



Exploration & Production

GENERAL SPECIFICATION

ELECTRICAL

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Construction site electrical installations

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1. Scope

This specification covers the minimum requirements imposed by Company for safety of workers against electric shocks during construction at Contractor's yard for topsides, FPSO hull, and at onshore sites during plant construction.

This specification concerns electrical equipment used on a construction site as electric drill, welding machine, distribution board assembly, temporary lighting, etc., as well as main electrical

2. Reference documents

The reference documents listed below form an integral part of this General Specification. Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and supplements, is the latest revision published at the EFFECTIVE DATE of the CONTRACT.

Electrical installations and equipment shall conform to the appropriate sections of the latest editions (with amendments) of the IEC standards and codes.

The following order of precedence shall apply:

- Applicable laws, rules and regulations of the country in which the construction site facilities are located
- This Specification
- Applicable International Electrotechnical Commission (IEC) standards.

Standards

Reference	Title
IEC 60038	IEC Standard Voltages
IEC 60050	International Electrotechnical Vocabulary
IEC 60059	IEC Standards current ratings
IEC 60245-4	Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables
IEC 60364 (All parts)	Electrical installations of buildings - (All parts)
IEC 60439-4	Low-voltage switchgear and controlgear assemblies – Part 4: Particular requirements for assemblies for construction sites (ACS)
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 61200-704	Electrical installation guide - Construction and demolition site installations

Professional Documents

Reference	Title
Not applicable	



Regulations

Reference	Title
Not applicable	

Codes

Reference	Title
Not applicable	

Other documents

Reference	Title
Not applicable	

Total General Specifications

Reference	Title
Not applicable	

3. Protection for safety

3.1 Protection against electric shock (refer [IEC 60364-4-41](#))

Attention shall be paid on measures of protection against direct and indirect contacts

Frequent inspection shall be carried out by Contractor on the protective measures as well as on electrical material and installation.

Protection against electric shock due to indirect contact shall be performed by:

- A proper earth fault protection system.
- An automatic disconnection of supply
- The use of class II equipment or by equivalent insulation
- electrical separation (limited to a transformer supplying a single item of equipment by a flexible cable)

Protection against electric shock due to direct contact shall be performed by:

- insulation of live parts ([IEC 60364-4-41](#) § 412.1)
- barriers or enclosures ([IEC 36064-4-41](#) § 412.2)

Protection by obstacles (as defined by the [IEC 60364-4-41 § 412.3](#)), which only protect against accidental contact with live parts is only acceptable when other protective measures cannot be used, and then only for a very limited time.

Protection by extra low voltage can be used in all circumstances, especially when working conditions are severe, such as in restrictive conductive locations for the supply to portable tools, for grinding equipment used in wet conditions, or for equipment used for heating concrete.

3.2 Protection against overcurrent ([IEC 60364-4-43 §43](#))

Protection against overcurrent shall be provided by circuit-breakers or fuse-switches.

Protection against overcurrent shall be performed by:

- A protection against overload current : every circuit shall be protected against overload current
- A protection against short-circuit.

4. Selection and erection of equipment

4.1 General

As construction sites submit electrical equipment to harsh conditions, electrical equipment shall be designed in order to withstand to these constraints.

All equipment shall have a degree of protection of at least IP44 and IK08.

Emergency switching device (e.g. red mushroom pushbutton type, etc.) located near dangerous equipment like crusher, diesel generator, etc., shall be installed.

4.2 Cables

To avoid damage, cables should not be run across side roads or walkways. Where necessary, protection against mechanical damage in pedestrian or vehicle passageways shall be provided.

If cable trays for overhead road crossing are used, they shall be fitted at a suitable height in order to avoid any clashes with trucks, crane, etc.

Underground cable routings shall be marked up with suitable cable trench markers. An updated underground cable layout shall be available on site.

Before any digging, pile driving, trenching, excavation work permit shall be implemented on locations where underground cables are installed.

