

## **17 Erection and Commissioning**

### **17.1 Scope of Work**

The scope of work shall cover complete and efficient erection, testing and commissioning and putting into successful commercial operation of all outdoor and indoor electrical equipment supplied under EPC Package.

The scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

### **17.2 Scope of Supply**

The work involves timely procurement and transportation to site in properly packed condition of all hardware, erection tools, implements and materials, labour, administrative, supervisory personnel and miscellaneous items etc. required to complete the erection job under this specification.

Miscellaneous steel structures, tray supports, hangers & brackets for cable trays, mounting of local panels, push button stations etc. shall be supplied. Any material or accessory, which may not have been specifically mentioned but which is usual and/or necessary shall be supplied.

All hardware, materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

Spare Parts

All relevant drawings, data sheet and technical leaflets on each piece of devices.

### **17.3 Scope of Services**

The work includes but is not limited to the followings:

Furnishing of all labour, skilled and unskilled, supervisory and administrative personnel, erection tools and tackles, testing equipment, implements, supplies, consumables and hardware for timely and efficient execution of the erection work.

Complete assembly, erection and connection, testing and commissioning, putting into successful and satisfactory commercial operation of all equipment and materials supplied under this package.

Hydraulic jacks or motorized jacks necessary for lifting of heavy equipment shall be provided by the Bidder.

Transport vehicles necessary for efficient transportation of equipment from Owner's stores to site of erection and excess materials back to Owner's stores.

Complete assembly, erection and connection, testing and commissioning, putting into successful and satisfactory commercial operations of the outdoor and indoor electrical equipment and accessories listed below but not limited to:

### **17.3.1 Power plant system**

- (a) Generator and Excitation system
- (b) Generator Transformers
- (c) Unit Transformers
- (d) Station Transformers
- (e) LV Transformer
- (f) Lighting Transformers
- (g) Stringing and Connections
- (h) Neutral Grounding Resistor Cubicles
- (i) Generator Busduct and auxiliary equipment.
- (j) 11/3.3 kV Busduct
- (k) 415 V Busduct/ Cables
- (l) 11 kV Switchgear
- (m) 3.3 kV Switchgear
- (n) 415 V Switchgears, Switchgear cum MCCs.
- (o) Motor Control Centres, AC/DC Distribution boards, Main lighting distribution boards and miscellaneous items.
- (p) Battery and Battery Chargers, Uninterrupted Power Supply Panels
- (q) Electrical Control Desks/Panels, Relay Panels, Data logger Panels etc.
- (r) Miscellaneous Local Panels.
- (s) Illumination system
- (t) Intercommunication and Telephone system
- (u) All electrical equipment and systems integral with mechanical equipment, systems and subsystems.
- (v) Emergency DG Set ( DG AMF Panel, DG MCC, DG Load Bank, Battery & battery Charger)
- (w) Generator Control / Misc. Panels :
- (x) PT & LA cabinet including fuse, PT,LA and Capacitor
- (y) Neutral Point Grounding transformer including dry type single phase tr., Secondary side resistance.
- (z) CT, Single phase disconnecter
- (aa) Regulator panel
- (bb) Converter/ suppression panel
- (cc) Field Grounding detector panel
- (dd) Manual excitation panel
- (ee) Generator protection panel:
- (ff) Generator Metering panel
- (gg) Generator fault recorder panel
- (hh) Terminal Box

The entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the Bidder for this purpose.

The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the Bidder. If, for any reason beyond the control of the Bidder, the work is held up then the Bidder shall bring it to the notice of the Owner's Engineer without any delay.

All erection work of equipment shall be carried out in a neat and efficient way so as not to impair their normal functioning in any way.

The pre commissioning checks as well as commissioning of different equipment shall be carried out as per guidance of actual manufacturer's supervisor and or as per written instructions in Erection manuals. In case of any site related problem in commissioning activities, Bidder shall seek advice of Owner's Engineers.

All erection work under this specification shall be carried out strictly in accordance with the approved drawings.

In order to avoid concentration of stresses, all sharp edges of clamps, connectors etc. shall be rounded off.

## **17.4 Design Criteria**

### **17.4.1 Equipment erection**

Equipment, conductors, hardware, insulators & clamps etc. installed in outdoor shall bear hot, humid & tropical atmosphere and will be used for extra high voltage system. All erection work shall be carried out in a neat and efficient way so as not to impair their normal functioning in any way.

The maximum temperature in any part of the clamps, connectors, conductors etc. at specified rating shall not exceed the permissible limits as stipulated in the relevant standards.

All equipment, conductors, clamps, connectors, insulators etc. shall be capable of withstanding the dynamic & thermal stresses of maximum short circuit current without any damage or deterioration.

Bi metallic connectors shall be used for any connection between dissimilar materials.

Expansion joints shall be provided in the Aluminium tube bus system, whenever necessary, to eliminate undue stresses on the equipment terminals and post insulator stacks.

Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply to all equipment.

The grounding system shall comply with Indian Electricity Rules, I.S. specifications & I.S. Code of Practice.

