No. 182
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Onshore Power Supply

Introduction

This recommendation is introduced to accommodate and/or facilitate the application of onshore power supply (OPS) which is also known as alternative maritime power (AMP), cold ironing, shore-side electricity, shore power connection, and not intended to prohibit other measures of onboard clean energy application.

In consideration that the international standard for Low Voltage Shore Connection (LVSC) Systems is under development, this document addresses general issues and specific requirements for High Voltage Shore Connection (HVSC) Systems and the requirements for low voltage may be further updated when the international standard for low-voltage OPS systems has been published.

1. General

1.1 Application

1.1.1 This document is intended to provide standardized provisions for the safe operation of OPS service in port (enabling the shipboard generators to be shut down while in port) on ships engaged on international voyages. For specific requirements relevant to particular ship's types, annexes in IEC/IEEE 80005-1:2019 (+AMD1:2022 +AMD2:2023) may be referred to at the discretion of the Society. This recommendation does not apply to the electrical power supply during docking periods, e.g. dry docking and other out-of-service maintenance and repair.

1.1.2 Onshore equipment and installations are not covered by this recommendation.

1.2 Definitions

1.2.1 Onshore power supply (OPS) system is the equipment that supplies onshore power to ships berthing in port, including ship-side installations and shore installations.

1.2.2 Ship-side installations are those onboard systems that are designed to accept shore power, typically involving incoming power receptacles and plugs, shore connection switchgear, and protections, transformer (if applicable), incoming switchgear and protections at the main switchboard, power cables (herein referred to as cables), automation, cable management system and associated instrumentation.

1.2.3 Shore installations is the equipment that is installed at quay or port for OPS, typically involving switchgear and protections, transformers, frequency convertors (if applicable), output power receptacles and plugs, cable management system and associated instrumentation.

1.2.4 Cable management system is all the equipment designed to control, monitor and handle the flexible power and control cables and their connection devices, allowing transmission of power and electrical signals and compensating for vessel's movement caused by tidal range and/or cargo operation.

1.2.5 High voltage (HV) is nominal voltage above 1,000 V AC and up to 15kV AC.

1.2.6 Low voltage (LV) is nominal voltage up to and including 1,000 V AC.

1.2.7 Emergency shutdown is manual and/or automatic shutdown in critical situations.

1.2.8 The first connection refers to the OPS connection on ship's first call at a shore power supply point.

1.2.9 Operation includes all activities necessary to permit the electrical installation to function. These activities include matters as switching, controlling, monitoring and maintenance, as well as both electrical and non-electrical work.

1.2.10 Shore-side circuit breaker is the dedicated switching and protection device on the shore-side which connects and disconnects shore-side power to the ship.

1.2.11 Ship-side circuit breaker is the dedicated switching and protection device on the ship-side which connects and disconnects shore-side power on the ship.

1.2.12 Equipotential bonding is the provision of electric connections between conductive parts, intended to achieve equipotentiality.

1.2.13 Equipotential bonding monitoring device is a device that monitors the equipotential bonding between two points.

1.2.14 Pilot contact is the contact of the plug and socket-outlet, which signals correct plug connection and is a safety-related component.

1.2.15 Supply point is the connection point of the flexible cable on shore.

1.2.16 Fail-safe means that it is able to enter or remain in a safe state in the event of failure.

1.2.17 Safety circuit is normally a closed interlocking circuit with pilot contacts and safety devices that shut down the HVSC system in response to specific initiating events.

1.2.18 Connector is a coupling device employed to connect conductors of one circuit element with those of another circuit element.

1.3 Safety Considerations

1.3.1 General reference is made to IEC/IEEE 80005-1:2019 (+AMD1:2022 +AMD2:2023) and IEC 62613-1:2019.

1.3.2 The safety of ships, personnel and power supply systems should be ensured by the shore-side and the ship-side during the establishment of a connection of the shore power, during all operations, in the event of a failure, during disconnection and when the systems are not in use.

1.3.3 A compatibility assessment of the OPS system should be available to verify the possibility of connecting the ship electrical system to the shore's installations.

1.3.4 An equipotential bonding between the ship's hull and shore grounding electrode should be established.

2. General provisions

2.1 General

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2.1.1 A typical HVSC system consists of all hardware components necessary to electrically connect ship to shore such as plugs and sockets, transformers (where applicable), switchboards, (static or rotating) frequency converters and alarm, control and safety systems.