Cables shall be mechanically protected (armour, cover, etc.) and as far as possible, they should not be accessible to people.

All connections shall be properly terminated in terminal block assemblies (no use of plug and sockets for control circuits).

Cables shall be arranged in such a way that no strain is placed on the conductor's terminations.

All temporary cables shall be tagged.

HV cables shall be clearly identified from other cables (colour sheath, special marking, etc.).

Any cable sheath crack/damage shall be suitably repaired in due time by the Contractor.

Splicing shall be avoided as far as possible. However when splicing is unavoidable, special care shall be taken (electrically and mechanically protected).

4.3 ACS: Assembly for construction site

ACS definition: Low-voltage switchgear and controlgear assembly for construction sites is a combination of one or several transforming or switching devices with associated control, measuring, signaling, protective and regulating equipment complete with all their internal electrical and mechanical connections and structural parts, designed and built for use on all construction sites, indoors and outdoors.

The construction site installation is connected to the main electrical supply by main ACS followed by subsidiary ACS.

One subsidiary ACS shall be dedicated to fixed equipment only, or to mobile and portable equipment only.

Assembly shall be tagged and identified with the particular supply from which it is energised and shall contain only components supplied by the same electrical power sources excepted for control, signalisation and stand by power.

ACS rated voltage shall be clearly indicated.

4.3.1 Low voltage temporary assembly Short circuit current

In order to take care of all eventualities such as relocation, re-arrangement, various modifications, it is advisable to choose, for one construction site, all ACSs with the same short-circuit rating, based on the maximum prospective short-circuit current.

4.3.2 Incoming and outgoings

4.3.2.1 Incoming

ACS main distribution board and distribution board for fixed equipment shall be equipped as a minimum with:

- A general external switching device
- A general overcurrent protection (overload and short circuit)
- A general delayed residual current device for TT and TN-S system.

ACS for mobile and hand-held distribution shall be equipped as a minimum with:

- A general external switching device
- A general overcurrent protection (overload and short circuit).

4.3.2.2 Outgoing

Each outgoing circuit shall be equipped with a padlockable circuit breaker or fuse-switch. Circuit breaker shall preferably be used (Easy setting, replacement and resetting).

Hand held and mobile outgoings shall be equipped with 30 mA instantaneous differential circuit breakers. A general instantaneous residual current device (30 mA max) is acceptable.

All socket outlet circuits shall be protected by a 30 mA device.

4.3.3 Enclosure

Each ACS shall be fitted with supports to stand on a horizontal surface (e.g. feet or legs, articulated or not) and/or with fixing system attached to the enclosure or to the supporting framework for wall mounting installation.

Lifting rings and/or handles (or any other equivalent system) shall be provided on the ACS and be firmly attached to the enclosure or supporting framework.

4.3.4 Arrangement

Bus bar and termination compartment shall be suitably insulated or protected by barriers or enclosure in order to avoid access to live parts.

Only socket-outlets, operating handles and control buttons may be accessible without the use of a key or tool. A manual command of the main switch shall be easily accessible.

Openings for cable entries, cover plates, etc., shall be such that, when the cables, including their anchoring devices, are properly installed, the protective measures against contact with live parts and the degree of protection are obtained.

The cable compartment shall be at a minimum distance from the ground compatible with the bending radius of the largest cable that may be connected to the ACS.

4.3.5 ACS Installation

Sufficient working space shall be ensured around the ACS to permit adequate maintenance and operation of the equipment.

ACS shall be installed in a proper and dedicated area. Provisions shall be taken to protect the ACS by fences or barricades in case of external dangers (Crane, fall of tools, etc.).

Warning signs shall be installed.

4.3.6 ACS use and maintenance

It shall be verified that access during normal use on the installation is carried out by:

- ordinary persons for simple work, such as the connection of an appliance by a plug
- instructed persons for all other work, such as the replacement of fuses
- skilled persons for all work and operations necessitating access to live parts.

