

CONSTRUCTION STANDARD
FOR
ELECTRICAL INSTALLATION

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1. SCOPE

1.1 This Standard Specification covers the requirements for installation, testing and setting to work, including the responsibility of contractor for maintenance period of the electrical installation associated with specified project.

2. SPECIFICATIONS, REGULATIONS, CODES AND STANDARDS

2.1 The work executed under this contract shall be carried out in accordance with the general conditions. Specification, Drawings, Orders, Rules and Regulations, Codes and Standards part thereof referred to herein where relevant.

2.1.1 Main contract documents.

2.1.2 Precommissioning test standard IPS-I-EL-217.

2.1.3 IPS Electrical Engineering, Standards.

2.1.4 Any special regulations laid down by the local utility services, such as power, water drainage, gas, and telecommunication governing the use of their services.

2.1.5 IPS Electrical standard drawings.

2.1.6 IPS safety regulations.

2.1.7 Earthing, bonding and lightning protection (IPS-E-EL-100/I).

2.1.8 آئین نامه های حفاظت و بهداشت کار (وزارت کار و امور اجتماعی)

2.2 Local Information

The contractor will be required to obtain any local information necessary to permit compliance with the above stipulations. Also to give notice to local Authorities (if required) to enable the electrical services to be made and requirement to be met in respect of approval of inspections and tests to which the installation is to comply.

2.3 On completion of fabrication the equipment shall be painted in accordance with IPS-E-TP-100 Table 3 painting standard.

3. CONSTRUCTION (INSTALLATION)

3.1 All installation work shall be carried out by skilled personnel in pertinent kind of installations.

3.2 The completed installation shall meet all requirement and to be carried out in accordance with relevant Rules, Regulations, Codes and Standards previously specified, and executed in good workmanship, to the satisfaction of Engineer.

3.3 All tools, measuring instruments and installation equipment for use by contractor shall be provided by himself.

3.4 Where special tools are recommended by the equipment Manufacturer, the Contractor shall conform to such recommendation.

4. EXAMINATION OF OWNER DRAWINGS AND LOCATION OF EQUIPMENT

4.1 The drawings indicate the extent and general arrangements of electrical equipment. Exact locations, distances and, levels will be governed by actual field conditions. The electrical contractor shall verify all dimensions in the field prior to the installation, as soon as possible and inform Engineer the discrepancies.

4.2 Changes

If any departures from the original intent of the drawings and or specifications are deemed necessary by the electrical Contractor, details of such departure with drawings, if necessary- together with reasons of departure shall be submitted to the owner as soon as practicable for approval. No such departure shall be made without the prior written consent of the Engineer. Phase and neutral colours plus the conductor numbering shall be clearly visible.

5. CABLES

5.1 All M.I.C.C cabling shall be neatly formed using levels and plumb lines.

5.2 Cables laid below ground shall be buried in accordance to the Company standard drawings unless otherwise specified in project drawings.

5.3 The cable shall be laid on a 100 mm sand base free from sharp protrusions and covered with 150 mm of sand. The cable run shall then be covered with concrete, brick cable covers with sufficient width to cover all cables in the run. To complete the installation, the trenches shall be backfilled and rammed with the soil originally removed. Routes deviations and location of joint boxes shall be indicated with concrete markers in accordance with standard drawings, by non-corrosive metal or plastic cleats at intervals on horizontal or vertical runs.

5.4 All cables shall be identified by their respective number stamped onto a lead tag and wired to the cable at each cable gland termination. Similar tags shall be attached to the cables at intervals of 3 meters in all situations other than in duct, but a tag must be wired to each cable where it enters or leaves a duct.

5.5 Where more than one cable is pulled through a duct or conduit, the cables shall be pulled through as a bunch and fed to eliminate crosses and abrasions of sheaths.

5.6 Cores of multi core control cables shall be identified by numbered beads or sleeves at the terminal of equipment.

5.7 Cables above ground shall be adequately supported on galvanized cable trays, fixed to steel brackets. cables shall be fixed or cleated to the trays.

5.8 On multiple cable runs the cables shall be neatly grouped and where bends are required, additional clipping to be used.

