirements are identified, the clause is not shown.

It should be noted that Annex A is considered informative for the purposes of this document. This annex contains performance-based requirements for shore connection cable, and was developed by technical experts from a number of countries. IEC technical committee 18, subcommittee 18A and IEC technical committee 20 were consulted regarding cable requirements. It was determined that existing standards for cable can be used at this time and there is presently no need to develop a separate standard for shore connection cables.

UTILITY CONNECTIONS IN PORT –

Part 1: High Voltage Shore Connection (HVSC) Systems – General requirements

1 Scope

This part of IEC 80005 describes high voltage shore connection (HVSC) systems, on board the ship and on shore, to supply the ship with electrical power from shore.

This standard is applicable to the design, installation and testing of HVSC systems and addresses:

- HV shore distribution systems;
- shore-to-ship connection and interface equipment;
- transformers/reactors;
- semiconductor/rotating convertors;
- ship distribution systems; and
- control, monitoring, interlocking and power management systems.

It does not apply to the electrical power supply during docking periods, e.g. dry docking and other out of service maintenance and repair.

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

It is expected that HVSC systems will have practicable applications for ships requiring 1 MW or more or ships with HV main supply.

Low-voltage shore connection systems are not covered by this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 60076 (all parts), *Power transformers*

IEC 60079 (all parts), *Electrical apparatus for explosive gas atmospheres*

IEC 60092-101:2002, *Electrical installations in ships – Part 101: Definitions and general requirements*

IEC 60092-201:1994, *Electrical installations in ships – Part 201: System design – General*

IEC 60092-301:1995, *Electrical installations in ships – Part 301: Equipment – Generators and motors*

IEC 60092-502:1999, *Electrical installations in ships – Part 502: Tankers – Special features*

IEC 60092-503:2007, *Electrical installations in ships – Part 503: Special features – AC supply systems with voltages in the range of above 1 kV up to and including 15 kV*

IEC 60092-504:2001, *Electrical installations in ships – Part 504: Special features – Control and instrumentation*

IEC 60146-1 (all parts), *Semiconductor convertors – General requirements and line commutated convertors*

IEC 60204-11:2000, *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV*

IEC 60332-1-2:2004, *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 60502-2:2005, *Power cables with extruded insulation and their accessories for rated voltages from 1kV(U_m=7,2 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 60502-4:2005, *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 4: Test requirements on accessories for cables with rated voltages from 6 kV (U_m = 7,2 kV) up to 30 kV (U_m = 36 kV)*

IEC 60947-5-1:2003, *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 61936-1:2002, *Power installations exceeding 1 kV a.c. – Part 1: Common rules*

IEC 62271-200:2003, *High-voltage switchgear and controlgear – Part 200: AC metal-enclosed switchgear and controlgear for rated voltages above 1 kV and up to and including 52 kV*

IEC 62613-1:2011, *Plugs, socket-outlets and ship couplers for high-voltage shore connection systems (HVSC systems) – Part 1: General Requirements*

IEC 62613-2:2011, *Plugs, socket-outlets and ship couplers for high-voltage shore connection systems (HVSC-systems) – Part 2: Dimensional compatibility and interchangeability requirements for accessories to be used by various types of ships*

SOLAS 2009, Chapter II-1/D, Regulations 42, 43 and 45

MIL-DTL-38999K, *General specification for connectors, electrical, circular, miniature, high density, quick disconnect (bayonet, threaded, and breech coupling), environment resistant, removable crimp and hermetic solder contacts*

MIL-STD-1560A, *Interface standard: Insert arrangements for MIL-C-38999 and MIL-C-27599 electrical, circular connectors*

MIL-PRF-29504/5C, *Performance specification sheet. Termini, fiber optic, connector, removable, environment resisting, socket terminus, size 16, rear release, MIL-DTL-38999, SERIES III*

3 Terms and definitions

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

3.1
cable management system
all equipment designed to control, monitor and handle the HV-flexible and control cables and their connection devices