4.4 Plugs and socket-outlets

Socket outlets may be located inside or outside on the frame of the assemblies.

Sockets shall match to the local standard (pins, etc.) and have a current rating of at least 16 A (2P+E).

Plugs of different rated currents or voltages shall not be interchangeable in order to avoid connection's errors.

For power socket rated above 32 A (3P+E), phases plug in and separation shall only be possible offload.

Connections for three-phase socket-outlets shall be made in such a way to respect phases order.

4.5 Electrical arc welding

Connection between metal pieces to be weld and the welding machine shall be performed by cables with sufficient section and in good condition.

4.6 Hand - held and portable equipment

Portable equipment is an equipment which is moved while in operation or which can easily be moved from one place to another while connected to the supply

Hand-held equipment is a portable equipment intended to be held in the hand during normal use, in which the motor, if any, forms an integral part of the equipment.

Hand - held equipment includes tools, portable lighting and measurement devices

All electrical portable tools shall be fitted with dead-man switches

Flexible cable which supplies hand held equipment and portable lighting shall have an elastomer sheath around all the conductors.

Flexible cable shall include protective conductor for class 1 equipment supply.

Flexible cable sheath shall be maintained in good condition including at equipment and plugs connection where it is clamped by a stopping traction device. As far as possible, cables shall be mechanically protected.

Apparatus contacts of protective circuits shall be effective before phase connections and opened after phase disconnections. The same principle shall exist inside the internal wiring in case of cable breaking.

Circuit's galvanic separation shall be limited to a transformer supplying a single item of equipment by a flexible cable

5. Permanent electrical installation and electrical room

5.1 Permanent electrical installation

In all cases design of installation and equipment, earthing and bonding, maintenance procedure of the permanent electrical installation shall be implemented in accordance with local regulation.

All cables shall be in good condition and correctly lay.

Electrical rooms and areas with limited access to authorised personnel shall be properly locked.

Documentation on electrical installation shall be as built and available.

All electrical distribution equipment shall be properly identified.

Appropriate warning signs, and voltage level indication shall be visible.

All defective electrical equipment (plugs, luminaries, etc.) shall be repaired or replaced.

5.2 Electrical rooms

Electrical rooms shall be clean and correctly lit.

All signalisations on switchboard shall work, and no fault indicator shall be activated when equipment is in operation.



Switchboards and distribution panels shall be closed and direct access to live parts and terminations shall not be possible without tools.

Portable fire fighting equipment for electrical fire shall be located in the electrical room. This equipment shall normally be stamped with date of inspection.

6. Neutral Earthing system

Neutral earthing system shall be clearly identified and implemented.

TT and TNS systems are preferably used for construction site installation.

TN-C may be used in the fixed part of the installation, upstream of the main ACS.

When IT system is used, earth fault monitoring shall be provided for first fault detection. In case of first fault detection, its search and suppression should be carrying out quickly.

7. Earthing and bonding

Earthing and bonding shall be in accordance with local regulations.

7.1 Bonding

All fixed or portable electrical equipment frame shall be suitably earthed to the main grid system via a local equipotential connection (Green/Yellow cable).

Class II equipment shall be not connected to earth.

Each connection shall be made with green/Yellow copper conductor. Section of this conductor shall be equal to the section of the active conductor up to 16 mm², and shall be 35 mm² above.

For metallic structures (partition, floor, pylon, reinforcement, roof, equipment frame, etc.), this earthing connection shall be realised by means of stainless steel lug welded to the structures and connected to a local earth bar through a 35 mm² green/yellow conductor minimum.

7.2 Connections to earth

Provision for earthing shall be established at the beginning of the works.

Where an earthing electrode intended for the final electrical installation is established, it may be used for the site installation for the duration of the works.

If it is not possible, a temporary earthing electrode shall be installed (underground bare conductor at the bottom of a trench, or interconnected electrodes of galvanised steel at least 1 m long).

8. Lighting

8.1 Normal lighting

Lighting shall be provided in rooms, in strategic areas or in case of night works on the construction site.