5.9 For bending radius of cables see Tables 9.1 to 9.5 in attachment to Electric System Design Standard No: IPS-E-EL-100/H.

5.10 Cable ducts or cable ways entering or leaving building shall be sealed at both ends by bitumastic compound or other accepted practices to prevent ingress of hydrocarbons, water etc., into cable.

5.11 Sufficient information is given in the project drawings to indicate the general routes of cables. Final route are to be determined on site and changes made only where absolutely necessary and with the approval of the Engineer.

On 3 and 4 core cables, phase colors to be: red, yellow, blue, and neutral color to be black.

On multi core control cables the same colour or number shall be used for each termination where identical duties are involved.

At termination points, where cable cores and conductors are connected to busbars, switches, terminal boards etc., the phases and neutral colors plus conductor labeling shall be clearly visible.

5.12 Glands for use with "PVCSWAPVC" and "PVCLCSWAPVC" cable shall be of the mechanical (non wiping) types flameproof or standard to suit the situation. A "PVC" shroud or lip shall be provided over the gland, where necessary

5.13 Glands for use with paper insulated cable (if any) shall be made of in hot compound filled cable boxes. The lead sheath shall be plumbed to the cable gland and the armour wires bonded, the earthing to be by adequately sized copper tapes. Care should be taken to ensure no air pockets occurs when filling the box with compound. The contractor shall employ a skilled cable jointer to carry out joints of this type, where necessary.

6. EARTHING OF ELECTRICAL CIRCUITS AND EQUIPMENT

6.1 The method used to connect metalwork to earth has to be compatible with the type of installation and its supply system. The requirement for the connection of metalwork of electrical equipment other than parts that are normally live on current carrying are specified in:

IPS E-EL-100-I "Earthing, Bonding and Lightning Protection"

6.2 However, in absence of earthing drawings:

All metallic structures, tanks, vessels pumps and other equipment shall be adequately bonded together and connected to the earth electrodes. Reference to be made to standard drawings

Notes:

a) Pipework joints where not electrically continuous shall be provided with copper jumpers.

b) Where insulated flanges are included in the pipe run in locations where cathodic protection is applied on pipe line, the application of jumper shall be avoided and special arresters to be used. This shall be coordinated with cathodics protection Engineer.

6.3 The jumperring method shall comply with accepted practice. Cadwelding or welding of studs or brackets to equipment shall have the approval of the Engineer before welding is commenced.

7. LIGHTNING AND STATIC EARTHING

7.1 The static earthing and bonding system shall be in accordance with the recommendation of BS 5958 where relevant..

8. MATERIALS

8.1 General

All materials provided by contractor shall be new and conform with the latest pertinent standard for the use and locations for which they are intended. All materials shall meet with the owner's approval.

8.2 Owner Supply

The electrical contractor shall take delivery of and install the items shown on the drawings, listed on the bill of materials and/or specified within the Contract documents as owner supplied materials.

The electrical contractor becomes responsible for owner supplied materials, upon receipt by the electric Contractor.

8.3 Electric Contractor Supply

All materials necessary for a complete operable electrical installation not designated owner supplied, shall be supplied and installed by the electrical contractor. Any material required or called for on the drawings and not listed in bill of materials shall be provided by the electrical contractor. Verification of quantities listed on the bill of materials is expected at early stages of work.

8.4 Expediting

It shall be the responsibility of the electrical contractor to determine what materials he must expedite to maintain the agreed construction schedules.

8.5 Delivery

It shall be the responsibility of the electrical contractor to provide on site, storage for all the electrical equipment and materials to keep them clean, dry and free from possible hazards in the field prior to installation.

9. EQUIPMENT INSTALLATIONS IN GENERAL

9.1 All electrical equipment such as rotating machinery, transformers, transformer-rectifiers switchgear and control-gear, M.C.C., protection system, batteries, charger, and 'UPS' shall be installed according to Company approved Manufacturer's instructions and engineering drawings, unless manufacturers are responsible for installation, of their delivered equipment.

For installation of electric equipment in hazardous areas see Clause 10 of this Standard.

