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GUIDELINES ON
HIGH VOLTAGE SHORE CONNECTION SYSTEMS FOR SHIPS

2020

Guidelines on

High Voltage Shore Connection Systems for Ships

2020

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Section 1

General

1.1 Scope and Applicability

1.1.1 It is becoming an increasingly common feature for ships to shut down generators and to connect to shore power for as long as practicable during stays in port, for a number of reasons including environmental considerations. This scenario of receiving electrical power and other utilities from shore is also referred to as "*cold ironing*".

1.1.2 These Guidelines are applicable to vessels equipped with a high voltage shore connection system (HVSCS) designed to power the vessel with shore power alone, enabling the shipboard generators to be shut down while in port/ at berth. The Guidelines indicate requirements related to the design, installation and verification of high voltage electrical connections

1.1.3 Vessels in compliance with the requirements in these Guidelines may be assigned additional notation **HVSCS**. The Guidelines require that the installations on-board the vessel have been verified and tested. Shore-side installations are not within the purview of these Guidelines.

1.1.4 These requirements are additional to those in the various parts of the IRS *Rules and Regulations for the Construction and Classification of Steel Ships*.

1.1.5 These Guidelines do not apply to the electrical power supply during docking periods, e.g. dry docking and other out of service maintenance and repair.

1.1.6 Additional requirements and/or restrictions may be imposed by the flag administrations, statutory and port authorities within whose jurisdiction the ship is intended to operate, and the same are to be complied with as relevant and applicable.

1.2 General

1.2.1 Connection to an external electric power supply is not to adversely affect the availability of main, auxiliary or emergency machinery, including ship sources of electrical power to allow ship power to be restored.

1.2.2 The HVSCS is to be located in areas where it cannot be damaged by in-port activities or vessel activities under normal operational circumstances.

1.2.3 The HVSCS is to be compatible with the forces, moments and deflections resulting from the movement of the moored ship under normal operational circumstances.

1.3 Definitions

1.3.1 *Cable Management System*: the cable management system comprises all equipment designed to control, monitor and handle the HV-flexible and control cables and their connection devices. It serves as an interface point on the ship with the shore power system.

1.3.2 *Earthing*: The manner in which the electrical power supply system is grounded. Grounding may be achieved by means of methods such as neutral earthing, low or high resistance earthing, etc. The protection of circuits is designed around the method of system grounding selected.

1.3.3 *Emergency shutdown:* is manual and/or automatic shutdown in critical situations.

1.3.4 *Equipotential bonding*: provision of electric connections between conductive parts, intended to achieve equi-potentiality.

1.3.5 *High Voltage (HV)*: The system nominal voltage in the range above 1kV AC and upto and including 15 kV AC is considered as high voltage for the purpose of these Guidelines.

1.3.6 *High Voltage Shore Connection System (HVSCS)*: The system on-board a vessel that is designed to receive high voltage shore power. Typically the system would consist of high voltage circuit breakers, step-down (or isolation) transformer, high voltage flexible cables, shore connection switchboard, cable management system and associated instrumentation.

1.3.7 *Low Voltage (LV)*: is nominal voltage upto and including 1kV AC.

1.3.8 *Receiving Point*: Receiving point for the high voltage flexible cable on the ship side.

1.3.9 *Shore Connection Switchboard*: Consists of shore connection circuit breakers and is a switchboard installed close to the receiving point. HV shore power is connected to the shore connection switchboard by means of HV plug and socket arrangement.

1.3.10 *Ship receiving switchboard*: Normally, a part of the ship's main switchboard to which the shore power is fed from the shore connection switchboard.

1.3.11 *Supply Point*: Supply point for the high voltage flexible cable on the shore side.

1.4 Documentation

1.4.1 The following documents/ details/ drawings are required to be submitted to IRS

(a) for approval

- Single line diagram of the HVSCS (ship side features/ elements)
- System earthing/ grounding details
- Details of instrumentation, safety interlocks, monitoring and alarms
- Load analysis and details of services supplied
- Cable specifications
- Details of cable management system, if installed
- Description of automatic synchronization system for the temporary generator parallel running of the ship's generator and shore power, if fitted.
- Details of supplementary arrangements required to protect equipment from exposure to moisture, condensation or temperatures outside their rating
- Tests and trial program, at manufacturer's works and on ship

(b) for information

- Overall description of HVSCS and operating philosophy
- Environmental conditions having consequences on shore connection (weather, tides, mooring arrangements, etc.)
- General arrangement showing location of connection equipment, cabinets, cable routing, etc.
- Type testing of plugs, sockets, cables, etc.
- Operation manual describing methods of connection, operating and monitoring instructions, etc.

