



Electrical Shore Connections / Cold Ironing

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CHANGES

Main changes:

This is a new document which replaces previous requirements in the ship rules, Clean+ chapter.

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1. General

1.1 Introduction

This standard for certification is related to design, installation, and verification of electrical shore connections intended for regular use in harbour for all types of vessels. Typical design intention is vessels following regular routes with frequent visits to the same ports, with port calls lasting more than 4 hours.

An electrical shore connection system can be seen as comprising four aspects:

- system functionality in way of circuit breakers and earthing switches;
 - System functionality in way of circuit breakers and earthing switches are considered in this standard for certification, and functional requirements to the electrical shore connection as a total system are given.
- control system interface between the shore and the ship;
 - Control system interface between the shore and the ship is considered in this standard for certification, and requirements are given to necessary functionality. However, the physical installation on shore is not covered by the certification.
- ship side electrical equipment and installations;
 - Ship side electrical equipment and installations shall comply with relevant parts of the DNV Rules for Ships Pt.4 Ch.8, and the installation is part of the certification based on this standard.
- shore side electrical equipment and installation.
 - Shore side electrical equipment and installation is governed by national requirements to shore side electrical installations, and is not verified as part of a certification based on this standard.

Each vessel shall be designed and verified for each port where it will use the electrical shore connection. Operational features with respect to power availability during loading and unloading are not considered as part of certification.

This Standard for Certification shall apply as the basis for the issue of certificate for electric shore connection for the on-board installation when this has been verified in accordance with the process described, and compliance with the technical requirements ensured.

While a type approval may be issued for a specific system design and component specification, a vessel specific certificate and/or declaration requires that the vessel have been verified together with the installation in the specified port.

1.2 Availability

The availability of the shore power supply depends on the utility systems onshore. However, this standard requires that a stand-by generator on-board is automatically started and connected upon loss of power from shore. Additionally, this standard does not require that discriminative protection in the vessel's electric distribution system is functional while powered by a shore connection. A short circuit in the vessel's electric distribution system may therefore, in worst case, result in a black-out. Hence, use of shore power supply during loading and unloading operations in port must be evaluated with respect to criticality of electric power supply. This Standard for Certification does not consider any critical cargo operations, and assumes that the vessel will stay safe in case a power interruption occurs.

2. Verification and Certification

2.1 Documentation

When an electrical shore connection shall be certified in compliance with this Standard for Certification, it shall be constructed in accordance with plans approved by the Society.

The following documentation shall be submitted for approval or for information:

- functional description including description of instrumentation, interlocks, monitoring and alarms
- overall single line diagram
- system earthing diagram and description
- load calculation for electrical shore connection supply
- electrical documentation of shore connection switchboard and the cubicle in the main switchboard associated with the electrical shore connection. (Including switchboard layout and arrangement drawings, and schematics with information on protection, synchronisation, breaker interlocks, undervoltage trips, remote control circuits as relevant.)
- data sheets for high voltage cables
- short circuit calculation and discrimination analysis

- assembly schedules and technical data with internal power cable and busbar dimensions as well as tables with switchgear rating for power circuits (e.g. making and breaking capacity)
- internal arc withstanding report for high voltage switchgear
- harmonic distortion calculations for systems fed from frequency converters
- test procedure for quay and sea trial, including vessel - harbour control signal interface
- operational manual.

For standard designs the case by case approval may be replaced by the type approval scheme.

2.2 Certification of components

Product certification of electrical components necessary for the electric shore connection is generally not required by this Standard for Certification, but may be requested by the customer as a contractual item for purchase of equipment. An exception is the electric shore connection cable which shall be delivered with NV product certificate or be Type Approved if it belongs to the shipboard installation. Verification is performed by document review and site survey.

2.3 On-board survey

On-board survey shall be performed as part of the certification process, and focuses on the installation on board as well as on the functionality of the electrical shore connection system.

