

**KARNATAKA POWER TRANSMISSION CORPORATION LIMITED**

**SECTION – ELECTRICAL EQUIPMENT INSTALLATION  
WORK**

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## **1.0      SCOPE**

This specification details the guidelines for work associated with installation, testing and commissioning of various electrical equipment including switchyard equipment. The work shall, however, at all times be carried out strictly as per the instructions of the OWNER/ENGINEER/MANUFACTURER and as per approved drawings where relevant. The scope of work shall be as indicated in Price Schedule.

## **2.0      CODES AND STANDARDS**

- 2.1      The electrical installation work shall confirm to the latest /applicable electricity rules, currently applicable standards, codes of practice indicated in Data Sheet A2, regulations and safety codes of the locality where the installation is to be carried out. In case of conflict between these standards and this specification, requirements of this specification shall govern. Nothing in this specification shall be construed to relieve the CONTRACTOR of his responsibility.
- 2.2      All codes and standards referred to in the specification shall be understood to be the latest version on the date of offer made by the bidder unless otherwise indicated.
- 2.3      The CONTRACTOR shall ensure that instruments and gauges to be used for testing and inspection of critical parameters as identified in the specification have valid calibration and the accuracy can be traced to National Standards.

## **3.0      GENERAL SCOPE**

- 3.1      The CONTRACTOR shall take over the equipment to be erected from the OWNER's storage yard/stores/sheds/railway siding, transport the equipments where required in actual position, erect, assemble all parts of the equipments, test and commission the same.
- 3.2      The work shall be carried out strictly as per the instructions and layout drawings of the OWNER/ENGINEER/MANUFACTURER. In case of any doubt/misunderstanding as to correct interpretation of the drawings or instructions,

necessary clarifications shall be obtained from the OWNER/ENGINEER. The CONTRACTOR shall be held responsible for any damage to the equipment consequent to not following the instructions correctly. MANUFACTURER's equipment manuals will be furnished to the CONTRACTOR who shall return the same after completion of work.

- 3.3 The CONTRACTOR shall furnish all tools, ladders, scaffolding, welding equipment, rigging materials, testing equipment, test kits etc. required for complete installation, testing and commissioning of the items included in the contract work.
- 3.4 The OWNER may engage specialist engineers from the equipment MANUFACTURERS to supervise the installation, testing and commissioning of their equipment. The CONTRACTOR shall extend full cooperation to these engineers 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.
- 3.5 The CONTRACTOR shall cooperate through the OWNER/ENGINEER with other CONTRACTORS at site, in all matters of common interest, so as not to obstruct operation of others and to ensure the safety of all personnel and works at the site. In case of any conflict OWNER / ENGINEER's decision will be final and binding.
- 3.6 It will be the CONTRACTOR'S responsibility to assist the OWNER to obtain approval from local statutory authorities including Electrical Inspector, wherever applicable, for carrying out any work or for installation carried out which comes under the purview of such authorities.
- 3.7 It is the responsibility of the CONTRACTOR to provide watch & ward and security for the equipments/component parts covered in this contract. Any loss of equipment/component parts, after take over by the CONTRACTOR, till the installation is handed over to the OWNER, shall be made good by the CONTRACTOR.
- 3.8 The CONTRACTOR shall be responsible for cleaning all equipment under erection, under storage, the work area and the

project site at regular intervals to the satisfaction of the OWNER/ENGINEER. In case the cleaning is not to the OWNER'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 to the CONTRACTOR's account.

- 3.9 In order to avoid hazards to personnel moving around the equipment such as switchgear etc. which is kept charged after installation, before commissioning, such equipment shall be suitably cordoned off to prevent anyone accidentally going near it.
- 3.10 The CONTRACTOR shall carry out touch-up painting on any equipment, if the finish paint on the equipment is soiled or marred during installation/handling. The paint including primer thinner & shade of the paint to match with Purchaser's specification, shall be estimated & supplied by the CONTRACTOR on unit rate basis as called for in Section-F.
- 3.11 The CONTRACTOR shall ensure workmanship of good quality and shall assign qualified supervisors/engineers and competent labour who are skilled having valid licence/authorisation/work permit, careful and experienced in carrying out similar works. The OWNER/ENGINEER shall reserve the right to reject non-competent person employed by the CONTRACTOR, if the workmanship is not found satisfactory. Wherever required the CONTRACTOR shall include loaning of skilled/unskilled personnel for work by OWNER/other agencies, on Man-hour/Manday rates, for normal & overtime work to meet the project schedule.
- 3.12 It shall be the responsibility of the CONTRACTOR to obtain necessary Licence/ Authorisation/permit for work for his personnel from the Licencing 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 recognised by the Licencing Board of the locality/state where the work is to be carried out.