1.4.2 When the approved arrangements are intended to be modified, details are to be forwarded to IRS for review.

Section 2

System Design Requirements

2.1 General

2.1.1 A typical HVSCS described in these Guidelines would consist of the following hardware components (Refer fig. 2.1.1):

- HV shore supply equipment
- Transformer
- Convertors, where applicable (for e.g. when the shore and vessel have different frequencies)
- Cables, plugs and sockets
- Cable management system, where fitted
- Shore connection switchboard
- Ship receiving switchboard (in general, a section of the main switchboard)

2.1.2 Functions are to be designed on the fail-safe principle

2.1.3. Each failure is to be identified by an alarm at a manned control station on-board.

2.1.4 Suitable warning notices are to be provided at locations along the connection equipment routes, including at connection locations.

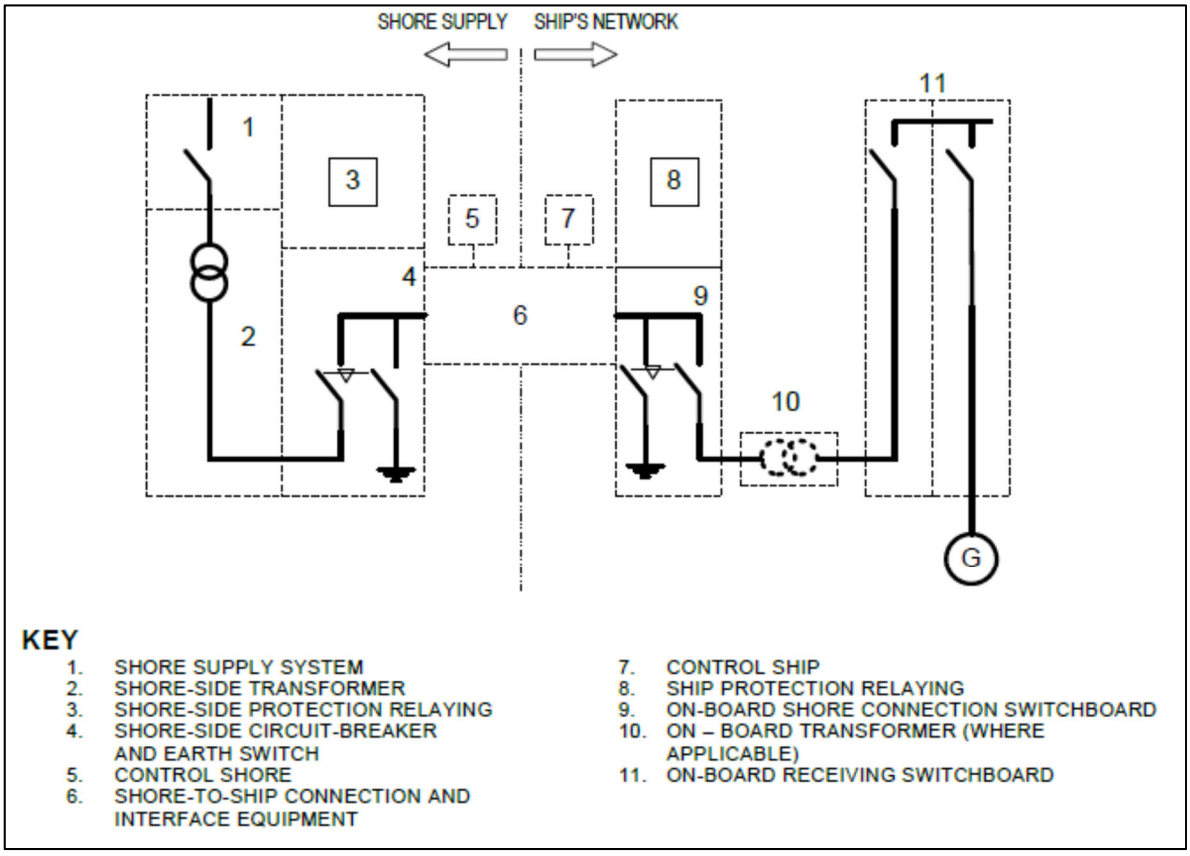

Fig. 2.1.1: Block diagram of a typical HVSCS arrangement

2.2 System Design

2.2.1 Arrangement

2.2.1.1 HVSCS is to be installed in access controlled spaces.

2.2.1.2 HVSCS is not to be installed in hazardous spaces

2.2.1.3 The shore connection switchboard is to be installed in a space protected from exposure.

2.2.1.4 The shore connection switchboard is to be installed as close as possible to the receiving point. The distance between the supply point and the receiving point is to be as short as possible.