On-board inspections shall be performed in order to evaluate that:

- the electrical installation is in accordance with the accepted or approved information and in accordance with the requirements in this Standard for Certification
- the craftsmanship is acceptable.

Function tests shall be performed in order to evaluate that the installation complies with the requirements in this Standard for Certification. The function testing shall verify that required interlocks is working properly.

3. System design requirements

3.1 Stand by generator

While the electric shore connection is supplying power to the vessel, at least one of the vessel's generators shall be in standby. I.e. this generator shall be automatically started and connected to the main switchboards in case of blackout (loss of power supply from shore).

3.2 Transfer of power

In order to transfer power between the vessel's supply and shore, means for synchronization shall be arranged in the vessel's main switchboard.

3.3 Shore connection box

A separate shore connection box is not required if the main switchboards breaker has overcurrent protection. The short circuit protection of the cable between the shore supply circuit breaker and the main switchboard's shore power incoming feeder shall be performed by the short circuit protection on the shore side supply system.

3.4 Voltage and frequency

When a vessel is powered by shore power supply, the system voltage and frequency of the shore utility supply must match the system voltage and frequency of the vessel.

A system design where parts of the vessel's consumers are powered by a shore connection with a different frequency than the nominal frequency of the vessel is acceptable (e.g. reefer load powered by 50 HZ shore power on a 60 Hz vessel). Also a system design with two electrical shore power connections, one with 50 Hz, and one with 60 Hz, is acceptable.

3.5 Selectivity / discriminative disconnection

This Standard for Certification does not require that the vessel's distribution system has full discrimination during electrical shore power supply. Limitations in the selectivity shall be described in the description of the system.

Guidance note:

A vessel's electrical distribution system is designed for a maximum short circuit current with respect to mechanical strength and circuit breaker rating. The system's discriminative properties (i.e. that the circuit breaker closest to a short circuit will trip, leaving the healthy part of the vessel's electrical distribution system operational) depends on maximum and minimum values of the prospective short circuit current of the electric generation and distribution system on board. In order to maintain discriminative protection in the vessel's distribution system, the shore power sup-

ply must have a short circuit capacity within the max and min values of the vessel's network. Typically when frequency converter is used, the short circuit level may be too low to achieve full discrimination.

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3.6 System Earthing

The vessel's designed system earthing is to be maintained in electrical shore connection operation. The selected design solution must be described in the documentation of the system.

There shall be a monitoring system ensuring proper connection between shore ground and hull.

3.7 Protective earthing

A separate conductor for protective earthing shall be connected between the hull of the vessel and the ground on the shore. Earth fault protection shall disconnect the shore power supply, both the shore side circuit breaker and the vessel's main switchboard feeder breaker, whenever an earth fault current flows in the protective earthing conductor of the shore power cable.

3.8 Galvanic isolation

For high voltage electrical shore connections, the shore side distribution system and the vessel's distribution system shall be galvanically separated. When this separation is performed by a transformer, this shall have separate windings for the primary and the secondary side. The transformer can be installed either on shore, or on board.

If a power transformer is installed on board for adaptation of the electric shore connection system voltage and the main switchboard voltage, the transformer shall include overvoltage protection, protecting the vessel against lightning impulse over voltages.

It is recommended that the same safeguards against overvoltage are applied when the transformer is installed on shore.

Guidance note:

Direct earthing of the lower voltage system, or the use of voltage limitation devices, are considered adequate protection. Alternatively, an earthed screen between the primary and secondary windings may be used.

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3.9 Switchgear

3.9.1 Circuit breakers

Electrical shore connection systems shall be equipped with circuit breakers suitable for isolation and interruption of possible short circuit currents, together with automatically operated earthing switches, at both the shore side and the ship's side of the shore connection.

The shore side circuit breaker shall have short circuit protection and under-voltage trip, disconnecting the electrical shore connection in case of loss of shore side distribution power.