#### **4.0 INSTALLATION WORK SCOPE**

##### **4.1 TEMPORARY LIGHTING ARRANGEMENT FOR THE WORK AREA**

The CONTRACTOR shall on his own arrange for the temporary lighting arrangement for the work area to carry out the installation work in the plant premises.

4.2 CONSTRUCTION POWER

Construction power including power for testing and temporary lighting will be made available at one point & suitable number of outlets to cater to all the requirements shall be derived by the CONTRACTOR. CONTRACTOR will be charged for the power consumed as per the rates indicated in Price Schedule. Construction power equipment is deemed to be included in the scope of installation CONTRACTOR. Only the power required for load test of the equipment will be made available to the CONTRACTOR free of cost.

4.3 The CONTRACTOR shall install, test and commission the equipments furnished by the OWNER. The quantities, approximate sizes and weights of the equipments shall be as indicated in Schedule of Prices.

4.4 Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Tolerances shall be as established in the MANUFACTURER's drawings or as stipulated by the OWNER/ENGINEER. No equipment shall be permanently bolted down to foundation or structure until the alignment has been checked and found acceptable by the OWNER/ENGINEER.

4.5 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 hinged members etc.

4.6 The CONTRACTOR shall move all equipment into the respective buildings through the regular doors or floor/wall openings provided specifically for lifting/moving the equipment. Wherever the OWNER's crane is made available for lifting heavy equipment and materials, the CONTRACTOR shall move the equipment from storage site to the crane, attach to the crane

hook to the point(s) provided specifically for handling and install in final location. The CONTRACTOR shall submit time schedule to the OWNER, of the requirements for use of cranes. The CONTRACTOR shall make his own arrangement for lifting of the equipment when the OWNER's crane or cranes are not available. Operation of the OWNER's crane shall be by OWNER's personnel only. No part of the structure shall be utilised to lift or erect any equipment without prior permission of the OWNER/ ENGINEER.

- 4.7 Foundation work for all transformers, switchgears, motors, control panels/desks, neutral grounding equipment, cable trenches etc. will be carried out by the civil CONTRACTOR. However minor modifications to foundations, wherever found necessary for proper installation, shall be carried out by the CONTRACTOR. Base frames for switchgear/control panel when called for in Price Schedule shall be fabricated by the CONTRACTOR.
- 4.8 All external cabling including end connections and earthing will be carried out separately under cabling and earthing works respectively.
- 4.9 CONTRACTOR shall arrange for periodic inspection of the material/equipment in his custody until taken over by OWNER. CONTRACTOR shall also keep a check on the deliveries/stored equipment/material covered under his scope of erection. The CONTRACTOR shall advise OWNER well in advance regarding possible hold-up in his work due to expected delays in delivery of free issue of materials.
- 4.10 The CONTRACTOR shall include the following in his scope, whenever applicable.
  - 4.10.1 Supply & installation of danger/warning plates, labels, insulation rubber sheets/gloves, first aid chart & box, sand bucket, fire extinguishers etc., quantities shall be as indicated in Price Schedule.
  - 4.10.2 Danger/warning plate having text written in English, Hindi and applicable vernacular language shall be provided on all electrical equipment for voltages 415V and above. The boards shall have the skull and cross bones, danger sign, together with

the inscription, inscribed in white letters on red background. Electrical installation CONTRACTOR shall mount these boards at site on any of the equipment which are not provided with danger/warning plates. The danger/warning plates shall comply with IS:2551 and Indian Electricity Rules.

- 4.10.3 Site fabrication of items to meet specific situations eg. Junction boxes, wire mesh enclosures etc. of different sizes, as called for in Price Schedule of the specification.
- 4.10.4 Chipping and punching holes/openings in concrete floors/walls and brick walls and finishing them good and providing channels and embedments wherever required.