2.2.1.5 Adequate space is to be provided around the shore connection switchboard to enable the operator to perform connection and disconnection operations

2.2.1.6 When determining the location of the HVSC system, the full range of cargo, bunkering and other utility operations are to be considered, including:

a) the cargo handling and mooring equipment in use on the ship and shore, and the areas that must be clear for their operation, along with any movement of the ship along the pier required to accommodate these operations;

b) traffic management considerations such that the use of an HVSC system does not interfere with other ships' operations (including mooring) or prevent necessary traffic flow on the pier and to maintain open fire lanes where required; and

c) personnel safety measures, such as physical barriers to prevent unauthorized personnel access to HVSC equipment or the cable management equipment.

2.2.1.7 When determining the connection point of the HVSC system, all tidal conditions and ship operations affecting ship’s free board are to be considered

2.2.2 Compatibility with shore power

2.2.2.1 The locations for controlling HV shore circuit breaker (for e.g. engine room) are to be provided with means to confirm status of shore power (for e.g. voltage, frequency, phase sequence, etc.).

2.2.3 Capacity

2.2.3.1 HVSC equipment is to be sufficiently rated to supply the following

- Normal loads required at berth
- Emergency loads
- Loads required to support ship operations at berth

2.2.4 Earthing

2.2.4.1 *Equipotential bonding*: Equipotential bonding between the ship and the shore is to be provided. An interlock is to be provided such that the HV shore connection cannot be established until the equipotential bonding has been established. The equipotential bonding cable may be integrated into the HV shore power cable. When the equipotential bonding cable is intended to carry the shipboard earth fault current, the cable size is to be sufficient to carry the design maximum earth fault current.

2.2.4.2 *Safe interlock for equipotential bonding*: Means for interlocking are to be provided such that connection with HV shore supply is automatically cut-off when equipotential bonding is lost.

2.2.4.3 *Compatibility with system earthing*: Arrangements are to be provided so that when the shore connection is established, the resulting system earthing onboard is to be compatible with the vessel's original electrical system earthing philosophy. Functions for earth fault detection and earthing protection are to remain available after the shore connection has been established.

2.2.4.4 The vessel is not to be permitted to establish shore power connection with an earth fault present in the HV system on either side.

2.2.5 Rated Voltage

2.2.5.1 The rated voltage of electrical equipment is to be appropriate for the earthing system.

2.2.6 Circuit Protection

2.2.6.1 The HV shore connection switchboard is to be provided with a circuit breaker to protect fixed HV electrical cables installed from that point onward.

2.2.7 Short circuit level protection

2.2.7.1 After a shore connection has been established, the prospective short-circuit current level at any point in the ship's power distribution system is not to exceed the short-circuit breaking and making capacities of circuit breakers installed onboard. Operational procedures are to be established for assessment of the shore side impedance, which determines the prospective short-circuit current level after the shore connection has been established. Such procedures are to be included in the operation manual.

2.2.8 Overvoltage Protection

2.2.8.1 Where a step-down transformer is installed onboard, the ship's low voltage system is to be protected against accidental overvoltage. This may be achieved by:

- Direct earthing of the lower voltage system while the shore power is connected; or
- Earthed screen between the primary and the secondary windings of the transformer

2.2.9 Coordination of protective devices

2.2.9.1 Shore connection circuit breakers are to be coordinated with circuit breakers for generators as far as possible so that a blackout does not occur even when a short circuit occurs in the HVSCS during parallel running of shore power and generators.

2.2.9.2 The circuit breaker in the on-board distribution system is to be coordinated as far as possible with the shore connection circuit breaker, so that shore power is supplied continuously to other circuits in the distribution system, even if short circuit occurs in the distribution system.

2.2.10 Transformer Protection

2.2.10.1 Transformer, (where provided), is to be protected against short-circuit and overload protection in accordance with the requirements of the IRS *Rules and Regulations for the Construction and Classification of Steel Ships*. The overload protection device is to have time-current protection characteristics consistent with the transformer's thermal damage characteristics.

2.2.11 Load Transfer

2.2.11.1 Load transfer between operation using ship sources of electrical power and an external electrical power supply is to be provided via short time parallel operation/ synchronization between the two sources or blackout.

.1 *Load transfer by short time parallel operation/ synchronization*: In ships where the load transfer can take place without blackout i.e. a short time parallel connection of the onboard generators and the shore power supply, the following requirements are to be complied with:

- The shore power voltage is to be within the regulation range of the automatic voltage regulator of the on-board generator
- Automatic means of synchronization are to be provided
- Automatic means of load transfer are to be provided
- The load transfer is to be completed in a time as short as practicable without causing failure of machinery or equipment or operation of protective devices. This time is to be used as the basis to define the transfer time limit (TTL). The TTL may be adjustable to match with the ability of the external source of power to accept and shed load. If the load transfer exceeds the TTL, arrangements are to be such that :
    - Transfer is aborted
    - The connection circuit breaker is opened
    - Load is removed from the ship's generators or shore power supply
    - An alarm is provided at the attended machinery control station, which is active when TTL is exceeded and is to indicate return to previous operating conditions.