3.2
equipotential bonding
provision of electric connections between conductive parts, intended to achieve equipotentiality

[SOURCE: IEC 60050-195:1998, 195-01-10]

3.3
emergency shutdown-1
ESD-1
shutdown initiated when the ship moves past the warning range of allowable motion forward, aft or outward from the dock, and which initiates an LNG-ESD signal from shore to ship

3.4
emergency shutdown-2
ESD-2
shutdown initiated when the ship moves past the maximum range of allowable motion forward, aft or outward from the dock, and which initiates loading arm disconnection on shore

3.5
high voltage
HV
nominal voltage in range above 1 000 V a.c. and up to and including 15 kV a.c.

3.6
liquefied natural gas-emergency shutdown
LNG-ESD
type of emergency shutdown defined at LNG terminals

3.7
low voltage
LV
nominal voltage up to and including 1 000 V a.c.

3.8
person in charge
PIC
individual responsible for HVSC systems operations

3.9
pilot contact
contact of the plug and socket-outlet which signals correct plug connection and is a safety-related component

3.10
receiving point
connection point of the flexible cable on the ship

3.11
safe
condition in which safety risks are minimized to an acceptable level

3.12
supply point
connection point of the flexible cable on shore

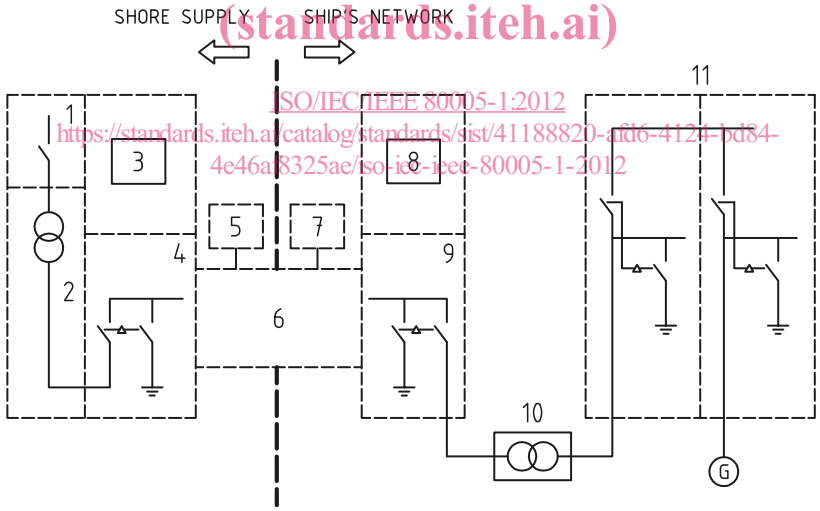
3.13
fail safe
design property of an item which prevents its failures from resulting in critical faults

[SOURCE: IEC 60050-195:1998, 191-15-04]

4 General requirements

4.1 System description

A typical HVSC system described in this standard consists of hardware components as shown in Figure 1.



KEY

1. HV-SHORE SUPPLY SYSTEM
2. SHORE SIDE TRANSFORMER
3. SHORE SIDE PROTECTION RELAYING
4. SHORE SIDE CIRCUIT BREAKER AND EARTH SWITCH
5. CONTROL
6. SHORE-TO-SHIP CONNECTION AND INTERFACE EQUIPMENT
7. CONTROL
8. SHIP PROTECTION RELAYING
9. SHORE CONNECTION SWITCHBOARD
10. ON-BOARD TRANSFORMER (WHERE APPLICABLE)
11. ON-BOARD RECEIVING SWITCHBOARD

Figure 1 – Block diagram of a typical described HVSC system arrangement

4.2 Distribution system

4.2.1 General

Typical distribution systems used on shore are given in IEC 61936-1. Typical ship distribution systems are given in IEC 60092-503.

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

4.2.2 Equipotential bonding

An equipotential bonding between the ship's hull and shore earthing electrode shall be established.