It shall be sufficient to work safely.

It shall be installed in fixed positions and connected to avoid electrical shocks. It shall be regularly checked and changed in case of fault.



8.2 Emergency lighting

Emergency lighting shall allow evacuation of persons during a black-out of the normal lighting system.

Emergency lighting shall be installed in fixed positions, and shall have at least one hour autonomy. Use of self-contained units is highly recommended.

Lighting points shall indicate the route to follow for a safe evacuation.

9. Works inside restrictive conductive location

A **restrictive conducting location** is one comprised mainly of metallic or conductive surrounding parts, within which it is likely that a person will come in contact through a substantial portion of his body with the conductive surrounding parts and where the possibility of interrupting this contact is limited.

Electrical portable equipment to be used in such location shall be specified for works inside restrictive conductive location.

This equipment shall be supplied by security Extra Low Voltage up to 25 VAC. This supply could be direct or by separation transformer.

Portable lighting shall be class III or class II with 24 V lamps.

Separation transformer shall always be located outside the restrictive conductive location

10. Initial verification of the temporary electrical installation

Conformity of temporary electrical installations shall be performed by a Contractor representative prior to first start up and after any change (repair, maintenance, replacement, supply of new equipment, etc.).

This conformity shall be reported on a dedicated document dated and signed by the Contractor representative.

After each main modification and panel's movements an inspection shall be performed before restarting the installation.

Initial verification shall include at least:

- Visual inspection (protection against electric shock, warning sign installation, cable terminations and protection, ACS IP rating, circuit breakers and fused-switch rating, setting of protective devices, location of emergency switching devices)
- Checking of all electrical connections and cable integrity
- Continuity of the protective conductors and of the equipotential bonding
- Measurement of the insulation resistance of the installation (cables, equipment)
- Measurement of the resistance of the earth electrode (max 50 ohm)
- Residual current devices functional test
- Checking of temporary diesel generators and electrical welding machines bonding.



11. Periodic installation verification

The installation shall be daily supervised in order to find any defects and to prevent their recurrence.

For this purpose, an electrically skilled person, known by name to all the staff, must be responsible for the temporary installation supervision including:

- Maintenance of equipment
- Proper condition of connections and protective conductors
- Proper condition of flexible conductors and their connections to portable equipment and hand-held equipment
- The size and condition of the fuse elements, and the setting of the circuit-breakers to ensure that they are not unduly altered
- The proper functioning of residual protective devices.

12. Maintenance

In order to comply with safety requirements, the installation must be subject to maintenance procedures.

Maintenance works shall be carried out by instructed persons or skilled persons, from the contractor or not.

In all the cases they shall have the required abilities, the security training adapted to maintenance of electrical installations and a good knowledge of the installation.

Maintenance people shall be equipped with all the necessary equipment and all necessary individual and collective security material required for the work to be performed.

Work on electrical systems shall be subject to Permit to Work and Isolation Procedure (live electrical equipment shall be tagged and locked out prior to work is being carried out).

Temporary electrical installation dated and signed reports shall be available at any time for Company review.

Procedures regarding electrical equipment inspection and follow up shall be also available for Company review (Diesel Generator, fixed electrical switchboards, movable electrical switchboards, socket outlet switchboards, fixed tools movable, hand-held equipments, cables, etc.).

As built one line diagram and layout drawings of the temporary installation shall be updated regarding modifications and progress and shall be available for Company review.

13. Maintenance and inspection of hand-held equipment

Hand-held equipment shall be maintained and regularly inspected. Their flexible cable shall have no splice or visible wear.

Portative equipment shall be inspected at least once a year and the inspection date shall be written on a dedicated register with the name and the function of people who did it.



14. Other references

Following standards are applicable: [IEC 60038](#), [IEC 60050](#), [IEC 60059](#), [IEC 60245-4](#), [IEC 60439-4](#), [IEC 60529](#) IEC, [61200-704](#).