2.1.2 Protection and safety systems should be designed based on the fail-safe principle and hard-wired.

2.1.3 Electrical power supply from an HVSC system should not adversely affect the availability of main, auxiliary or emergency machinery, including ship sources of electrical power to allow ship power to be restored.

2.2 Equipotential bonding

2.2.1 An equipotential bonding between the ship's hull and shore earthing system should be provided.

2.2.2 Integrity of the equipotential bonding should be continuously checked as a part of the ship shore safety circuit.

2.2.3 Loss of continuity in the equipotential bonding should result in the shutdown of the HVSC and the ship system should perform a standard restart after blackout.

Note: The adoption of special arrangements (e.g. detection of corrosion currents across the equipotential bonding circuit) against electrochemical corrosion should be considered, especially in the case of aluminum ships.

2.2.4 As an alternative to the continuous monitoring of the equipotential bonding, periodic testing and maintenance of the bonding connection may be accepted on a case-by-case basis, considering the operative profile of the ship. Documentation should be made available onboard as a reference for the surveyor in charge for survey.

2.3 Failures

2.3.1 An alarm should be given at the ship's manned station during HVSC system operation whenever a failure occurs on the HVSC system or in ship's systems required to maintain ready availability.

2.3.2 The failure effects should be analyzed and the consequences should be found acceptable from the safety point of view. Detailed procedures for the failure recovery should be included in the operation manual.

2.4 Location

2.4.1 HV equipment should be located in access-controlled spaces.

2.4.2 In addition, at least the following matters should be considered when ship-shore equipment location is evaluated:

.1 the safe and efficient operation of the ship's bunkering, cargo handling and mooring systems,

.2 interference with ship’s other operations,

.3 traffic flow on the pier and to maintain open fire (or other emergency) lanes,

.4 need for physical safeguards to prevent injuries (e.g. personnel falling from the shore or the ship because of HVSC system operations) and ample space around the shore connection switchboard (for the operating crew to freely perform connecting and disconnecting operations),

.5 all tidal conditions,

.6 presence of hazardous areas (the shore connection switchboard should be located in a compartment that is sheltered from the weather. HV shore cables should enter this compartment through a temporary opening with weathertight arrangement. This compartment should not have any opening(s) within a designated hazardous area).

2.5 Short-circuit calculation

2.5.1 In calculating the maximum prospective short-circuit current, the fault current contributions of all simultaneously connected sources should be considered. This includes the fault contributions of the maximum permitted number of generators, the maximum number of motors and the contribution of the shore supply system.

2.5.2 The calculations may take into account any arrangements that:

.1 prevent permanent parallel connection of high voltage shore supply with ship sources of electrical power and/or,

.2 restrict the number of ship generators operating during parallel connection to transfer load,

.3 restrict load to be connected.

2.5.3 The maximum number of generators or transformers may be evaluated without taking into consideration short-term parallel operation for load transfer, provided that suitable interlocks are foreseen.

2.6 Emergency shutdown and emergency stop

2.6.1 Emergency shutdown system should be provided to open instantaneously all shore connection circuit-breakers at ship-side, when activated.

2.6.2 The high voltage power connections should be:

.1 automatically earthed (so that they are safe to touch) immediately following the isolation from ship and shore electrical supply, or

.2 arranged for manual earthing, routed and located such that personnel are prevented from access to live connection cables and live connection points by barriers and/or adequate distance(s) (see Note) under normal operational conditions.

Note: barriers and/or adequate distance(s) may be satisfied with operational procedures established to:

• restrict un-authorized access to HVSC spaces,

• control personnel access to HVSC spaces and areas when the HV connection is live with locking arrangements, and

• arrangement for the safe discharge of HV conductors.

2.6.3 Where connection equipment can move into a potentially hazardous area, HVSC equipment that is not certified safe type should be automatically isolated and earthed in accordance with paragraph 2.6.2.1.

2.6.4 The emergency shutdown system should be activated in the event of:

.1 loss of continuity in the equipotential bonding circuit, if applicable (see paragraph 2.2.3),

.2 over-tension on the flexible cable (mechanical stress),

.3 loss of any safety circuit,

.4 activation of any emergency stop buttons,

.5 activation of protection relays provided to detect faults on the HV connection cable or connectors, and

.6 disengaging of power plugs from socket-outlets while HV connections are live.