10. ELECTRICAL INSTALLATIONS IN HAZARDOUS AREAS (POTENTIALLY EXPLOSIVE ATMOSPHERES)

When electrical work is carried out in hazardous areas requirement of IEC 79.14 shall be adhered to in conjunction with the area classification drawings and the following standards:

IPS-E-EL-110/1	"Area Classification and Extent"
IPS-E-EL-110/2	"Safe-Guarding in Hazardous Area"

11. STEELWORK FOR SWITCH-BOARD

Switchboard sole plates, unistrut or other mounting steel work shall be installed within the tolerance specified by the Manufacturer. The steelwork shall be installed electrically clear of floor reinforcing fabric.

12. INSTALLATION OF TRANSFORMERS

Large transformers shall be installed over an oil pit whose volume is compatible with the quantity of oil in transformer. Transformers can stand on skid or on caster.

While they have to be on caster, proper iron rail to allow movement of transformer shall be provided. Transformer base shall be surrounded by gravel as recommend on pertinent drawings.

13. STORAGE AND CARE OF ELECTRICAL EQUIPMENT

13.1 General checking of equipment materials, and electrical equipment and machinery shall be examined as soon as possible following arrival at the site.

Checking should be carried out against respective orders and specifications and where deficiencies or non compliance with an order occurs details shall immediately be notified, to site Engineer.

Wherever possible equipment shall be returned to its original packing for storage until required for use.

13.2 Storage and Protection

Methods of storage and the degree of protection required will vary according to the type of equipment and the area of operation concerned.

Details of storage accommodation and proposed methods of storage for electrical hardware should be discussed and agreed with site Engineer.

13.3 Cable Storage and Inspection

Underground cable supplied under a bulk order is delivered to site in a sequence largely dictated by the Manufacturer both in regard to volume and content of individual consignments. Initial site planning of cable storage space should be based on the overall volume of cable involved and convenience of handling to the various site locations.

As far as possible different types and sizes of cables should be segregated and grouped into single line formation with drum marking readily visible.

Adequate space should be left between drum formations to allow access for the heavy duty lifting equipment and transport involved. Cable deliveries shall be inspected on arrival at the site and checked against.

13.4 Storage in Outdoor Location

Generally storage should be provided in a secured and weatherproof building. Exception may be justified for items of equipment which form part of packaged unit for outdoor installation such motor drive etc., it should be noted however, that such equipment may not necessarily be fully protected until installation procedures have been completed, machined flanges associated with flameproof enclosures and cable glands are particularly vulnerable in this respect and equipment within this category should be carefully checked both before and during period of storage.

Electrical plant and equipment should be stored on a supported base above floor level and in outdoor locations, should be adequately covered to ensure protection against the local weather, environment etc., and in particular in rain, snow and dust as may be applicable. Any discrepancies or damage shall immediately be notified to site Engineer.

14. SURFACE HEAT TRACING

Where surface heat tracing comes under responsibility of electrical contractor it shall be coordinated among the Engineer, electric contractor, and cathodic protection contractor. No two flanges which are provided by insulator rings shall be jumpered.

No earthing shall be provided on pipelines unless discussed and agreed by the Engineer with due consideration to insulation ring for cathodic protection.

For standard of installation of surface heating see BS 6351 part 3: Code of practice for installation, testing and maintenance of electric surface heating system.

15. PAINTING OF ELECTRICAL INSTALLATIONS

The electrical contractor shall arrange for:

- a) Touch up of all electrical and control equipment marred by shipment or erection, using the same type of finish as the original.
- b) Paint all conduit works, trunking trays, lighting poles, lighting towers, lighting fitting etc. pertinent to electrical installation according to Company standard for painting (IPS-E-TP-100, Table 3).

16. LABELING AND IDENTIFICATION OF APPARATUS AND CIRCUITS

16.1 All electrical distribution apparatus shall have permanently fixed by danger labels with black lettering on a yellow background and shall comply with IEC 417 (traffolyte is adequate).

16.2 Each distribution board must be fitted with a circuit or distribution way list. Against each circuit, the designation and number of current consuming devices shall be shown and size of fuse to be given.

16.3 Switch fuses, busbar chamber and distribution boards shall be fitted with labels stating the voltage and phases, where it is fed from ? and where it is feeding to?

