CHAPTER 8: ELECTRICAL EQUIPMENT INSTALLATION AND COMMISSIONING

ELECTRICAL EQUIPMENT INSTALLATION AND COMMISSIONING

SCOPE

The below specification are general guidelines. If specific requirement is made for individual items, that will supersede the below details.

This chapter describes board guidelines for installations, testing and commissioning of electrical equipment. The work shall, however, be carried out strictly as per the instruction of the MANUFACTURER / EMPLPOYER.

CODES AND STANDARDS

The electrical installation work shall comply with the latest applicable standards, regulations, electricity rules and safety codes of the locality where the installation is carried out. Nothing in this specification shall be construed to relieve the CONTRACTOR OF HIS RESPONSIBILITY. If any IS/IEC/ Any Other International standard, is required during the detailed engineering stage, the same shall be provided by EPC without any additional cost.

GENERAL

The CONTRACTOR shall transport the equipments where required in actual position. Erect, assemble all parts of the equipments and test and commission the same. The CONTRACTOR shall furnish all tools, welding equipment, rigging materials, testing equipment, test connections and kits, etc. required for complete installation, testing and commissioning of the items included in the contract work. The EMPLOYER may engage specialist Employer to supervise the installation, testing and commissioning of their equipment. The CONTRACTOR shall extend full co-operation to these Employers and carry out the works as per their instructions. The CONTRACTOR'S work shall include minor rewiring modifications as may be necessitated during commissioning. Providing such assistance shall be deemed to be included in the CONTRACTOR'S basic scope. The CONTRACTOR shall co-operate through the EMPLOYER with other contractors at site, in all matters of common interest, so as not to abstract operation of others and to ensure the safety of all personnel and works covered under this specification. It will be the CONTRACTORS responsibility to assist the OWNER to obtain approval/ clearance from local statutory authorities including electrical inspector, wherever applicable, for conducting any work or for installation carried out which comes under the purview of such authorities. The work shall be carried out strictly as per the instructions and layout drawings of the EMPLOYER/ manufacturer. In case of any doubt/ misunderstanding as to correct interpretation of the drawings or instructions, necessary clarifications shall be obtained from the EMPLOYER. The CONTRACTOR shall be held responsible for any damage to the equipment consequent to not following the MANUFACTURER'S instructions correctly. All necessary drawings/MANUFACTURER'S equipment manuals will have to be arranged by the contractor as this is a Turn-key contract.

All thefts of equipment/component parts till the including executed portion handed over to the EMPLOYER shall be made good by the CONTRACTOR.

The CONTRACTOR shall have a separate cleaning gang to clean all equipment during erection and as well as the work area and the project site at regular intervals to the satisfaction of the EMPLOYER. In case the cleaning is not to the Employer's satisfaction, he will have the right to carry out the cleaning operations and any expenditure incurred by the OWNER in this regard will be the CONTRACTOR'S account.

In order to avoid hazards to personnel moving around the equipment such as switcher etc. which is kept charged after installation before commissioning, such equipment shall be suitably cordoned off to prevent any one accidentally going near it.

Safety of the Contractor's personnel engaged in erection and commissioning job will be Contractor's responsibility.

The CONTRACTOR shall carry out touch-up painting on any equipment indicated by the EMPLOYER if the finish paint on the equipment is soiled for marred during installation handling.

The CONTRACTOR shall ensure workmanship of good quality and shall assign qualified supervisors/Employers and competent labour who are skilled, careful and experienced in their several trades in similar works. The EMPLOYER shall reserve the right to reject non-competent persons employed by the CONTRACTOR, if the workmanship is not of good order.

It shall be the responsibility of the CONTRACTOR to obtain necessary Licence/ Authorisation, Permit for work from the Licensing Board of the Locality/ state where the work is to be carried out. The persons deputed by the CONTRACTOR'S firm should also hold valid permits issued or recognized by the Licensing Board of the locality/State where the work is to be carried out. A list of the personnel engaged in erection and commissioning work should be submitted to the Employer before commencement of the work.

INSTALLATION WORK SCOPE

Equipment shall be installed in neat, workmanlike manners so that it is level, plump, square and properly aligned and oriented. Tolerances shall be established in the Manufacturer's drawings or as stipulated by the EMPLOYER. No equipment shall be permanently bolted down to foundation or structure until the alignment has been checked and found acceptable by the EMPLOYER.

Care shall be exercised in handling to avoid distortion to stationary structures, the marring of finish, or damaging of delicate instruments or other electrical parts. Adjustment shall be made as necessary to the stationary structures for plumb and level, for the sake of appearance or to avoid twisting of frames, binding of hanged members, etc.

