

1.0 GUIDELINES FOR INSTALLATION OF ELECTRICAL EQUIPMENT

1.1 All electrical equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, squat and properly aligned and oriented. Tolerances shall be as established in the Manufacturer's drawings.

1.2 Transformers

Care shall be taken during handling of insulating oil to prevent ingress of moisture or foreign matter. In the testing, circulating, filtering or otherwise handling of oil, rubber hoses shall not be used. Circulation and filtering of oil, heating of oil by regulated short circuit current during drying runs and sampling and testing of oil shall be in accordance with the Manufacturer's instructions and specified Code of Practice.

1.3 Switchgear, Control/Relay Panels

1.3.1 Switchgears and control relay panels/desks shall be installed in accordance with specified code of practice and the Manufacturer's instructions.

1.3.2 In joining shipping sections of the switchgear/panels/control centres together, adjacent housing or panel sections provided shall be bolted together after alignment has been completed.

1.4 Motors

The installation, commissioning of the motors shall be as per the applicable code of practice and the Manufacturer's instructions.

1.5 Battery and chargers

Each cell of the battery bank shall be inspected for breakage and condition of cover seals as soon as received at site. Each cell shall be filled with electrolyte in accordance with the Manufacturers instructions. Battery shall be set up on racks as soon as possible after receipt, utilising lifting devices supplied by the MANUFACTURER. The cells shall not be lifted by the terminals.

1.6 Switchyard

1.6.1 Switchyard equipment installation shall be carried out as required in the approved drawing/plan and elevation drawings of switchyard showing bus bar configurations, sizes, tensions, insulator details etc.

1.6.2 The above shall include installation of complete set of bus bars and all bays, conductors, complete with tension/suspension insulator strings, bus post insulators, equipment connections, bus bar connections to equipment, lightning shield wires including down comers where they shall be connected to the test links. Tube type conductor lengths shall be joined by welding procedure.

1.6.3 Installation work of breakers shall also include compressors with accessories whenever applicable and necessary adjustments/alignments for

proper operation of circuit breakers and their operating mechanisms. All insulators and bushings shall be protected against damage during installation.

**4.7.3. BLANK****4.7.4. Instruction Plates**

All plates showing designations or instructions for operation, safety, lubrication, etc. shall have a uniform design.

4.7.5. Nomenclature

Bay & LCC shall be named specifically for ensuring safety and clarity in operation.

4.8. Colour Code**4.8.1. Colour Coding For Electrical Connections**

Live parts of electrical connections shall be colour coded as follows:

Conductor Designation	Coding Alphanumeric	Symbol	Colour
A.C. NETWORK 3 PHASE	Phase 1	R	Red
	Phase 2	Y	Yellow
	Phase 3	B	Blue
	Neutral	N	Black
a.c. single phase	Phase	P	Red
	Neutral	N	Black
	Earth	E	Green-yellow
d.c. Network	POSITIVE	a	Red
	Negative	b	Black

4.9. Workmanship

The Contractor shall level and adjust all parts of the equipment on the foundations and after each item is set up and the Engineer's approval obtained, grouting or concreting will be carried out by other Contractors



and verified by the Contractor. The Contractor shall be responsible for ensuring that such work is carried out to his satisfaction and that levels and adjustments made by him are not disturbed by the grouting operation. The Contractor shall be responsible for ensuring that the positions, levels and dimensions of the Works are correct according to the drawings notwithstanding that he may have been assisted by the Engineer in setting out the said position, levels and dimensions.

4.9.1. BLANK

4.9.2. BLANK

4.9.3. BLANK



4.10.6. Priming

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4.10.6.2. Galvanising

Unless otherwise specified, all structural steel including ladders, platforms, hand rails and the like and all exterior and interior steel surfaces of outdoor Works, as well as bolts and nuts associated with galvanised parts shall be hot-dip galvanised, electrolytically galvanised or sheradized, as may be appropriate to the particular case.

Material:

For galvanising, only original blast furnace raw zinc shall be applied, which shall have a purity of 98.5%.

The thickness of the zinc coat shall be:

- For bolts and nuts, approx. 60 micrometer
- For all other parts, except for hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 70 micrometer
- For hydraulic steel structures or parts intermittently or permanently submerged in water, approx. 140 micrometer, in accordance with "VDEW, Druckrohrleitungen -Association of German Electricity Utility Companies, Steel Penstocks".