.2 *Load transfer via blackout*: In such cases, the interlocking means are to be provided such that the HV shore power circuit breaker activates only in the no voltage condition. Interlocking means are to be provided so that shore power and on-board power are not switched on simultaneously onto a dead switchboard.

2.2.12 Restoration after disruption/ failure

2.2.12.1 When shore power is lost, on-board power required for safety operations are to be automatically restored. The detailed procedures for failure recovery are to be included in the Operation Manual (see Sec.3.10).

2.2.13 Distortion Control

2.2.13.1 When convertors are provided in the shore connection equipment to acquire the required voltage or frequency, the total harmonic distortion is to be within 5% in all the operating load ranges, whereas a single harmonic distortion is not to exceed 3%.

2.2.14 Emergency Shutdown

2.2.14.1 Emergency shutdown facilities are to be provided such that they are automatically activated under the following conditions:

- Loss of equipotential bonding
- Failure of shore connection safety circuits
- High tension level (over extension) in the HV cable
- Activation of emergency stop button

2.2.14.2 Activation of the emergency shut down is to instantaneously:

- Open all shore connection circuit breakers
- Connect to earth the HV power connections

2.2.14.3 The emergency stop buttons are to be installed at the following locations:

- Remote control location for controlling circuit breakers (if fitted)
- Ship's manned station during HVSCS operations
- Shore connection switchboard
- Control location for automatic tension device in the cable management system
- Other locations, as deemed necessary.

2.2.14.4 The emergency stop buttons are to be clearly marked so that their operation method is clearly visible, prevent inadvertent operation and easily followed. The emergency stop button is to be reset manually, once activated.

2.2.14.5 Activation of the emergency stop button is to result in a visual warning and easily distinguishable audible alarm at a manned station.

2.2.14.6 Consequences of emergency shutdown activation on ship installations are to be evaluated.

2.2.15 Control, Monitoring and Alarms

2.2.15.1 Arrangements are to be provided to ensure that the shore connection circuit-breakers cannot be operated when:

- One of the earthing switches is closed (shore-side/ship-side)
- The pilot contact circuit is not established
- Emergency-stop facilities are activated
- Ship or shore control, alarm or safety system self-monitoring properties detect an error that would affect safe connection
- The data-communication link between shore and ship is not operational
- The high-voltage supply is not present
- Earth fault is detected.

2.2.15.2 The measuring point for all instrumentation related to the shore power is to be on the upstream side of the incoming circuit breaker that isolates the shore power from the vessels power system.

2.2.15.3 An independent means of voice communication is to be provided between the ship and the shore control locations. A reliable data communication link is recommended to be provided between the ship and shore control locations.

2.2.15.4 The following monitoring and alarms are to be provided at the location from which the HVSC circuit breakers are controlled, and at other strategic locations that are normally manned if deemed necessary:

- Over tension alarm on HV flexible shore connection cables, or cable management system over deployment (low remaining cable length) alarm, prior to the emergency shutdown
- The loss of shore power
- Emergency shutdown
- Manual emergency-stop
- Safety device activation alarms (e.g., overcurrent, earth fault)

2.3 Fire Protection of HVSCS

2.3.1 At-least the fire protection and extinguishing requirements required for “Other Machinery Spaces”, as stipulated in the IRS *Rules and Regulations for the Construction and Classification of Steel Ships* are to be complied with in the spaces where HVSCS are installed (excluding spaces where ship receiving switchboards are installed). Machinery and equipment installed in directly exposed parts/ spaces would be specially considered.

Section 3

Equipment Requirements

3.1 General

3.1.1 Electrical equipment are to be constructed of durable, flame-retardant, moisture-resistant material, which are not subject to deterioration in the marine environment and at the temperatures to which they are likely to be exposed.

3.1.2 The determination of equipment protection class (IP rating) is to be in accordance with Part 4, Chapter 8, Table 1.13.1 of the IRS *Rules and Regulations for the Construction and Classification of Steel Ships.*

3.1.3 Effective means are to be provided to prevent moisture accumulation and condensation, even if equipment are idle for long periods of time. Appropriate arrangements are to be provided for storage of removable HVSC equipment when not in use. Such arrangements should also take into account issues such as dust, moisture, physical damage of sockets, plugs, cables etc.

3.2 Shore Connection Switchboard

3.2.1 The HV shore connection switchboard is to be designed, manufactured and tested in accordance with a recognized standard such as IEC 62271-200.