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## **17.5 Specific Requirements - Services**

### **17.5.1 Responsibility of erection**

The Bidder shall be fully and finally responsible for proper erection, safe and satisfactory operation of plant and equipment under his scope of work to the entire satisfaction of the Owner.

The work shall be executed in accordance with the directions, instructions, approved drawings and specifications.

Equipment and material which are wrongly installed shall be removed and re-installed to comply with the design requirement at the Bidder's expense, to the satisfaction of the Owner without any cost implication to Owner.

### **17.5.2 Extra work**

The Bidder shall, when requested by the Owner, perform extra work and furnish extra materials not covered under his scope of work, but necessary to complete the installation without any price implication.

### **17.5.3 Methods and workmanship**

All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

All details on installation shall be electrically and mechanically correct.

The installation shall be carried out in such a manner as to preserve access to other equipment installed.

### **17.5.4 Protection of work**

The Bidder shall effectively protect his work, equipment and materials under his custody from theft, damage or tampering.

Finished work where required shall be suitably covered to keep it clean and free from defacement or injury.

For protection of his work Bidder shall provide fencing and lighting arrangement, connect up space heaters and provide heating arrangement as necessary or directed by the Owner.

Bidder shall be held responsible for any loss or damage to equipment and material issued to him until the same is taken over by the Owner according to Contract.

Bidder shall insure his entire workman against accidental injury/ death. The Bidder shall also take out insurance policies which would cover the risk of losses/damages of his tools & tackle and material/equipment which is in his custody as also loss/ damages to any personnel.

#### **17.5.5 Safety measure**

All safety rules and codes as applicable to work shall be followed without exception.

All safety appliance and protective devices including belts, hand gloves, aprons, helmets, shields, goggles etc. shall be provided by the Bidder for his personnel.

The Bidder shall provide guards and prominently display caution notices if access to any equipment/area is considered unsafe and hazardous.

#### **17.5.6 Co-operation**

The Bidder shall at all times work in close coordination with the Owner's supervising personnel and afford them every facility to become familiar with erection and maintenance of the equipment.

The Bidder shall arrange his schedule of work and the method of operation to minimise inconvenience to other Bidders working on the project.

In case of any difference, the decision of the Owner's Engineer shall be final and binding on all parties concerned.

#### **17.5.7 Erection programme and progress**

The Bidder shall submit at such times and in such forms as may be requested by the Owner's Engineer, schedule showing the programme and the order in which the Bidder proposes to carry out the work with dates and estimated completion time for various parts of the work.

Such schedules shall be approved by the Owner prior to starting the erection. The Bidder shall adhere to this approved programme for all practical purposes. If for any reason the work is held up, the Bidder shall bring it to the attention of the Owner in writing without any delay.

During the progress of work the Bidder shall submit monthly progress report and such other reports on erection work and organisation as the Owner may direct.

If in the opinion of the Owner the progress of erection work by the Bidder at any stage needs expediting so as to ensure completion of work within stipulated time, the Owner shall have the right to instruct the Bidder to increase Bidder's manpower in appropriate categories and/or the working hours per day and/or erection tools and tackles and the Bidder shall comply with such instruction forthwith.

#### **17.5.8 Consumables and hardware**

The Bidder shall furnish all erection materials, hardware and consumables required for the completion of the installation.

The materials shall include but not be limited to the following:

- (a) Consumables: Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.
- (b) Hardware: Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.
- (c) Materials: Junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc.

Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Bidder.

#### **17.5.9 Erection tools and tackle**

The Bidder shall provide all tools, tackle, implements, mobile equipment such as crane, trailers, scaffoldings, ladders, welding machines, gas cutting, bending machine, hand cart, chain pulley blocks wire clues, hydraulic jack/motorised jack, wooden slipper, drill machine, hand/hydraulic compression tools for cable termination, vacuum cleaners box spanner of various size etc. which are required for transportation, handling and erection of the plant and equipment.

Special erection tools, if any & if supplied by the manufacturer along with the equipment may be used by the Bidder. Such tools shall be returned in good conditions to the Owner on completion of work.

Owner's tools and equipment may be made available on payment of charges if and when available.

#### **17.5.10 Testing equipment**

The major testing equipment that are required to be provided by the Bidder are listed below:

- (a) Insulation Tester
  - Power Operated Megger -2.5 kV, 5.0 kV and 10 kV Grade
  - Hand Operated Megger – 500 V and 1 kV Grade
- (b) Hand driven Earth Resistance Megger, range 0 1/3/30 Ohms.
- (c) High Potential Testing Set roller mounted type for LV, HV & EHV equipment
- (d) Tong testers of suitable ranges
- (e) Contact resistance measuring set for Micro ohms.
- (f) Torque wrench of various sizes
- (g) Multi-meters, test lamp, field telephone with buzzer set, spirit level, different gauges etc.
- (h) Insulating oil testing set of range 0 -60 kV.
- (i) Stream line filter for transformer.
- (j) Current Transformer for primary injection set
- (k) Relay testing and checking bench
- (l) Tan delta test kit

Other test equipment as required will be arranged by the Bidder.