2.6.5 Emergency stop push buttons, manually activating the emergency shutdown system, should be provided at least at the:

.1 ship's manned control station during HVSC system operation,

.2 active cable management system control locations, if installed onboard, and

.3 ship-side circuit-breaker locations.

Additional emergency stop push buttons may also be provided at other locations, where considered necessary.

2.6.6 The emergency stop devices should be clearly visible, protected against accidental or inadvertent operation. They should require a manual action to reset.

2.6.7 An alarm should be given at the ship's manned station during HVSC system operation, upon emergency shutdown activation. The alarm should indicate the cause of the activation of the emergency shutdown system.

3. Ship requirements

3.1 Shore connection switchboard

3.1.1 A shore connection switchboard for the reception of the ship to shore connection should be provided at a suitable location, near the supply point.

3.1.2 The shore connection switchboard should comply with IEC 62271-200:2021 or other recognized standards as appropriate.

3.1.3 The switchboard should include a circuit-breaker to protect the shipboard fixed electrical cables and electrical equipment downstream.

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3.1.4 In order to have the installation isolated before it is earthed, the circuit breaker, disconnector and earthing switch should be interlocked in accordance with IEC 62271-200:2021.

3.1.5 A circuit-breaker and automatically controlled or manually controlled earthing switch should be provided.

3.2 Instrumentation and protection of shore connection switchboard

3.2.1 The shore connection switchboard should be equipped with:

.1 a voltmeter, all three phases,

.2 short-circuit devices: tripping and alarm,

.3 overcurrent devices: tripping and alarm,

.4 earth fault indicator: alarm,

.5 unbalanced protection for systems with more than one ship inlet,

The protection and safety system should be continuously powered. A reserve battery for power supply to the protection and safety system with automatic change-over should be provided with a capacity for at least 30min. Upon failure of the battery's charging or activation of the back-up system, an alarm should be activated to warn relevant duty personnel.

3.2.2 Alarms and indications should be provided at the ship's manned station during HVSC system operation and at any other appropriate location for safe and effective operation.

3.3 System separation

3.3.1 Galvanic separation should be provided between the onshore and onboard systems, where applicable.

3.3.2 If necessary, means should be provided to reduce transformer current in-rush and/or to prevent the starting of large motors, or the connection of other large loads, when an HV supply system is connected.

3.4 Onboard receiving switchboard

3.4.1 An additional panel should be provided in the ship's receiving switchboard (in general a section of the main switchboard).

3.4.2 Where parallel operation of the HV-shore supply and ship sources of electrical power for load transfer is possible, necessary instruments and synchronizing devices should be provided, with the shore connection circuit breaker suitable for short time parallel operation.

3.5 Instrumentation for onboard receiving switchboard

3.5.1 When parallel operation for load transfer is implemented, the following instruments should be available:

.1 two voltmeters,

.2 two frequency meters,

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.3 one ammeter (with an ammeter switch to read the current in each phase), or an ammeter in each phase,

.4 phase sequence indicator or lamps, and

.5 one synchronizing device.

One voltmeter and one frequency meter should be connected to the switchboard's busbars. The other voltmeter and frequency meter should enable the voltage and frequency of the shore connection to be measured.

3.5.2 When transfer of supply from ship to shore and vice-versa is made passing through blackout condition, the following instruments should be available:

.1 one voltmeter,

.2 one frequency meter,

.3 one ammeter (with an ammeter switch to read the current in each phase), or an ammeter in each phase,

.4 phase sequence indicator or lamps.

The voltmeter and frequency meter should enable the voltage and frequency of the shore connection to be measured.

3.6 Protection for onboard receiving switchboard

3.6.1 The following alarms and circuit-breaker trips should be implemented in the event of:

.1 short-circuit: tripping with alarm,

.2 overcurrent: in two steps - alarm, and tripping with alarm,

.3 earth fault: tripping with alarm if required by the type of isolation system used,

.4 over/under voltage: in two steps - alarm, and tripping with alarm,

.5 over/under frequency: in two steps - alarm, and tripping with alarm,

.6 reverse power: tripping with alarm,

.7 phase sequence protection with alarm and interlock.

3.6.2 At least the following protective devices, or equivalent protective measures, should be provided to satisfy the requirements of paragraph 3.6.1 (see Note):

.1 synchrocheck

.2 undervoltage

.3 reverse power

.4 phase sequence voltage

.5 overload

.6 instantaneous overcurrent

.7 overcurrent

.8 earth fault

.9 overvoltage

.10 frequency (under and over)

Note: Reverse power protection and synchrocheck are not required when load transfer via blackout is chosen.