## **5.0 EQUIPMENT INSTALLATION**

### **5.1 SWITCHYARD**

- 5.1.1 The CONTRACTOR shall carryout switchyard installation as shown in the OWNER's drawings of switchyard showing busbar configurations, equipment layout lightning arresters, circuit breakers, isolators, CVTs, CTs, VTs, wave traps, bay marshalling boxes, reactors etc. All equipment including connectors (unless otherwise specified), will be supplied by the OWNER. The quantities of all equipment will be indicated in the Bill of Materials on the drawings and Price Schedule.
- 5.1.2 The CONTRACTOR shall install complete set of busbars and all bay conductors, complete with tension/suspension insulator strings, bus-post insulators, equipment connections, busbar connections to equipment, lightning shield wires including downcomers.
- 5.1.3 Installation work of breakers and isolators shall include all accessories wherever applicable and necessary adjustments/alignments required for proper operation of circuit breakers, isolators and their operating mechanisms. All insulators and bushings shall be protected against damage during installation. Insulators or bushings damaged due to negligence or carelessness of the CONTRACTOR shall be replaced by the CONTRACTOR at no extra expenses to OWNER and without altering the commissioning schedule.



- 5.1.4 Whenever specified in Section-C, the CONTRACTOR shall undertake the design, fabrication and installation of switchyard structures as per the OWNER/ENGINEER's requirements. The design calculations shall be furnished by the CONTRACTOR to the OWNER/ENGINEER for approval before the CONTRACTOR releases his drawings for fabrication work. The quantity of steel is indicated in Section-C & Price Schedule, the design requirements for each type of structure will be furnished to the CONTRACTOR.

## 5.2 TRANSFORMERS

- 5.2.1 Site inspection, storage, installation, testing and commissioning of transformers shall be in accordance with the specified code of practices, MANUFACTURER's instructions and the commissioning check list enclosed with the specification.
- 5.2.2 Normally transformers will be delivered without oil, filled with inert gas and without bushings and externally mounted accessories as applicable. The CONTRACTOR shall (a) assemble the transformers with all fittings such as bushings, cooler banks, radiators, conservators, valves, pipings, cable boxes, marshalling boxes, OLTC, cooling fans/pumps etc. (b) arrange for oil filtration before filling, (c) Provide wedges/clamps to rigidly station all transformers on rails, (d) connect up the transformer's terminals and (e) lay and terminate the cables/conduits between all the accessories mounted on the transformer tank/cooler and the transformer marshalling kiosk.
- 5.2.3 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/specified Code of Practice.

## 5.3 SWITCHGEARS, MCCS, PCCS, PDBS, CONTROL & RELAY PANELS

- 5.3.1 All the AC/DC Switchgears, MCCs, PCCs, PDBS and control and relay panels/desks, lighting distribution boards etc. shall be installed in accordance with specified Code of Practice,

drawings furnished and the MANUFACTURER's instructions and respective commissioning check lists enclosed with the specification. The switchgear/panels shall be installed on finished surfaces or concrete or steel sills. These panels may be bolted on to the foundation pockets or welded to base frame members as detailed in the drawings to be furnished to the CONTRACTOR. The CONTRACTOR shall be required to install and align any channel sills which form part of the foundations. Proper aligning, joining of various vertical shipping sections, busbar connections, inter panel wiring etc. will be the responsibility of the CONTRACTOR. 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. 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.

- 5.3.2 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 panels/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 OWNER/ENGINEER.

#### 5.4 BUSDUCT

- 5.4.1 Whenever called for, busducts (segregated/ non-segregated or isolated as the case may be) supplied by others, will have to be erected by the CONTRACTOR in accordance with specified code of practice, manufacturer's instructions and the drawings furnished by the VENDOR/OWNER. Indoor portion of the busduct may be supported from the floor or ceiling beams and outdoor portion of the busduct shall be supported from ground below on suitable foundation (which is by civil CONTRACTOR). Wall frame assembly shall also be installed as per VENDOR drawings, wherever called for.

#### 5.5 MOTORS

- 5.5.1 Unless otherwise specified, the motors will be installed by the driven equipment VENDOR. However, the CONTRACTOR under this specification shall undertake precommissioning checks and testing of the motors. The installation/commissioning shall be as per the applicable code of practice, MANUFACTURER's instructions and commissioning check list for motors enclosed with the specification.