The incoming feeder in the vessel's main switchboard shall, in addition to overcurrent and bi-directional short circuit protection, also have an under-voltage trip, disconnecting the shore power supply in case of loss of power on the incoming feeder.

3.9.2 Earthing switches

High voltage electrical shore connection systems shall be equipped with automatically operated earth switches at both sides of the cable connecting the vessel to shore enabling safe discharge of the cable and safe handling of the plug and socket.

3.10 Plugs and sockets

The shore connection cable shall be connected by plug and socket connection. Plugs and sockets shall be designed in such a way that incorrect connection is not possible. Further, connection with power on should not be possible. The plug and socket system shall be of a type tested design.

3.11 Cable management system

There shall be installed equipment enabling efficient cable handling and connection.

The equipment shall ensure mechanical tension control of the cable and provide alarm at high cable tension to a manned position. At high high tension, the shore connection shall be automatically disconnected, and the earthing switches closed.

3.12 Interlocks

Circuit breakers that are part of the electrical shore connection system, inclusive on board circuit breakers for generators, earthing switches and others, shall have necessary interlocks preventing any hazardous switching operations. These interlocks shall be described in the documentation.

The following interlocks shall be provided:

- Automatic opening of circuit breakers and, for high voltage systems, closing of earthing switches:
 - Upon high high mechanical tension of shore connection cable
 - By missing confirmation of healthy protective earthing connection
 - By emergency disconnection signal
 - Short circuit detection on either side of the shore connection cable.
- Operation of the plug and socket:
 - When the plug and socket is manually operated, it shall not be possible to insert or withdraw the plug unless the circuit breakers are open. For high voltage connections, the earthing switches shall be closed. An attempt to insert or withdraw the plug shall initiate opening of circuit breakers and closing of earthing switches. For automatically operated plug and socket, the same feature shall be implemented in the control system.

3.13 Protection, monitoring and alarms

3.13.1 General

A control system shall be arranged on-board the vessel for the electric shore connection system. This system shall trip both shore side breaker and main switchboard incoming feeder in case of:

- earth fault
- short circuit / overcurrent
- shore side under voltage
- cable break
- failure of protecting earthing connection.

There shall be an interlock preventing closing of shore circuit breaker unless plug and socket is correctly connected and eventual earthing switches opened.

Upon opening of the shore side circuit breaker an earth switch shall automatically connect all phases of the cable to earth, to discharge the cable and ensure connection to earth. It shall not be possible to open the earth switch unless the shore connection is connected and protective earth connection between the vessel and shore is verified.

Closure of circuit breakers shall not be possible if confirmation of proper protective earthing connection is not confirmed. If proper earthing connection is lost, the breakers shall open.

Activation of protective functions (including high cable tension and emergency disconnection) shall give an alarm to a continuously manned location.

3.13.2 Emergency disconnection

An independent system for emergency disconnection shall be arranged with emergency stop push buttons. There shall be one emergency stop button in each of the following locations: at the ship's side where the electrical shore connection is located, where the cable management system is handled, at the shore connection switchboard, and at a continuously manned location.

Activation of emergency stop shall result in disconnection of circuit breakers and closing of earthing switches. Opening, or release, of the plug and socket may be a manual operation.

3.14 Instrumentation

Electric Shore Connection systems shall be equipped with the following instrumentation:

- phase sequence indicator
- voltmeter
- ampere meter in each phase or fitted with ampere meter switch
- energy measurement (kWh counter).

4. Installation requirements

4.1 General

The on board electrical installations for the electrical shore connection system shall comply with the installation requirements given in DNV Ship Rules Pt.4 Ch.8 Sec.10.

4.2 Marking

All high voltage equipment shall be marked with high voltage warning sign.

4.3 Cables

A flexible shore connection cable can be arranged either on board the vessel or situated at key. In both situations a cable handling system must be arranged.

All cables installed on board shall be DNV type approved or case by case approved.