3.6.3 Load shedding of unessential consumers and restoration of ship power should be considered where these measures could prevent complete power loss.

3.7 Shore connection circuit-breaker for onboard receiving switchboard

3.7.1 Interlocks should be provided to ensure that the shore connection circuit-breakers cannot be closed when:

.1 one of the earthing switches is closed (shore-side/ship-side),

.2 the safety circuit is not established,

.3 the emergency shutdown system is activated,

.4 self-monitoring properties of ship or shore alarm, control and safety systems detect an error that would affect safety of the connections,

.5 the data communication link between shore and ship is not operational (where applicable),

.6 the high voltage supply is not present,

.7 equipotential bonding is not established, if applicable (see paragraph 2.2),

.8 an earth fault on ship distribution system is detected.

3.8 Ship power restoration in case of failure of HVSC

3.8.1 If any failure occurs on the HVSC supply, all shore connection circuit-breakers should automatically open. Failures include loss of HV power and disconnection (including activation of emergency shutdown or electrical system protective device activation).

3.8.2 In such failures, the ship’s main source of electric power should be restored to an extent that the safe operations of the ship can be maintained.

3.8.3 An alarm should be given at the ship's manned station during HVSC system operation to indicate activation of the shore connection circuit-breaker opening required in paragraph 3.8.1. The alarm should indicate the failure that caused the activation.

3.9 Load transfer via blackout

3.9.1 When load transfer is via blackout, interlocking means should be provided to ensure that the shore supply can only be connected to a dead switchboard.

3.9.2 The simultaneous connection of an HVSC and a ship source of electrical power to the same dead section of the ship's electrical system should be prevented.

3.9.3 The interlocking system should be fault tolerant so that connection to a live switchboard is prevented when operating normally and also in the event of a fault, for example a fault in the blackout monitoring circuit.

3.10 Load transfer via temporary parallel operation and automatic synchronization

3.10.1 When parallel operation for load transfer is foreseen, loads should be automatically synchronized and transferred between the HV shore supply and ship source(s) of electrical power after their connection in parallel.

3.10.2 The load transfer should be completed in as short a time as practicable without causing machinery or equipment failure or intervention of protective devices and this should be used as the basis for defining the transfer time limit (as mentioned in 2.2.5 of Appendix).

3.10.3 When the HVSC system is not connected, systems or functions used for paralleling or controlling the shore connection load transfer should not affect the ship's electrical system.

3.10.4 When the defined transfer time limit (as mentioned in 2.2.5 of Appendix) for transferring of load between HV shore supply and ship source(s) of electrical power has elapsed, one of the sources should be automatically disconnected and an alarm should be given at the ship's manned station during HVSC system operation.

3.10.5 When load reductions are required to transfer load, this should not result in the loss of essential or emergency services.

3.10.6 Where operation of only designated or a restricted number of ship’s generators is required to permit the safe transfer of load between an HV shore supply and ship source of electrical power, the arrangements should fulfil this requirement before and during parallel connection.

4. Ship to shore connection

4.1 Standardization

4.1.1 Standardized HVSC systems, including cables and their accessories, socket-outlets, data and communication links between ship and shore and earthing, should be used as far as practicable.

4.1.2 The ship to shore connection cable installation and operation should be arranged to provide adequate ship movement compensation, cable guidance and tension control, anchoring and positioning of the cable during normal planned ship to shore connection conditions.

4.2 Cable management system (when provided on board)

4.2.1 Cable management system should:

.1 be capable of moving the ship to shore connection cable, enabling the cable to reach between the supply point and the receiving point,

.2 be capable of maintaining an optimum length of cable which minimizes slack cable, and prevents the tension limits from being exceeded,

.3 be equipped with a device (e.g. limit switches), independent of its control system, to monitor maximum cable tension and maximum cable pay-out,

.4 address the risk of submersion by prevention or through the equipment's design,

.5 be positioned to prevent interference with ship berthing and mooring systems, including the systems of ships that do not connect to shore power while berthed at the facility,

.6 maintain the bending radius of cables above the minimum bending radius recommended by the manufacturer during deployment, in steady-state operation and when stowed,

.7 be capable of supporting the cables over the entire range of ship draughts and tidal ranges, and

.8 be capable of retrieving and stowing the cables once operations are complete.