5.6 BATTERY AND CHARGERS

- 5.6.1 Installation and testing of battery and battery chargers shall be carried out in strict compliance with the MANUFACTURER's instructions and commissioning check list enclosed with the specification. Each cell shall be inspected for breakage and condition of cover seals as soon as it is 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, utilising lifting devices supplied by the MANUFACTURER. The cells shall not be lifted by the terminals. Contact surfaces of battery terminals and intercell connectors shall be cleaned, coated with acid resistant grease and assembled. Each connection shall be properly tightened. Each cell shall be tested with hydrometer and thermometer and results logged. Freshening charge, if required, shall be added. When handed over to the OWNER, the battery shall be fully charged and electrolyte shall be at full level and of specified specific gravity.

5.7 NEUTRAL GROUNDING EQUIPMENT

- 5.7.1 The CONTRACTOR shall install, test and commission the neutral grounding equipment (NGR, NGT etc.) as per MANUFACTURER's instructions/relevant codes and standards and commissioning check list enclosed with the specification.

5.8 MISCELLANEOUS ITEMS

- 5.8.1 Whenever applicable, communication equipment, space heater panels, local starters, capacitors and every other electrical equipment within the plant premises shall be installed, tested and commissioned as per respective equipment VENDOR's instructions, relevant code of practice and the drawings

furnished by OWNER/VENDOR. Suitable brackets, angle/channel section for wall mounted equipment shall be provided by the CONTRACTOR.

## **6.0 TESTING AND COMMISSIONING**

- 6.1 All checks and tests as per the MANUFACTURER's drawings/manuals, relevant code of installation and the enclosed commissioning check lists for various types of equipment e.g. transformers, circuit breakers, isolators, lightning arresters, insulators, CVTs, wave traps, CTs, VTs, reactors, motors, relays, meters etc. shall be carried out by the CONTRACTOR as part of the installation work.
- 6.2 The OWNER may ask for such additional tests as in his opinion are necessary to determine that the works comply with the specification, MANUFACTURER guarantees/instructions or the applicable code of installation. The CONTRACTOR shall carry out such additional tests also.
- 6.3 The CONTRACTOR shall perform operating/functional tests on all switchgears and panels to verify operation of switchgear/panels and correctness of the interconnections 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 checks of all control circuits, e.g. closing, tripping, control interlock, supervision and alarm circuits. All connections in the switchgear shall be tested from point to point for possible ground or short-circuit.
- 6.4 All site connections and shortings and interpanel wiring etc. required to be carried out at site on terminals of any electrical equipment in the plant shall be carried out by the CONTRACTOR at no additional cost.
- 6.5 Insulation resistance tests shall be carried out by meggers of following ratings:
- (a) Control circuits upto 220V - by 500V megger
  - (b) Power circuits, busbars, connections upto 11 kV - by 1000V megger

- |     |  |                                     |
|-----|--|-------------------------------------|
| (c) | Power circuits, busbars<br>connections above 11 kV &<br>upto 33 kV | - by 2500V motor<br>operated megger |
| (d) | Power circuits, busbars,<br>connections above 33 kV                | - by 5000V motor<br>operated megger |

6.6 The CONTRACTOR shall make available the following Testing and Commissioning equipment for testing and commissioning of various equipment in the plant :

- 6.6.1 500V and 1000V hand operated meggers.
- 6.6.2 5000V/2500V motor operated meggers.
- 6.6.3 Earth resistivity testing equipment.
- 6.6.4 Phase sequence indicators.
- 6.6.5 Frequency meters.
- 6.6.6 Micrometers
- 6.6.7 High potential testing sets suitable for testing cables upto 33 kV grade complete with transformer, rectifier stack, instruments and control.
- 6.6.8 Miscellaneous instruments/accessories like clip-on ammeters, voltmeters, watt meters, multi-meters, power factor-meters, time-interval meters, single-phase and three-phase variacs, portable transformers, switches etc.
- 6.6.9 Continuity testers.
- 6.6.10 Primary injection equipment.
- 6.6.11 Secondary injection testing kit.
- 6.6.12 Insulating oil breakdown test set with accessories.
- 6.6.13 Equipment for measuring the thermal resistivity of the soil.
- 6.6.14 Transformer oil filtration equipment.

- 6.6.15 Relay test kits.
- 6.6.16 Breaker timing device for Circuit breaker opening/closing time measurement.
- 6.6.17 CT & VT testing apparatus.
- 6.6.18 Low resistance measuring instrument.
- 6.6.19 Partial discharge measuring equipment.
- 6.7 The OWNER's authorised representative shall be present during every test as called for by the OWNER. The CONTRACTOR shall record all test values and furnish the required copies of the test data to the OWNER. Electrical circuits and equipments shall be energised or used at normal operating voltage only after such reports have been accepted as satisfactory by the OWNER.