3.2.2 The circuit breakers in the shore connection switchboard are to be as follows:

- HV circuit breaker is to be equipped with low voltage protection (LVP)
- The rated short-circuit making capacity of the circuit breaker is to be greater than the prospective peak value of the short-circuit current
- The rated short-circuit breaking capacity of the circuit breaker is to be greater than the maximum prospective short-circuit current (rms value).
- HV shore connection circuit breaker is to be remotely operated

3.2.3 Backup power supply for operation of at least 30 minutes is to be provided for the instrumentation devices. In the event of a breakdown of this backup power supply, alarm is to be given in the machinery control room. The following instrumentation is to be provided in the shore connection switchboard:

- Voltmeter (all phases)
- Short circuit protection device (open circuit and alarm)
- Overload protection device (open circuit and alarm)
- Earth fault detector
- Unbalance protection device (for multiple connections)

3.2.4 The shore connection switchboard is to be located onboard the vessel in a dry space close to the connection point, for the reception and extension of the ship to the shore connection cable.

3.3 Ship Receiving Switchboard

3.3.1 The ship receiving switchboard is to be designed, manufactured and tested in accordance with a recognized standard such as IEC 62271-200.

3.3.2 The circuit breakers in the ship receiving switchboard are to be as follows:

- The rated short-circuit making capacity of the circuit breaker is to be greater than the prospective peak value of the short-circuit current
- The rated short-circuit breaking capacity of the circuit breaker is to be greater than the maximum prospective short-circuit current (rms value).
- HV connection circuit breaker is to be remotely operated

3.3.3 The following instrumentation is to be provided in the ship receiving switchboard:

a) If load transfer by synchronization

- Two voltmeters
- Two frequency meters
- One phase sequence indicator
- Synchronizing device (if designed for short term parallel operation)
- Ammeter for each phase
- Short circuit protection device (open circuit and alarm)
- Overload protection device (open circuit and alarm)
- Earth fault detector

One voltmeter and one frequency meter are to be connected to the switchboard bus bars; the other voltmeter and frequency meter are to enable the voltage and frequency of the shore connection to be measured.

b) If load transfer by blackout

- One Voltmeter
- Phase sequence indicator
- One Frequency meter
- Ammeter for each phase
- Short circuit protection device (open circuit and alarm)
- Overload protection device (open circuit and alarm)
- Earth fault detector

3.4 Cable Management System

3.4.1 A cable management system (cable reels, crane, etc) enabling the connection of cables between the shore connection switchboard and the ship receiving switchboard and suitable for the different places where the vessel intends to connect is to be provided.

3.4.2 Cable management system, cables are to be equipped with warning notices to highlight the presence of high voltage, moving parts, obstacles, risks of fall, etc.

3.4.3 The cable management system is to be arranged to provide an adequate movement compensation (due to ship movement, tidal changes, etc.) and to maintain an optimum length of cable which avoids slack cable or exceeding of tension limits.

3.4.4 The cable management system is to ensure that the cable tension does not exceed the permitted design value.

3.4.5 The cable management system is to be equipped with a device (e.g. limit switches), independent of its control system, to monitor maximum cable tension and deployed cable length.

3.4.6 The detection of tension in the cable is to activate an alarm at a first stage and an emergency shutdown at a second stage.

3.4.7 The cable management system, cables are to be physical protected against heavy seas and mechanical damages.

3.4.8 Power connections with external electrical power supply arrangements may be made with either suitable connections or by using socket-outlets and plugs in accordance with 3.6.

3.4.9 Power, control and monitoring cables are to be at least of a flame-retardant type in accordance with the requirements given in IEC 60332-1-2. The outer sheath is to be oil-resistant and resistant to sea air, seawater, solar radiation (UV) and not hygroscopic.

3.4.10 Power, control and monitoring may be based on a single cable or cables in bunch.

3.4.11 Arrangements is to be provided to stow the cable management system and associated cable when not in operation.

3.4.12 The breakaway capability of the vessel is to be demonstrated. The time necessary to disconnect the shore connection system is to be recorded.

3.4.13 Consequences of mooring breaks on the shore connection are to be considered. It is not to lead to critical damages on the installation.

3.5 Transformer

3.5.1 Where provided, the transformer is to be in compliance with the requirements of Part 4, Chapter 8 of the *IRS Rules and Regulations for the Construction and Classification of Steel Ships*. The level of harmonics current is to be taken into account, whilst deciding the rated capacity of the transformer.

3.5.2 The transformer is to be protected from short circuit and overloads.

3.6 HV Voltage Plugs and Sockets

3.6.1 The plug and socket-outlet arrangement are to be fitted with a mechanical-securing device that locks the connection in engaged position.

3.6.2 The plugs and socket-outlets are to be designed so that an incorrect connection cannot be made.

3.6.3 Socket-outlets and inlets are to be interlocked with the earth switch so that plugs or connectors cannot be inserted or withdrawn without the earthing switch in closed position. The earthing contacts are to make contact before the power contacts do when inserting a plug.