16.4 Any remote switch located out of sight of load it controls, shall be provided with labels stating the name of load and pertinent precautions to be taken while putting the remote switch in on or off position.

16.5 As appropriate all apparatus outgoing ways, outlets and extension outlets units shall have permanently fixed external labels to identify the connected apparatus and the source of supply.

17. CLEANUP AFTER COMPLETION OF WORK

17.1 The electrical contractor shall be responsible for keeping his works areas clean and free from debris and waste materials at all times.

The interior of all electrical boxes, cabinets, control panels, motor control centers etc., shall be cleaned of dust, dirt and loose materials. Wireways under computer floor etc., shall be kept free of moisture and debris, the above areas shall be vacuum cleaned to the satisfaction of owner.

17.2 All opening in chambers, panels, conduit work, and unused cable entries to be closed up or plugged to avoid entry of dust, rodents etc., to electrical installation.

18. PRELIMINARY INSPECTION AND CHECK

18.1 Every electrical installation shall be inspected and tested by installer before commissioning test, this is to ensure as far as practicable that all the requirements of the contract has been carried out and installation is ready for precommissioning. The contract requires that the test carried out shall not in any way be a danger to persons, property or equipment even if a circuit is faulty, it is important then that the following test are carried out wherever relevant before commissioning test:

- a)** Ring final circuit continuity when applicable.
- b)** Protective conductor continuity including bonding.
- c)** Measurement of earth electrode resistance.
- d)** Insulation resistance.
- e)** Insulation of site built assemblies.
- f)** Protection by electrical separation.
- g)** Protection by barriers and enclosures.
- h)** Verification of polarity.
- i)** Earth fault loop impedance.
- j)** Operation of residual current devices.
- k)** In double pole, 3 pole and 4 pole switches ensure that phase pass through the fuse and switch.
- l)** In hazardous areas ensure that phase(s) pass through the fuse(s) and switch(es) and neutral is linked (no fuse and directly connected to outgoing terminal of switch fuse).

18.2 Warning shall be affixed to electric installation regarding the frequency of inspection and testing.

"IEE Regulation 732.01.02 advises that the inspection and testing shall not cause danger to persons or livestock and shall not cause damage to property and equipment even if the circuit is defective and notice shall be provided for peri-

odic inspection and details of when it should be tested again". The period between tests may be 3-5 years depending on environmental and maintenance service, but this can be made less if this is thought appropriate by the Engineer.

18.3 The Engineer is entitled to inspect, examine and test the workmanship during the course of installation; any such inspection shall not release the contractor from his obligation under the contract. Any work in the opinion of the Engineer which is not upto standard shall be rectified at the Contractor own expense.

18.4 After completion of installation and preliminary check precommissioning (pre-accepting test) to be carried out in accordance with precommissioning test standard IPS-I-EL-217.

19. RETURN OF UNUSED MATERIALS AND EQUIPMENT TO CLIENT

At the end of the work contractor shall provide a list of unused materials and equipment for Company representative for return of them to Company store allocated for the purpose, unless otherwise specified in the contract.

20. PREPARATION OF AS BUILT DRAWINGS FOR CLIENT

A set of as built drawings shall be marked up by the electrical contractor in red on a daily basis. The owner shall have access to view this set of drawings at all times.

Before final acceptance of the work, the electrical contractor shall furnish the owner with one completely detailed set of as built drawings showing final locations and connections for all electrical work carried out. Such as built drawings shall includes all pertinent notes and dimensions necessary to show clearly the location and physical characteristics of all conduits, conductors and connections. As built drawing will be verified and shall not be deemed complete until they are to the satisfaction of owner

21. PREPARATION FOR PRECOMMISSIONING TESTS

- 1)** A program shall be provided for precommissioning test with the approval of Engineer.
- 2)** All provision such as testing equipment special tools and coordination for availability of power and all pertinent work permit shall be envisaged.

22. PROVISIONAL ACCEPTANCE OF ELECTRICAL INSTALLATION

After completion of installation, client shall provide provisional acceptance test certificate complete with defect lists (which shall be remedied in agreed time). When defects and cleared and inspection results are satisfactory acceptance certificate will be issued.