## DATA SHEET – A2

1.0	APPLICABLE STANDARDS	
1.1	INSTALLATION AND MAINTENANCE & SUPERVISION OF TRANSFORMERS	<input type="checkbox"/> IS : 10028 <input type="checkbox"/> BS : <input type="checkbox"/> IEC :
1.2	ELECTRICAL MAINTENANCE OF MINERAL INSULATING OIL IN EQUIPMENT	<input type="checkbox"/> IS: 1866 <input type="checkbox"/> BS : 15730 : <input type="checkbox"/> IEC: 422
1.3	INSTALLATION AND MAINTENANCE OF SWITCHGEAR & CONTROLGEAR	<input type="checkbox"/> IS : 10118
		<input type="checkbox"/> BS: 6423: CODE OF PRACTICE FOR MAINTENANCE OF ELECTRICAL SWITCHGEAR AND CONTROL GEAR FOR VOLTAGES UPTO AND INCLUDING 1 KV.
		<input type="checkbox"/> BS: 6867: CODE OF PRACTICE FOR MAINTENANCE OF ELECTRICAL SWITCHGEAR FOR VOLTAGES ABOVE 36 KV.
1.4	INSTALLATION & MAINTENANCE OF INDUCTION MOTORS	<input type="checkbox"/> IS : 900 <input type="checkbox"/> BS :
1.5	GUIDE FOR SAFETY PROCEDURES AND PRACTICES IN ELECTRICAL WORK	<input type="checkbox"/> IS : 5216 : <input type="checkbox"/> BS :
1.6	HOT DIP GALVANISING OF IRON & STEEL	<input type="checkbox"/> IS : 2629 : <input type="checkbox"/> BS :
1.7	CODES FOR WELDING	<input type="checkbox"/> IS : <input type="checkbox"/> BS : <input type="checkbox"/> IEC:
1.8	ELECTRICAL WIRING INSTALLATIONS VOLTAGE > 650 V	<input type="checkbox"/> IS : 732 <input type="checkbox"/> BS : <input type="checkbox"/> IEC:
1.9	FIRE SAFETY OF BUILDING (GENERAL) – ELECTRICAL INSTALLATIONS	<input type="checkbox"/> IS : 1646 <input type="checkbox"/> BS : <input type="checkbox"/> IEC:
1.10	DANGER NOTICE PLATES	<input type="checkbox"/> IS : 2551
1.11	INSULATING OIL	<input type="checkbox"/> IS : 335
1.12	INDIAN ELECTRICITY ACT - 1910 (as amended)	
1.13	ELECTRICITY SUPPLY ACT 1948 (as amended)	
1.14	INDIAN ELECTRICITY RULES, 1956 (as amended)	

### DATA SHEET – B

SR. NO.	ITEM		BIDDER
1.0	ITEMS OF SUPPLY (Wherever applicable)		
1.1	EQUIPMENT/STRUCTURES/ TOWERS :		
	Following will be fabricated, painted, galvanised and delivered to site. (a) (b) (c) (d) (e)	(In metric tons)	
1.1.1	Structures Painting Details (when applicable) (a) Type of primer and No. of Coats (b) Type , colour and no. of coats of finish paint		
2.0	<u>INSTALLATION WORK ITEMS</u> Equipment indicated in Price Schedule will be installed, tested and commissioned (indicate which items of work will not be undertaken)		Yes/No
2.1	<u>Tools</u> Following tools / equipment will be provided by the CONTRACTOR for the installation work and taken back after completion of work : (a) All necessary installation tools, tackles, welding and brazing equipment (b) Jacks for lifting transformers (if required) (c) Necessary oil filtration set (if required)		Yes/No  Yes/No  Yes/No



	(d) Oil testing set		Yes/No
	(e) All items covered in clause 6.6 of Section D of the specification.		Yes/No
<u>NOTE TO BIDDER</u> 1. ITEMS WHICH DEVIATE FROM THE SPECIFICATION SHOULD BE MARKED. 2. THIS DATA SHEET SHALL BE FILLED UP COMPLETELY AND A COPY SHALL BE ENCLOSED WITH EACH COPY OF THE BID.			SIGNATURE OF BIDDER   DATE