Where the cable management system employs cable reel, the HVSC system rated power should be based on the operating condition with the maximum number of wraps of cable stowed on the reel that is encountered during normal operations. Where applicable, the cable sizing should include appropriate de-rating factors.

4.2.2 The cable management system should not permit the cable tension to exceed the permitted design value. A means to detect maximum cable tension should be provided, or where an active cable management system that limits cable tension is provided, means to detect the shortage of available cable length should be provided with threshold limits provided in two stages:

.1 stage 1: alarm,

.2 stage 2: activation of emergency shutdown facilities.

4.2.3 The cable management system should enable the cables to follow the ship's movements over the entire range of the ship's draughts and tidal range. Where the cable length may way, the remaining cable length should be monitored, and threshold limits should be arranged in two stages:

.1 stage 1: alarm,

.2 stage 2: activation of emergency shutdown facilities.

Consideration may be given to equivalent alternative measures (e.g. automatic break-away release, connectors with shear bolts and pilot lines, connection with ship-shore emergency shutdown systems, etc.).

4.2.4 The equipotential bond monitoring device, where utilized, should be installed either ashore or onboard where the cable management system is installed. Equipotential bond monitoring termination devices, where utilized, should be installed on the other side.

4.2.5 Slip ring units for cable reel should be tested in accordance with IEC 62271-200:2021 as applicable for:

.1 HV tests,

.2 impulse-voltage withstand tests,

.3 insulation resistance measurements,

.4 heat run test with nominal currents,

.5 short-circuit withstand tests,

.6 arc test, if accessible under energized conditions, and

.7 ingress protection tests (IP rating).

4.3 Connectors

4.3.1 Connectors should comply with IEC 62613-1:2019 and the following.

4.3.2 The shore-side of the connection cable should be fitted with plug(s) if a socket-outlet is used onshore. Cable connections may be permanently connected onshore to suitable terminations.

4.3.3 The shipside of the connection cable should be fitted with connector(s) if a socket-inlet is used onboard. Cable connections may be permanently connected onboard to suitable terminations.

4.3.4 Sockets of the ship should be interlocked with the earth switch so that plugs or connectors cannot be inserted or withdrawn without the earthing switch in closed position.

4.3.5 Handling of connectors should be possible only when the associated earthing switch is closed.

4.3.6 The earthing contacts should make contact before the live contact pins do when inserting a plug.

4.3.7 Both ship-side and shore-side connectors should be fitted with pilot contacts to ensure continuity verification of the safety loop.

4.3.8 Contact sequence should be the following:

.1 connection: earth contact, power contacts and pilot contacts,

.2 disconnection: pilot contacts, power contacts and earth contact.

4.3.9 Each plug and socket-outlet should have a permanent, durable and readable nameplate with the following information:

.1 Manufacturer's name and trademark,

.2 type designation, and

.3 applicable rated values.

The nameplates should be readable during normal service.

4.3.10 Support arrangements should be foreseen so that the weight of connected cable should not be borne by any plug or ship connector termination or connection.

4.3.11 Pilot contact connections should open before the necessary degree of protection is no longer achieved during the removal of an HV plug or connector. Pilot contacts should be part of the safety circuit.

4.3.12 Interlocking with earthing switches should be arranged to ensure that the HV power contacts remain earthed until:

.1 all connections are made and the pilot contact circuit (paragraph 4.3.11) is closed,

.2 no emergency stop is activated,

.3 the communication link between shore and ship is operational,

.4 self-monitoring properties of ship or shore alarm, control and safety systems detect that no failure would affect safe connections, and

.5 the permission from ship and shore is activated.

Interlocking should be hardwired.

4.3.13 The current carrying capacity of the earth contact should be at least equal to the rated current of the other power contacts.

4.4 Ship to shore connection power cable, control & monitoring cable (when provided onboard)

4.4.1 Cables should be at least of a flame-retardant type in accordance with the requirements given in IEC 60332-1-2:2004, and suitable for dynamic service in marine environment.

4.4.2 The outer sheath should be oil-resistant, resistant to sea air, sea water, solar radiation (UV) and non-hygroscopic. Temperature class should be at least 90°C.

4.4.3 Due consideration should be given to requirements for smoke emission, acid gas evolution and halogen content for cable installed or stored in accommodation spaces and passenger areas.