3.6.4 Plugs are to be designed so that no strain is transmitted to the terminals, contacts and cables.

3.6.5 Connection plug and socket-outlets are to be designed according to international or national standards. Type test reports are to be submitted.

3.7 HV Cables

3.7.1 Permanently fixed cables are to be connected between the shore connection switchboard and the ship receiving switchboard connection point.

3.7.2 Ship to shore connection cable extensions are not to be permitted.

3.7.3 Fixed HV cables installed on-board are to comply with the provisions of IEC 60092-353 and IEC 60092-354. The cables are to be at least of a flame retardant type in accordance with IEC 60332-1-2. The outer sheath is to be oil-resistant and resistant to sea air, seawater, solar radiation (UV) and not hygroscopic. HV flexible cables would be specially considered.

3.7.4 HV cables are not to be laid in the same cable tray as low voltage cables (below 1kV).

3.7.5 HV cables are not be laid through accommodation spaces, as far as is practicable. If it is unavoidable to pass HV cable through accommodation spaces, fully closed cable runs are to be used.

3.7.6 When HV cables are installed in a cable tray or equivalent, the cables are to have continuous metal sheathing or armour, which is earthed effectively. If this is not feasible, the entire length of HV cable is to be covered effectively by earthed metallic case.

3.7.7 HV cables are to be appropriately marked for easy identification.

3.8 Compatibility Assessment

3.8.1 It is recommended that a compatibility assessment to confirm the consistency with shore power systems be carried out prior to receiving HV shore power. These may include, but not be limited to, the following:

- Rated capacity of shore power, ship-shore connections, ship side connections
- Maximum and minimum prospective short circuit current
- Acceptable voltage variations in the range of loads from no-load to maximum loads of on-board distribution switchboard
- System study and calculations
- Compatibility with ship control voltage
- Compatibility with communication link
- Compatibility with distribution system
- Compatibility with safety circuits
- Shipside earth fault protection, monitoring and alarm functions during HV shore power connections
- Cable length adequacy
- Total harmonic distortion
- Consideration of hazardous areas, where applicable
- Equipotential bond monitoring

3.9 Maintenance Plan

3.9.1 A maintenance plan indicating the periodic tests and maintenance procedures for the HVSCS is to be prepared and included in the Operation Manual.

3.10 Operation Manual

3.11.1 A manual depicting the operational procedures for the HVSCS is to be stored at an easily accessible location to the crew, preferably at the operating stations. The operation manual is to include, but not be limited to, the following

- Operator qualification requirements
- Compatibility assessment procedures (also refer 3.8)
- Actions to be taken when the shore power supply is incompatible with on-board equipment
- Step-by-step instruction for shore power connection and disconnection, including equipotential bonding and load transfer
- Procedure for transmitting “permission to close” shore side HVSC circuit breaker
- Emergency shutdown procedure and restoration of power (in at least the following conditions: loss of equipotential bonding, high cable tension or shortage of remaining cable length, "safety circuit pilot loop" failure, manual activation of the emergency stop system and disconnection of plugs while energized)
- Procedure for recovery from fault conditions
- Storage requirements for HVSC equipment
- HVSCS maintenance plan

Section 4

Test and Trials

4.1 General

4.1.1 All HV Systems components are to clear the applicable type tests and routine tests according to the relevant IEC standards, in particular IEC 62271-200.

4.1.2 Tests are to be carried out to show that the electrical system, control, monitoring and alarm systems have been correctly installed and are in good working condition before being put into service. Tests are to be realistic and simulations are to be avoided as far as is practicable.

4.1.3 Electrical and control engineering equipment is to be surveyed at manufacturer's works and undergo survey and operational trials on board in accordance with the approved test schedules and applicable testing requirements in Part 4 of the *IRS Rules and Regulations for the Construction and Classification of Steel Ships* .

4.1.4 All tests/ trials indicated in this Section are to be carried out in presence of the Surveyor, unless specified otherwise.

4.2 Tests at Manufacturing Works

4.2 1 HV Switchboard

4.2.1.1 HV switchboards are to be subjected to an AC withstand voltage test in accordance with relevant national or international standards.

4.2.2 HV cable reel and slip rings

4.2.2.1 The slip rings are to be subjected to an AC withstand voltage test in accordance with relevant national or international standards such as IEC 62271-200.The following tests are to be carried out:

- HV withstand test
- Impulse voltage withstand test
- Insulation resistance measurement
- Heat run test with nominal current
- Short circuit withstand test
- Arc test (if accessible in energized condition)
- IP test (IP rating)

4.2.3 Transformers

4.2.3.1 Transformer tests are to be carried out in accordance with the requirements specified in Part 4, Chapter 8 of the *IRS Rules and Regulations for the Construction and Classification of Steel Ships*.