The CONTRACTOR shall move all equipment into the respective building through the regular doors or floor opening provided specially for lifting the equipment.

All external cabling including end connections and earthling shall also be carried out.

POWER AND INSTRUMENT TRANSFORMERS

Physical inspection on receipt, storage, installation, testing and commissioning of transformers shall be in accordance with the specified code of practice and Manufacturer's instructions.

Transformer may be delivered without oil filled with inert gas and without bushings and external mounted accessories. As applicable, the CONTRACTOR shall.

Assemble the transformers with all fittings such as bushings, cooler banks, radiator, conservators, valves, piping, cables boxes, marshalling boxes OLTC, cooling fans/pumps, etc.

Arrange for vacuum and oil filtration of the transformers. Oil filtration shall be done as per the standard practice. Oil tanker in this effect are to be used and filtration to be done while the oil is inside the tanker. On getting the standard value of the oils the same shall be pushed into the main tank and other portion of the transformer. Final filtration to be done after entire oil is filled in the transformer. Prior to that vacuum treatment of the tank of the transformer with the windings are to be taken up.

Provide wedges/clamps to rigidly station all transformers on rails.

Connect up the transformer's terminals.

Lay and terminate cables/ conduits between all the accessories mounted on the transformer tank/cooler and the transformer-marshalling kiosk and RTCC panels etc.

Pre commissioning checks shall be carried out as per relevant standards and Employer's instructions.

The CONTRACTOR shall arrange the oil filtration equipment.

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, the 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.

SWITCHGEAR, CONTROL/ RELAY PANELS

Switchgears and control relay panels/desks shall be installed in accordance with specified Code of Practice and the Manufacturer's instructions. The switchgear panels shall be installed on finished surfaces or concrete or steel sills. The CONTRACTOR shall be required to install and align and channel sills which form part of the foundations. In joining shipping sections of the switchgear/panels /control centers together with adjacent housing or panes sections provided shall be bolted together after alignment has been completed. Power bus, enclosures, ground and control splices of conventional nature shall be cleaned and bolted together, being drawn up with torque wrench of proper size or by other approved means. Tape or compound shall be applied where called for by the MANUFACTURER'S drawings.

The CONTRACTOR shall take utmost care in handling instruments. Relays and other delicate mechanisms. Wherever the instruments and relays are supplied separately, they shall be mounted only after the associated control panel/desks have been erected and aligned. The blocking materials/mechanism employed for the safe transit of the instruments and relays shall be removed after ensuring that the panels/desks have been completely installed and no further movement of the same would be necessary. Any damage to relays and instruments shall be immediately reported to the EMPLOYER and shall have to be rectified at contractor's cost.

Pre-commissioning checks on relays have to be carried out on all relays in accordance with manufacturer's instruction and in presence of Employer.

BATTERY AND CHARGERS

Installation and testing of battery and battery chargers shall be done in strict compliance with the manufacturer's instructions. Each cell shall be inspected for break ate and condition of cover seals as soon as received at site. Each cell shall be filled with electrolyte

in accordance with the MANUFACTURER'S instructions. Battery shall be set up on racks as soon as possible after receipt, utilizing lifting devices supplied by the MANUFACTURER. The cells shall not be lifted by the terminals. Contact surfaces of battery terminals and inter-cell connectors shall be cleaned, coated with protective grease and assembled. Each connection shall be properly tightened. Each cell shall be tested with hydrometer and results logged. Freshening charge, if required, shall be added. When turned over to the EMPLOYER, the battery shall be fully charged and electrolyte shall be at full level and of specified specific gravity.

Battery shall be put in commercial use only after carrying out charge/discharge cycle as per Manufacturer's instruction.

SWITCHYARD

The CONTRACTOR shall carry out switchyard installation as required as per approved plan and elevation drawings of switchyard showing bus bar configurations, sizes, tensions, insulator details, etc. All equipment including connectors (unless otherwise specified) will be supplied by the VENDOR. The bus bar arrangement shall be:

One & Half Breaker – 400kV (both AIS & GIS)

Main Bus-1 and Main Bus-2 (Two Main) / (for GIS) (Double Main cum Transfer / Double Main and Transfer for AIS)

Main Bus-1 and Main Bus-2 (Two Main) (for GIS) Main bus and transfer bus - 132 KV side (for AIS). Single Bus with Sectionalizer for 33kV AIS

The CONTRACTOR shall install complete set of bus bars and all bays' conductors complete with tension with tension suspension insulator strings, bus-post insulators, equipment connections, bus bar connections to equipment, lightning shield wires including down comers up to a height of 1000

mm. From ground level where they shall be connected to the Employer's test links.