Cleaning:

All material to be galvanised shall be cleaned carefully of rust, loose scale, dirt, oil, grease, and other foreign matters. Particular care shall be taken to clean slag from welded areas.

Galvanising of plates and shapes:



Where pieces are of such lengths that they cannot be dipped in one operation, great care shall be exercised to prevent warping.

Finished compression members of steel structures shall not have lateral variations greater than one-thousandth of the axial length between the points, which are to be supported laterally. Finished tension members shall not have lateral variations exceeding 3 mm for each 1.50 m of length. Materials with sharp kinks or bends shall be rejected. All holes in material shall be free of excess spelter after galvanising.

Galvanising of hardware:

Bolts, nuts, washers, locknuts and similar hardware shall be galvanised in accordance with the relevant standards. Excess spelter shall be removed by centrifugal spinning.

Straightening after galvanising:

All plates and shapes, which have been warped by the galvanising process, shall be straightened by being re-rolled or pressed. The material shall not be hammered or otherwise straightened in a manner that will injure the protective coating. Materials that have been harmfully bent or warped in the process of fabrication or galvanising shall be rejected.

Repair of galvanising:

Material on which galvanising has been damaged shall be redipped unless the damage is local and can be repaired by soldering or by applying a galvanising repair compound; in this case, the compound shall be applied in accordance with the manufacturer's instructions.

Soldering shall be done with a soldering iron using 50/50% solder (tin and lead). Surplus flux or acid shall be washed off promptly and the work shall be performed so as not to damage the adjacent coating or the metal itself. Any member on which the galvanised coating becomes damaged after having been dipped twice shall be rejected.

4.10.7. Painting

4.10.7.1. Surface Preparation (Primed, Galvanised Or Stainless Steel Surfaces)

All surfaces to be painted shall be thoroughly cleaned by suitable means before application of paint. After cleaning the surfaces shall be rinsed in a manner that no residues will remain.



between the bottom blocks and the cable gland plate being a minimum of 200 mm. Sufficient terminals shall be provided to allow for the connection of all incoming and outgoing cables, including spare conductors and drain wires. In addition, 20 percent spare terminals shall be provided. In enclosed cubicles, the terminal blocks shall be inclined toward the door for facilitating terminations.

Terminals shall be of the channel mounting type and shall comprise a system of individual terminals so that terminal blocks can be formed for easy and convenient cabling consistent with the high reliability required of the circuits.

Terminal blocks shall be provided with shorting links and paralleling links where applicable and mounting identification numbers and/or letters.

Terminal blocks shall disconnecting link type for CT, PT and incoming supplies AC/DC & for balance fixed link type conforming to the applicable standards. The smallest size to be used shall be designated for 2.5-sq. mm wire and not more than two conductors shall be connected under one terminal clamp.

Terminal identification shall be provided corresponding to wire number of connected leads.

Circuit terminals for 415 V AC shall be segregated from other terminals and shall be equipped with nonflammable, transparent covers to prevent contact with live parts. Warning labels with red lettering shall be mounted thereon in a conspicuous position.

6.5.6. Equipment wiring

All wiring connections shall be readily accessible and removable for test or other purposes. Wiring between terminals of the various devices shall be point to point.

Splices or tee connections between terminal points are not acceptable. Wire runs shall be neatly trunked inside the panels or in wiring troughs. Whenever possible, unused areas of the panels shall be kept free of wiring to facilitate the installation of future equipments.

Multiconductor cables shall be connected to the terminal blocks in such a manner as to minimise crossovers. Approved claw washers of crimp type connector shall be used to terminate all small wiring. Each conductor shall be individually identified at both ends through a system providing ready and permanent identification, utilising slip-on ferrules approved by the Engineer.



Markers may be typed individually or made up from sets of numbers and letters firmly held in place. Open markers will not be accepted.

Markers must withstand a tropical environment and high humidity and only fungus proof materials will be accepted. Ferrules of adhesive type are not acceptable.

All trip circuits shall employ markers having a red background.

Sensitive control circuits shall be effectively shielded against extraneous signals and interference. A separate terminal shall be provided for termination of individual cable shields, which will be grounded at source end only.

6.5.7. Cubicles and control panels

Cubicles and control panel enclosures shall be of cold rolled sheet steel with minimum thickness for load bearing members as 2.5mm and non load bearing as 2 mm, of rigid, self-supporting construction and supplied with channel bases made to ensure no bulging takes place.

Cubicles shall be fitted with close fitting, gasketed, hinged, lift-off doors capable of being opened through 180 deg. The doors shall be provided with integral lock and master key.