4.4.4 Control and monitoring cables should be independent of the power cable assembly, and if integrated with the power cable assembly, able to withstand internal and external short-circuits.

4.5 Protection

4.5.1 If unbalanced damaging (above the rated cable current) current among multiple phase conductors (parallel power cables and connectors) occurs, the ship HV circuit-breakers should trip opening all insulated poles.

4.5.2 Protective devices to satisfy the requirement of paragraph 4.5.1 should be installed ashore to isolate the connection in the event of damaging unbalanced detection.

4.6 Data communication (where required by the ship-specific annex of IEC/IEEE 80005-1:2019 (+AMD1:2022 +AMD2:2023))

4.6.1 At least the following data should be communicated at the ship's manned station during HVSC system operation:

.1 shore transformer high temperature alarm,

.2 HV shore supply circuit-breaker protection activation,

.3 permission to operate HV circuit-breakers (as mentioned in 3.2) for HV ship to shore connection,

.4 alarm given by self-monitoring facilities of the ship or shore alarm, control or safety systems, when an error that would affect safe connection is detected,

.5 emergency stop activation,

.6 where provided, shore control functions,

.7 emergency disconnection of the shore supply, and

.8 failure of the battery charging or activation of the back-up power system (paragraph 3.2.1).

The communication protocol for communication link between ship and shore should be in accordance with IEC/IEEE 80005-2:2016.

4.7 Storage

4.7.1 When not in use, shipboard equipment should be stored in dry spaces in such a way that it does not present a hazard during normal ship operation.

4.7.2 Parts dismantled after use of the communication link should be provided with stowage arrangements.

4.7.3 When stored, plugs, socket-outlets, inlets and connectors should maintain their IP ratings.

4.7.4 Temporary coverings should consider to satisfy paragraphs 4.7.1, 4.7.2 or 4.7.3.

5. Testing

5.1 General

5.1.1 Before a new installation or any alteration or addition to an existing installation is put into service, the electrical equipment should be tested in accordance with the following.

5.2 Type approved components

5.2.1 Plugs, connectors and socket-outlets should of conformity may be considered at the discretion of the Society.

5.2.2 Cables used for the connection, control and monitoring, except those cables from a shore-side cable management system, should be type tested or type approved by the Society. Reference is made to Annex A of IEC/IEEE 80005-1:2019 (+AMD1:2022 +AMD2:2023).

5.3 Component testing

5.3.1 HV system components should be type and routine tested according to the relevant applicable requirements.

5.3.2 Tests should be carried out to demonstrate that the electrical system and its alarm, control and safety systems have been correctly installed and are in good working order.

5.4 Initial tests of shipside installation before delivery

5.4.1 Tests should be carried out on the ship's HVSC system, including alarm, control and safety equipment, according to a prescriptive test program to be agreed with the Society, to verify that the shipside installation complies with the requirements of this Section.

5.4.2 Tests should be carried out after completion of the installation.

5.4.3 The following tests should be carried out:

.1 visual inspection,

.2 power frequency test for switchgear assemblies and voltage test for cable,

.3 insulation resistance measurement,

.4 ship-side bonding connection resistance measurement,

.5 functional tests including correct settings of the protection devices,

.6 functional tests of the interlocking system,

.7 functional tests of the control equipment,

.8 earth fault monitoring test,

.9 phase sequence test,

.10 functional tests of the cable management system, where applicable,

.11 integration tests to demonstrate that the shipside installations such as the power management system, integrated alarm, control and safety systems, etc. work properly.

5.5 Tests at the first call at a shore supply point

5.5.1 The tests required in paragraph 5.4 do not exempt from the requirement to carry out at least the following tests at the first call at a shore supply point:

.1 visual inspection,

.2 power frequency test for switchgear assemblies and voltage test for cable,

.3 insulation resistance measurement,

.4 measurement of the earthing resistance,

.5 functional tests of the protection devices,

.6 functional tests of the interlocking system,

.7 functional tests of the control equipment,

.8 equipotential bond monitoring test, if applicable (see paragraph 2.2.4),

.9 phase sequence test,

.10 functional tests of the cable management system, where applicable, and

.11 integration tests to demonstrate that the shore and shipside installations work properly together,

.12 function test of the emergency stops.