4.3 On-board Tests and Trials

4.3.1 The tests / trials are to be carried out as per the approved trial protocols. In general, the following tests/ trials are to be carried out after installation onboard:

.1 General visual examination of HVSCS
.2 Insulation resistance test of the HV shore connection and ship receiving switchboards

.3 Voltage withstand test
.4 Measurement of the earthing resistance
.5 Function test including correct setting of the protection devices
.6 Function test of the interlocking system
.7 Function test of the control equipment and alarms
.8 Load transfer (blackout/ synchronization, as relevant)
.9 Earth fault monitoring test
.10 Phase sequence test
.11 Function test of the cable management system, where fitted
.12 Function tests of the emergency shutdown arrangements

4.3.2 Any additional tests, as required by the statutory authorities are also to be carried out, as applicable.

4.4 Annual Surveys

4.4.1 A record of maintenance, repairs, equipment modifications (if any) and test results are to be available on-board for review by the Surveyor.

4.4.2 A general examination of the HVSC system is to be carried out by the Surveyor.

4.4.3 Insulation resistance measurement and voltage withstand test of the cable are to be carried out in the presence of the Surveyor.

4.4.4 If the shore connection equipment has been used and no modifications have been carried out or the insulation resistance measurement or the voltage withstand test has been carried out in the previous 30 months, then the above tests may be omitted. Records of the testing are to be made available to the Surveyor.

4.4.5 If it is noted that the HVSC equipment has not been used in the previous 30 months, the tests as indicated in 4.3.1 are to be repeated.

Section 5

Additional Specific Ship Type Requirements

5.1 General

5.1.1 The requirements in this Section are additional to those in the previous Sections, based on specific ship types and are to be read in conjunction with those requirements.

5.1.2 IEC 80005-1 may also be referred for detailed requirements.

5.2 Ro-Ro Cargo Ships and Ro-Ro Passenger Ships

5.2.1 HVSC systems are not to be installed in areas which may become hazardous areas, such as car decks, upon failure of required air changes per hour during loading and offloading cargo or during normal operations.

5.2.2 The nominal voltage is to be 11 kV AC. Nominal voltage of 6.6 kV AC may be used in coastal vessels.

5.2.3 Galvanic isolation may not be required where a HV shore supply is dedicated to supply only ships which have galvanic isolation on board.

5.2.4 One cable is to be used for HVSC system up to a power demand of 6.5 MVA.

5.2.5 The shore side facility may be equipped with cable management systems in the case of these ships.

5.2.6 If data-communication link is installed, data communication shall be performed utilizing fibre optic systems. Emergency shutdown functions are to be performed with pilot conductors (as per IEC 62613-1, IEC 62613-2 and Annex A of IEC 80005-1).

5.3 Cruise Ships

5.3.1 Periodic verification of the ship's earthing system is recommended.

5.3.2 The HVSC system is to be rated for at least 16 MVA (but 20 MVA is recommended where practical) at nominal ship system voltages of 11 kV A.C. and/or 6.6 kV A.C.

5.3.3Measures are to be taken so that ships with power demands higher than the HVSC system rating will reduce their power demand prior to connecting.

5.3.4 Some ships may require on-board isolation transformer.

5.3.5 The prospective short-circuit contribution level from the HV shore distribution system is to be limited by the shore-sided system to 25 kA r.m.s.

5.3.6 The prospective short-circuit contribution level from the on-board running induction motors and the generators in operation is to be limited to a short circuit current of 25 kA r.m.s. for 1s.

5.4 Container Ships

5.4.1 The nominal voltage of the HVSC is to be 6.6 kV.

5.4.2 Two parallel cables with three pilot conductors each is to be used for HVSC systems up to a maximum power demand of 7.5 MVA.

5.4.3 The cable management system is to be located on the ship.

5.4.4 If data-communication link is installed, data communication shall be performed utilizing fibre optic systems. Emergency shutdown functions are to be performed with pilot conductors (as per IEC 62613-1, IEC 62613-2 and Annex A of IEC 80005-1).

5.5 LNG Carriers

5.5.1 In addition to the compatibility assessment in 3.10, the following are also required to be observed:

- Compatibility of shutdown system and disconnection equipment
- Availability of shore power supply for cargo operations

5.5.2 The prospective short-circuit contribution level from the HV shore distribution system should be limited by the shore-sided system to 16 kA r.m.s.

5.5.3 The prospective short-circuit contribution level from the on board running induction motors and the generators in operation should be limited to a short circuit current of 16 kA r.m.s.

5.5.4 Special requirements for the distribution systems in LNG carriers are also to be complied with in accordance with IEC 60092-502.

5.5.5 Connections should be made at a nominal voltage of 6.6 kV A.C. and a frequency of 60 Hz.

5.5.6 Emergency Shutdown

5.5.6.1 Emergency shutdown is to be initiated in two steps: ESD-1, when the ship moves past the warning range, and ESD-2, when the ship moves past the maximum range of movement of the ship.