Cubicles and panels shall be vermin proof. Removable gland plates shall be supplied and located to provide adequate working clearance for the termination of cables. Under no circumstances shall the floor/roof plate be used as a gland plate. The cables and wiring shall enter from bottom or top as approved or directed by the Engineer.

The cubicles and panels shall be adequately ventilated, if required, by vents or louvers, and shall be so placed as not to detract from the appearance. All ventilating openings shall be provided with corrosion-resistant metal screens or a suitable filter to prevent entrance of insects or vermin. Space heating elements with thermostatic control shall be included in each panel.

Where cubicles are split between panels for shipping, terminal blocks shall be provided on each side of the split with all necessary cable extensions across the splits. These cable extensions shall be confined within the panels with suitable internal cable ducts.

Unless stated otherwise, all cubicles and panels shall be provided with a ground bus with 40mm copper bar extending through out the length. Each end of this bus shall be drilled and provided with lugs for connecting ground cables ranging from 70 to 120mm².



6.7. Earthing System

The Contractor shall coordinate between the suppliers of Electro-Mechanical Equipment who shall design, supply and install the necessary earthing material and the sub contractor responsible for civil works during earth mat laying.

6.8. Labels and Plates

6.8.1. General

Labels and data plates shall be provided in accordance with applicable standards and as detailed hereunder.

The proposed material of the labels, size, exact label lettering and proposals for the arrangement of the labels shall be submitted to the Engineer for approval.

Where applicable, designations in the selected local language shall appear above or to the right of the designation in the Contract language. The translations into and writings in the local language shall be submitted for approval.

6.8.2. Equipment Labels and Instruction Plates

Labels written in the Contract language shall be provided for all instruments, relays, control switches, push buttons, indication lights, breakers, etc. In case of instruments, instrument switches and control switches, where the function is indicated on the device, no label is required. The label shall be fixed close to the devices in such a way that easy identification is possible. Fixing on the dial glass of instruments will not be accepted. The wording shall conform to the wording used in engineering documents.

Each separate construction unit (cubicle, panel, desk, box, etc.) shall be identified by its Works identification number. Cubicles and similar units shall also bear this identification number on the rear side if rear access is possible. The overall designation of each unit shall be given in the Contract language and - if required - also in a selected local language. These labels shall be made of anodised aluminium with black engraved inscriptions, arranged at the top section of the units. Manufacturer's trade labels shall - if desired - appear in the bottom section of the units.



- All protective measures, e.g., pumping, etc., to keep the various parts of the plant and the erection site free from water during the time of erection.
- Provision of cable and pipe ducts, trenches, block-outs, etc., in accordance with the drawings supplied by the Contractor and supervised by the Contractor.
- Adequate safety covers and protective measures against injury or damage to the Contractor's employees and equipment and to the works due to any operations in the civil works.
- If chequered plates or other covers provided under the civil contract require special care for fitting to plant and installations, such work (cutting, matching, welding of supports, etc.) shall be performed by the Contractor.



All Works inside cubicles, panels, boxes, etc., shall be properly labelled with their item number. This number shall be the same as indicated in the pertaining documents (wiring diagrams, Works list, etc.).

Instruction plates in the Contract and selected local language, the sequence diagrams or instructions for maintenance shall be fitted on the inside of the front door of the electrical switchboards.

6.8.3. Warning Labels

Warning labels shall be made of synthetic resin with letters engraved in the Contract and selected local language, where required in particular cases.

For indoor circuit breakers, starters, etc., transparent plastic material with suitably contrasting colours and engraved lettering would be acceptable.

Details are stated in the Particular Technical Specifications or will be fixed at a later date.

6.8.4. Labels for Conduits, etc.

The material shall be non-corrosive and the description be done with 4 mm high letters/figures.

6.8.5. Labels for Cables

Each cable when completely installed shall have permanently attached to each end and at intermediate positions as may be considered necessary by the Engineer, non-corrosive labels detailing identification number of the cable, voltage, and conductor size.

The cable identification numbers shall comply with those of the cable list.

All cables in cable pits and at the entry to buildings shall be labelled utilising the aforementioned type of label.

6.8.6. Rating Plates

Works (hoists, machines, transformers, etc.) rating plates and other technical data/informative plates shall either be of the enamelled type or be of stainless steel suitably protected after engraving with a transparent paint resistant to aggressive atmosphere and solar radiation.