5.5.2 The tests in paragraphs 5.5.1.2 to 5.5.1.4 should be performed only if the ship-side installations have been out of service or not in use for more than 30 months.

5.6 Tests at repeated calls of a shore supply point

5.6.1 If the time between repeated port calls (the same shore supply point) does not exceed 12 months and if no modifications have been performed either on the shore- or ship-side installations, the following verification should be conducted:

.1 visual inspection,

.2 confirmation that no earth fault is present,

.3 statement of voltage and frequency,

.4 an authorized switching and connection procedure, and

.5 function test of the emergency stops.

5.6.2 If the time between repeated port calls (the same shore supply point) exceeds 12 months, then the tests in paragraphs 5.5.1.1 to 5.5.1.12 should be conducted.

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Appendix

1. Operation and maintenance

1.1 Operation procedures

1.1.1 Personnel working on handling, connection and operation of OPS systems should wear personal protective equipment (PPE) as required by national regulations (shore-side) or as specified in the ship safety management system (ship-side).

1.1.2 Pre-connection, connection, power supply and disconnection procedures should be in accordance with IMO Guidelines on OPS.

1.2 Safety precautions before maintenance

1.2.1 The planned maintenance program for OPS systems should include the following "lock out/tag out" and equipment grounding procedures to ensure personnel safety:

.1 switch off,

.2 lock against reclosure,

.3 confirm that lines and equipment are de-energized,

.4 ground and short circuit phases, and

.5 cover, partition or screen of adjacent line sections.

1.3 There should be a suitable cross-boundary procedural requirement that is jointly controlled by the ship and shore persons in charge (PIC). This should include appropriate procedures for ensuring the integrity of any isolations, such as a "lock out/tag out" system.

1.4 Both shore- and ship-sides should specify responsibilities and assignments, including the person in charge (PIC) of the operation.

1.5 Both shore- and ship-sides should complete a pre-connection checklist (see paragraph 2.2.9) prior to the ship's arrival and connection at a shore supply point.

1.6 The person in charge (PIC) should confirm that there are no safety-critical operations on the ship prior to connecting to the shore power supply.

1.7 For a reliable communication, the following provisions apply:

.1 a voice communication link, e.g. communication devices or other equivalents, should be provided to facilitate communication between the operational personnel from the shore- and ship-side;

.2 equipment for voice communication should be functional;

.3 in case of any VHF or UHF voice communications, the ITU Maritime Mobile Services frequencies should be used;

.4 voice communications should be carried out in the common working language of the terminal and the ship or in English; and

.5 the ship should make a public address announcement advising the crew prior to OPS connection or disconnection.

1.8 Compatibility

1.8.1 At least the following matters should be considered when ship-shore network compatibility is evaluated:

.1 nominal ratings of the shore supply, ship to shore connection and ship connection (power, alarm, control, safety and communication cables),

.2 maximum prospective short-circuit current (electrical system design, including short-circuit protective device rating, is to be suitable for the maximum prospective short-circuit current at the installation point),

.3 acceptable voltage variations at ship switchboards between no load and rated load (considering steady state and transient ship load demands),

.4 shore supply response to step changes in load,

.5 verification of ship equipment impulse withstand capability,

.6 configuration compatibility assessment of neutral point connection,

.7 cable length,

.8 quality of shore supply including total harmonic distortion (THD),

.9 presence of hazardous areas.

2. Documentation

2.1 OPS operation procedures should be included in the ship safety management system.

2.2 The following information should be available onboard:

.1 a complete system description, including circuit diagrams, operation instructions and specification of set points of protection, monitoring and alarming devices of the ship installations,

.2 records of completed compatibility assessments, including port-specific information, such as agreed joint switching procedures,

.3 step-by-step instructions for OPS connection and disconnection, including equipotential bonding and load transfer,

.4 means to inhibit the starting of equipment which would result in failure, overloading or activation of automatic load reduction (if any) measures when a supply system is connected,

.5 procedures for setting the transfer time limit, which may be adjustable in order to match the ability for an external source of electrical power to accept and transfer load, if applicable,

.6 emergency shutdown and ship power restoration procedures,

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.7 appropriate provisions for the storage of OPS equipment when not in use,

.8 a maintenance plan to establish periodic tests and maintenance procedures for the system, and

.9 a pre-connection checklist, to include but not limited to berth, OPS supply point, communication method, operational limitations during berthing, contact information for PICs, estimated power consumption and agreed switching procedures.

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