Installation work of breakers and isolators shall include adjustment/ alignments necessary for proper operation of circuit breakers, isolators and their operating mechanisms. All insulators and bushings shall be protected against damage during installation. Insulators and bushings damaged due to negligence or carelessness of the CONTRACTOR shall not be in any way accepted and shall be replaced by him at his expense.

General requirements of Installation of Cabling:

The supplier shall install, test and commission the cables. Cables shall be laid on cable trays and supports, in conduits and doctor or bare on walls, ceiling, etc. as required. The supplier's scope of work includes laying, fixing, jointing, bending and terminating cables. The supplier shall also supply necessary materials and equipment required for jointing and terminating of cables. The supplier shall prepare detailed layout drawing for cable trenches, cable tray layouts for approval by Employer and construct cable routes strictly according to these drawings.

Sharp bending, twisting and kinking of cables shall be avoided. The bending radius for various types of cables shall not be less than those specified by cable manufacturer.

In each cable run, some extra length shall be kept at a suitable point to enable one or two straight through joints to be made. Should the cable develop fault at a later date.

Cable joints in the middle of the run for control cables will not be an accepted.

All cable terminations shall be made in a neat. Workmanlike manner. Terminations shall be made for each type of wire or cable in accordance with instructions issued by cable manufacturers and the Employer.

Metal sheath and Armour of the cable shall be bounded to the earthing system of the sub- station.

GENERAL REQUIREMENTS OF INSTALLATION FOR CONDUITS, PIPES AND DUCTS.

The supplier shall supply and install conduits pipes (PVC thick but flexible suitable for taking inside the roof and walls) and ducts as necessary for the lighting system. All accessories/fittings required for making installation complete. Including but not limited to ordinary and inspection tees and elbows, check nuts, make and female reducers and enlargers, wooden plugs, caps, squat headed male plugs, nipples, gland sealing fittings, motion boxes, pull boxes, conduit outlets, outlet boxes, splice boxes, terminal boxes, glands, gaskets and box covers, saddles and all steel supporting work shall be supplied. Conduit fittings shall be of the galvanized one. Flexible metallic conduits shall be used for termination of connections to equipment such as motors or other apparatus to be disconnected at periodic intervals.

Conduits (thick and flexible PVC) and accessories shall be adequately protected against mechanical damage as well as corrosion.

GENERAL REQUIREMENTS OF INSTALLATION FOR EARTHING AND LIGHTNING PROTECTION SYSTEMS

SCOPE OF INSTALLATION

The supplier shall install steel conductors (GI flats) and braids, as required for system and individual equipment earthing. All work such as cutting, bending, supporting, painting coating drilling, brazing/soldering/welding, clamping, bolting and connection on to structures, equipment frames, terminals, rails or other devices shall be in the scope of work. All incidental hardware and consumables such as fixing cleats/clamps. Anchor fasteners, lugs, bolts, nuts, washers, bituminous compound, anticorrosive paints as required for the complete work shall be deemed to be included as part of the installation work.

The quantities, sizes and material of earthing conductors and electrodes to be installed and routes of the conductors and location of the electrodes shall be as per specification mentioned elsewhere and approved drawings for the optimal capacity of the Sub-station taking the future requirement in to account.

The scope of installation of earth conductors in outdoor areas, buried in ground shall include excavation in earth at least up to 700 mm. Deep and 450 mm, wide (unless otherwise stated), brazing/welding as required of main grid conductor joints as well as risers of 500 mm. Length above ground at required locations and back filling. Backfilling material to be placed over buried conductor shall be free from stones and other harmful mixtures. Backfill shall be placed in layers of 150 mm, uniformly spread along the ditch and tempered utilizing pneumatic tempers or other approved means.

The scope of installation of earth connection leads to equipment and risers on steel structures/walls shall include laying the conductors, welding/ cleating, at specified intervals, welding/brazing to the main earth grids risers, bolting at equipment terminals and coating welded/brazed joints by bituminous paint. Galvanized conductors shall be touched up with zinc rich paint, where holes are drilled at site for holding to equipment/ structure.

The electrodes shall be installed either directly in earth or in constructed earth pits as shown in approved drawings.

The scope of installation of lightning conductors on the roof of buildings shall include laying, anchoring, fastening and cleating of horizontal conductors, grouting of vertical rods where necessary, laying, fastening/cleating/welding of the down comers on the walls/columns of the building and connection to the test links above the ground level.

The scope of installation of the test links shall include mounting of the same at specified height on wall/column by suitable brackets and connections of the test link to the earth electrodes.

Earthing connections:

All connections in the main earth conductors buried in earth/concrete shall be welded/brazed type. Connection between main earthing conductor and earth leads shall also be of welded/brazed type.