Verification of the equipotential bonding shall be a part of the safety circuit (see 7.2.5). Loss of equipotential bonding shall result in the shutdown of the HVSC system, and the ship shall go into ship power restoration mode (see 8.6).

NOTE The terms earth(ing) and ground(ing) are used interchangeably throughout this standard and have the same meaning (see IEC 60050-195:1998,195-01-08).

4.3 Compatibility assessment before connection

Compatibility assessment shall be performed to verify the possibility to connect the ship to shore HV supply. Compatibility assessment shall be performed prior to the first arrival at a terminal.

Assessment of compatibility shall be performed to determine the following:

a) compliance with the requirements of this standard and any deviations from the recommendations;
b) minimum and maximum prospective short-circuit current (see 4.7 and 4.8);
c) nominal ratings of the shore supply, ship to shore connection and ship connection (see 5.1);
d) any de-rating for cable coiling or other factors (see 7.2.1);
e) acceptable voltage variations at ship switchboards between no-load and nominal rating (see 5.2);
f) steady state and transient ship load demands when connected to a HV shore supply, HV shore supply response to step changes in load (see 5.2);
g) system study and calculations (see 4.8);
h) verification of ship equipment impulse withstand voltage;
i) compatibility of shore and ship side control voltages, where applicable;
j) compatibility of communication link;
k) distribution system compatibility assessment (shore power transformer neutral earthing);
l) functioning of ship earth fault protection, monitoring and alarms when connected to a HVSC supply (see 8.2.2);
m) sufficient cable length;
n) compatibility of safety circuits, in accordance with 9.1;
o) total harmonic distortion (THD) (see 5.2);
p) consideration of hazardous areas, where applicable (see 4.6.4);
q) when a HV supply system is connected, consideration shall be given to provide means to reduce current in-rush and/or inhibit the starting of large loads that would result in failure, overloading or activation of automatic load reduction measures;
r) consideration of electrochemical corrosion due to equipotential bonding;

s) utility interconnection requirements for load transfer parallel connection; and

t) equipotential bond monitoring.

4.4 HVSC system design and operation

4.4.1 System design

The design and construction shall be integrated and coordinated among the parties responsible for shore and ship HVSC systems.

System integration of shore and ship HVSC systems shall be managed by a single designated party and shall be performed in accordance with a defined procedure identifying the roles, responsibilities and requirements of all parties involved.

4.4.2 System operation

During the operation of HVSC systems, PIC(s) shall be identified at the shore facility and on board the ship for the purposes of communication.

The PIC(s) shall be provided with sufficient information, instructions, tools and other resources for safety and efficiency of these activities.

4.5 Personnel safety

Construction of the HV equipment and operating safety procedures shall provide for the safety of personnel during the establishment of the connection of the ship supply, during all normal operations, in the event of a failure, during disconnection and when not in use.

The use of the term “safe” is not intended to suggest or guarantee that absolute safety can be achieved in any situation and/or by compliance with the recommended practices set forth herein. The use of terms such as “safe,” “intrinsically safe,” “electrically safe work practices,” “safe work condition,” “safe work environment,” “safe design,” “safe distance,” “safe work method,” “safe work area,” “safe use,” etc. describe practices, conditions, etc. in which safety risks are minimized but not eliminated absolutely, such that safety is not guaranteed.

4.6 Design requirements

4.6.1 General

Protection and safety systems shall be designed based on the fail safe principle.

Suitable warning notices shall be provided at locations along connection equipment routes including connection locations.

4.6.2 Protection against moisture and condensation

Effective means shall be provided to prevent accumulation of moisture and condensation, even if equipment is idle for appreciable periods.

4.6.3 Location and construction

HVSC equipment shall be installed in access controlled spaces.

Equipment shall be suitable for the environment conditions in the space(s) where it is expected to operate. Ship equipment shall comply with the applicable requirements of IEC 60092-101 and IEC 60092-503.