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#### **17.5.11 Taking delivery**

The Bidder shall make his own arrangement to store all the materials supplied by him.

Materials delivered shall be stored or brought to the erection site or erected as necessary.

The Bidder shall submit a detailed account of materials after completion of work and transport back the excess materials to Owner's stores.

#### **17.5.12 Opening of case**

All packing cases and packages shall be opened in presence of Owner or his authorised representatives.

Packing cases shall be opened carefully to avoid damage to timber. Nails and strips shall be collected separately in boxes and not to be thrown away at random.

All packing materials, timbers, nails and strips shall become property of the Owner and shall be delivered to the Owner or disposed of as directed by the Owner.

#### **17.5.13 Checking and cleaning of parts**

All equipment, accessories and materials shall be carefully inspected and checked with packing list and identified with the erection drawings.

All parts shall be thoroughly cleaned, all rust removed and surface polished as required.

Cleaned and polished parts shall be coated with anticorrosive paints where necessary and stored with care, ready for erection.

### **17.6 Installation**

#### **17.6.1 General**

Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions/ recommendations where the same are available.

Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

All erection work shall be carried out in strict compliance with manufacturer's instructions and shall include all necessary adjustments, checks and measurements.

All internal wiring of the equipment which has been left incomplete because of shipping split or which requires minor modifications shall be carried out by the Bidder.

The Bidder shall record results of all erection tests and measurements. The Bidder shall submit copies of those test results to the Owner for his reference and record.

High voltage test of transformer oil shall be carried out taking samples from individual transformer and also from each insulating oil drum. If the result of di-electric test is not to the satisfaction of the Owner's Engineer, oil filtration, heat run and conditioning shall be carried out for the concerned transformer to improve the dielectric strength of oil and insulation to the acceptable value.

The storage and installation of transformer with all its accessories shall be carried out in strict compliance with manufacturer's instructions. Extreme care shall be taken to avoid ingress of moisture and foreign particles into the transformer tank.

Bidder should provide specific details of installation for following equipments:

- (a) Cabling and Grounding
- (b) Cable trays
- (c) Conduit and Accessories
- (d) Lightning protection

Above list is for reference only. Bidder needs to submit installation details of other equipments also.

#### **17.6.2 Steel fabrication**

All racks, supports, hangers and brackets wherever necessary shall be fabricated by the Bidder.

Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edges.

#### **17.6.3 Painting**

The Bidder shall paint all racks, supports and miscellaneous steel fabrication with two (2) coats of red oxide primer and two (2) coats of synthetic enamel paint of approved shade.

#### **17.6.4 Foundation and civil works**

Equipment foundations, equipment mounting structure foundation, panel foundations and other civil work will be provided by the Bidder.

The Bidder shall check these foundations before commencement of erection to ensure their suitability.

All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the Bidder including minor modification of civil work as may be required for erection.

#### **17.6.5 Cleaning up of work site**

The Bidder shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

Upon completion of work, the Bidder shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.



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## **17.7 Inspection and Testing plan**

### **17.7.1 Site tests**

Bidder shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit after erection and installation at site.

If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

All equipment shall be subject to High Potential test.

All protective relays shall be checked for correctness of operations.

All current transformers shall be subjected to Primary Injection test.

Generator Bus duct Polarisation Index (P.I. value) shall be measured.

### **17.7.2 Pre commissioning tests at site**

The installation of different type of equipment and accessory shall be tested by the Bidder after completion of his erection work with an advance notice to the Owner's Engineer concerned so that he may witness the same also.

The test result of any installation or equipment or its parts, if considered unsatisfactory to the Owner's Engineer, the concerned installation/equipment and its accessories shall be properly rectified and tested again to the satisfaction of the Owner's Engineer by the Bidder at his own cost.

The site tests to be carried out on completion of installation/erection of equipment are broadly to be listed for ready reference by Bidder.

The major testing equipment which will be necessary for carrying out pre commissioning tests at site are already listed in this specification. However, any testing equipment apart from listed above if required for testing purpose shall be made available by the bidder free of cost.

### **17.7.3 Commissioning and trial run**

Following successful inspection and testing, the equipment shall be commissioned and put on trial run along with the main plant in a manner mutually agreed upon based on the commissioning schedule of main plant.

The Bidder shall assist the Owner in commissioning and trial run with men and material as required and/or as directed by the Owner.

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#### **17.7.4 Taking over of installation**

On successful testing, commissioning and trial run, the Bidder shall request Owner in writing for taking over the installation.

The Owner, on receipt of the request, shall arrange to take over the installation either wholly or in part as the case may be after a final inspection.

Till such taking over, the responsibility of the whole installation against theft or damage of any kind shall remain with the Bidder.

#### **17.7.5 Guarantee**

In the installation if any trouble arises due to the use of defective or faulty material and/or bad workmanship within a period of 12 months from the date of taking over, the Bidder shall guarantee to replace or repair the defects to satisfaction of the Owner free of charge.