Welding and brazing operations and fluxes/alloys shall be of approved standards.

All connections shall be of low resistance. Contact resistances shall also be minimum.

All bi-metallic connections shall be treated with suitable compound to prevent moisture ingress.

Earth Electrodes:

Electrodes shall as far as practicable, be embedded below permanent moisture level.

Pipe electrodes shall be housed in test pits with concrete covers for periodic testing of earthing resistively

pipe electrodes in test pits shall be convenient for inspection, testing and watering.

Earth pits shall be treated with salt, charcoal and bentonite where ever required.

Soil, salt and charcoal placed around the electrode shall be finely graded free from stones and other harmful mixtures. Backfill shall be placed in the layers of 250 mm. Thick uniformly spread and compacted. If excavated soils are found unsuitable for backfilling, the contractor shall arrange for a suitable soil from outside.

TESTING OF EARTHING SYSTEM

The Supplier shall ensure the continuity of all conductors and joints. The Purchaser may ask for earth continuity tests, earth resistance measurements and other tests, which in his opinion are necessary to prove that the system is in accordance with the design, specifications and code of practices. The supplier shall have to bear the cost of all such tests.

GENERAL REQUIREMENTS OF INSTALLATION FOR LIGHTNING SYSTEM AND POWER RECEPTACLES

The supplier shall supply, install, test and commission complete lighting system and power receptacles in accordance with relevant Standards. Concealed conduit wiring (thick flexible PVC pipes suitable for taking inside the roof and walls) shall be adopted for the control building.

Wiring shall be colour-coded so as to enable easy identification of phase and neutral conductors, and DC wire (colour-coded as follows – white – phase wire, black – neutral wire, grey / DC wires.)

There shall be switch on each live conductor of supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in neutral wire in the form of switch or fuse unit.

Fixtures shall be ground by 1.5sq mm. flexible PVC copper wires (green colour) and taken to earth strips.

All fixtures, associated accessories, conduits, wires, junction boxes, cables, switches, switch boxes, etc. required for complete wiring of the lighting system as per approved drawings shall be supplied.

TESTING AND COMMISSION

All checks and tests as per the Manufacturer's drawings/manuals, relevant code of installation/erection practices and commissioning checks for various types of equipment e.g. transformers, breakers, isolators, CTs, PTs, motors, relays, meters, etc. shall be carried out by the CONTRACTOR as part of the installation work.

The owner may ask for such additional tests on site as in his opinion are necessary to determine that the works comply with the specification, Manufacturer's guarantee/instructions or the applicable code of installation. The CONTRACTOR shall carry out such additional tests also.

The CONTRACTOR shall perform operating tests on all switchgear and panels to verify operation of switchgear/panels and correctness of the inter-connections between various items of the equipment. This shall be done by applying normal AC or DC voltage to the circuits and operating the equipment for functional checking of all control circuits e.g. closing, tripping, control interlock supervision and alarm circuits. All connections in the switchgear shall be tested from point for possible ground or short circuit.

Insulation resistance tests shall be carried out by following rating megger:

Control circuits up to 220 V : By 500 V Megger

Power circuits, busbars : By 5000 Motor connections for 132 KV. Operated Megger.

Power circuits, busbars : By 5000 V Motor connections above 220 KV. Operated Megger.

The Employer's authorized representative shall be present during every test as called for by the EMPLOYER. The CONTRACTOR shall record all test values and furnish the required copies of the test data to the EMPLOYER. Electrical circuits and equipments shall be energized or used at nominal operating voltage only after such reports have been accepted as satisfactory by the EMPLOYER.

COMPLETION CHECKS

Name plate details according to approved drawings/ specifications.

Any physical damage or defect and cleanliness.

Tightness of all bolts, clamps and connections

Oil leakages and oil level.

Condition of accessories and their completeness.

Clearances.

Earthing connections.

Correctness of installation with respect to approved drawings/ specifications.

Lubrication Moving parts.

Alignment.

Correctness and condition of connections.

COMMISSIONING TESTS

Insulation resistance measurement of equipment, accessories, cabling/ wiring. etc.

Dielectric tests on equipment, accessories, cabling/wires. etc.

Phase sequence and polarity.

Voltage and current ratios.

Vector group.

Resistance measurement of winding. Contacts, etc.

Continuity tests.

Calibration of indicators, meters, relays. etc.

Control and interlock checks.

Settings of equipment accessories.

Checking of accuracy/error.

Checking of operating characteristics, pick/up voltages and currents. Etc.

Operational and functional tests on equipment, accessories, control schemes, alarm/ trip/ indication circuits, etc.

Measurement of guaranteed/approved design values including lighting levels, earth resistance measurements, etc.

Complete system commissioning checks.