5.5.6.2 Means should be provided to facilitate emergency physical disconnection of the HVSC cables in the event of ESD-2 (movement of the ship away from the dock) being detected.

5.5.6.3 Disconnection may be triggered by an "active" system employing an external mechanical force or by a “passive” system employing a weak link in the design. Suitable "passive" systems may be fitted at the ship or shore side or as part of a coupler in the HVSC power cable.

5.5.6.4 LNG-ESD may be initiated manually, by fusible links, by process deviation or by excessive movement of the loading arms. The LNG-ESD signal is to be passed between ship and shore (or vice versa) and is to cause cargo pumps and compressors to be stopped and cargo valves to be closed on ship and shore.

5.5.7 HVSC Point location

5.5.7.1 It is recommended that the physical location of the HVSC point may be in accordance with Table 5.5.7.1 (a) and 5.5.7.1 (b)

Table 5.5.7.1 (a) LNGC 140000 – 225000 cu.m		
HVSC Point	Dimensions (m)	
	Minimum	Maximum
From cargo manifold centre-line	112	130
Above design waterline	5.35	8.85
From berthing line	0	11.5

Table 5.5.7.1 (b) LNGC > 225000 cu.m		
HVSC Point	Dimensions (m)	
	Minimum	Maximum
From cargo manifold centre-line	120	149
Above design waterline	5.55	9.05
From berthing line	0	11.5

5.5.8 The cable management system should be located on shore.

5.5.9 The maximum short-circuit current of 16 kA / 1 s and a maximum peak short-circuit current of 40 kA are recommended.

5.5.10 Certified intrinsically safe or fibre optic systems may be a suitable means of communication.

5.5.11 It is recommended that hardline telephones are provided as the means of voice communication required between ship and shore control locations.

5.5.12 If data-communication link is installed, data communication is to be performed utilizing fibre optic systems. Emergency shutdown functions are to be performed with pilot conductors (as per IEC 62613-1, IEC 62613-2 and Annex A of IEC 80005-1).

5.5.13 ESD Philosophy

5.5.13.1 An emergency shutdown philosophy is to be agreed between terminal and ship during compatibility assessment of the HVSC system. It is to at least cover actions in the event of the following situations:

- manual shutdown of cargo operations
- loss of electrical power (initiates LNG-ESD)
- LNG-ESD
- ESD-1
- ESD-2
- Simultaneous release of mooring hooks.

5.5.13.2 The HVSC shutdown system is to be self-contained and the emergency shutdown philosophy should not require additional signals to be transmitted from ship to shore (or vice versa) by the existing LNG terminal shutdown system. However, the LNG terminal shutdown system is to provide ESD-1 & ESD-2 signals to the HVSC shutdown system.

5.5.13.3 The LNG-ESD should not be required to have an automatic effect on the HVSC system.

5.5.13.4 The ESD-1 is to be communicated from shore to ship via the fibre-optic system and is to initiate automatic starting, synchronization and connection of the ship main source of power followed by isolation and earthing of the shore power connection(s) both onshore and on-board.

5.5.13.5 The ESD-2 is to be communicated from shore to ship via the fibre-optic system and should trigger an emergency-stop as described in 3.10 (i.e. the immediate opening of all the shore supply circuit-breakers etc.) and earthing of the shore power connection(s) both onshore and on-board.

5.5.13.6 Additional emergency-stop switches would be required on shore in the terminal control room where the HVSC controls are located and at the cable management system operating location.

5.6 Tankers

5.6.1 It is possible that an area in the tanker that is regarded as safe in accordance with IEC 60092-502 may fall within one of the hazardous zones of the terminal. If such a situation should arise and, if the area in question contains electrical equipment that is not of a safe type, certified or approved by a competent authority for the gases encountered, then such equipment may have to be isolated whilst the tanker is at the berth. Requirements of IEC 60079 are to be considered during the compatibility assessment.

5.6.2 The prospective short-circuit contribution level from the HV shore distribution system is to be limited by the shore-sided system to 16 kA r.m.s.

5.6.3 The prospective short-circuit contribution level from the on board running induction motors and the generators in operation is to be limited to a short circuit current of 16 kA r.m.s.

5.6.4 Special requirements applicable to the distribution systems of tankers are to be complied with in accordance with IEC 60092-502.

5.6.5 Connections for tanker ships are to be made at a nominal voltage of 6,6 kV A.C.

5.6.6 The cable management system is to be located on shore.

5.6.7 Certified intrinsically safe or fibre optic systems may be a suitable means of communication.

5.6.8 It is recommended that hardline telephones are provided as the means of voice communication required between ship and shore control locations.

End of Guidelines