

**TECHNICAL QUALIFYING REQUIREMENT**

The bidder should have manufactured, type tested (as per IEC/IS or equivalent standard) and supplied 400kV or higher voltage class clamps and connectors as on the original date of technical bid opening of this tender.

**Remark:**

Document for proof of supplies need to be submitted along with the technical offer.

*proof of supplies can be PO copies, or  
MRC & invoice copies etc.*

*ayh*  
*31/08/21*  
PREPARED BY

*[Signature]*  
REVIEWED BY

*312011*  
*31/8/21*  
APPROVED BY

# BHARAT HEAVY ELECTRICALS LIMITED

## TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

|                                       |   |          |    |       |                                 |          |          |
|---------------------------------------|---|----------|----|-------|---------------------------------|----------|----------|
| DOCUMENT No.                          | TB-413-316-103  | Rev. No. | 00 |       | Prepared                        | Checked  | Approved |
| TYPE OF DOC.                          | TECHNICAL SPECIFICATION   |          |    | NAME  | DS                              | JK       | SKS      |
| TITLE<br><b>Clamps and Connectors</b> |   |          |    | SIGN  | <i>[Handwritten Signatures]</i> |          |          |
|                                       |   |          |    | DATE  | 16.06.21                        | 16.06.21 | 16.06.21 |
|                                       |   |          |    | GROUP | TBEM                            | W.O. No  |          |
| CUSTOMER                              | MAHARASHTRA STATE POWER GENERATION CO. LTD.<br>(MAHAGENCO)                          |          |    |       |                                 |          |          |
| PROJECT                               | 400KV SWITCHYARD- GT CONNECTION WORK- 1 X 600MW BHUSAWAL THERMAL POWER PLANT UNIT-6 |          |    |       |                                 |          |          |

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| <b>Rev No.</b>      | <b>Date</b> | <b>Altered</b> | <b>Checked</b> | <b>Approved</b> | <b>REVISION DETAILS</b> |                    |  |
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**SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.**

**[1] SCOPE**

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of Clamps & Connectors to site.

This section covers the scope, quantities, Specific Technical Requirements for Clamps & Connectors as specified by the customer. The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

**The specification comprises of following sections**

- Section-1 Scope, project specific technical requirements & bill of quantities.
- Section-2 Standard Technical Specification for Clamps & Connectors.
- Section-3 Project details & general technical Specifications for all the equipments under the project.
- Section-4 Annexures
  - Annexure-A (Compliance Certificate)
  - Annexure-B (Schedule of Technical Deviations)

In case of any discrepancies between the requirements mentioned under different Sections of technical specifications, order of precedence shall be as follows:

Section-1 shall precede Section-2, Section-2 shall precede Section-3.

In general, no deviation from the requirements specified in various clauses of this specification shall be allowed and hence, a certificate to this effect shall have to be furnished along with the offer (**Annexure-A**), however bidder shall furnish list of conflicts/ ambiguities/ deviations (if any) in *Schedule of Technical Deviations* (**Annexure-B**). Any conflicts/ ambiguities/ deviations mentioned elsewhere in technical offer shall not be reviewed. In case the

deviations mentioned in the *Schedule of Technical Deviations* are not technically acceptable, the offer of the bidder will be liable to rejection.

The scope of supplies shall be as per commercial terms and conditions enclosed separately with the enquiry.

**[2]** The Clamps & Connectors are required for the following Project

Customer: MAHARASHTRA STATE POWER GENERATION CO. LTD.  
(MAHAGENCO)

Project: 400KV SWITCHYARD- GT CONNECTION WORK- 1 X 600MW  
BHUSAWAL THERMAL POWER PLANT UNIT-6

**[3] SPECIFIC TECHNICAL REQUIREMENTS**

**System Fault Level & creepage**

| S.No | Description  |                              |
|------|--|------------------------------|
| 1    | Nominal system voltage   | <b>400 kV</b>                |
| 2    | Highest system voltage   | 420 kV                       |
| 3    | Current Rating   | 2000A                        |
|      | Maximum short circuit level  | 50kA for 3 sec               |
| 4    | Frequency  | 51 Hz $\pm$ 5%               |
| 5    | System Earthing  | Effectively earthed          |
| 6    | Spacing between sub-conductors of the bus                              | 450mm                        |
| 7    | Corona extinction Voltage  | 320kV                        |
| 8    | Max. Radio interference voltage for frequency between 0.5MHz and 2 MHz | 1000 microvolts at 266 kVrms |
| 9    | Creepage   | 31mm/kV                      |

**[4] OTHER TECHNICAL REQUIREMENTS:**

- 4.1** All equipment shall perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.
- 4.2** All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc. for the equipment.
- 4.3** The equipment shall also comply to facilitate erection of equipment, all items to be assembled at site shall be "match marked".

**[5] BILL OF QUANTITIES: Please refer Annexure\_BOQ**

- 5.1** Individual quantity may vary up to any extent however total contract value may vary up to  $\pm 20\%$ .
- 5.2** The scope of supply shall also include:
  - i) All connector hardware along with bimetallic washers / strip/liners as required.
  - ii) All hardware required for connecting to the respective equipment terminals.
  - iii) Minimum 5 % extra hardware and bimetallic washers/strips/liners of each type.

**[6] GTP/DRAWINGS**

Bidder to submit detailed GTP in line with technical specification during contract stage for review and approval, it will be the bidder's responsibility to get the same approved from the ultimate customer M/s MAHAGENCO/ DCPL.

**[7] QUALITY PLAN**

The contractor shall carry out contract works in accordance with sound quality management principles which shall include controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirements shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

**[8] TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE**

**Please refer Section-2 of technical specification for the details of type test requirement.**

All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

The reports for all type tests as per technical specification shall be furnished by the bidder along with equipment / material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located or as applicable).

Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within last 10 (Ten) years from the original date of technical bid opening of this tender.

In case the test reports are of the test conducted earlier than 10 (Ten) years from the original date of technical bid opening of this tender, the contractor shall repeat these test(s) at no extra cost to BHEL / MAHAGENCO.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost and time implication to BHEL / MAHAGENCO.

The Bidder shall intimate BHEL with the detailed program about the type tests at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

Note – (1.) Type test report shall be reviewed for approval in detailed engineering stage only. However, for evaluation purpose, the confirmation of valid type test reports is to be submitted along with the technical bid.

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## SECTION-2

### **17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS**

17.1 All power clamps and connectors shall conform to IS:5561 or other equivalent international standard and shall be made of materials listed below :

| <b>Sl. No.</b> | <b>Description</b>   | <b>Materials</b>  |
|----------------|--|---|
| a)             | For connecting ACSR conductors/AAC conductors/ Aluminium tube  | Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617   |
| b)             | For connecting equipment terminals mad of copper with ACSR conductors/AAC conductors/ Aluminium tube | Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner/strip and all test shall conform to IS:617 |
| c)             | For connecting G.I   | Galvanised mild steel shield wire   |
| d)             | Bolts, nuts & plain washers  | Electro-galvanised for sizes below M12, for others hot dip galvanised.  |
| e)             | Spring washers   | Electro-galvanised mild steel suitable for atleast service condition-3 as per IS:1573   |

17.2 Necessary clamps and connectors shall be supplied for all equipment and connections. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.

17.3 Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.

17.4 Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.

17.5 No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner/strip of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic liner/strips shall be provided for Bi-metallic clamps.

17.6 All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.

17.7 Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of IPS AL tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.

17.8 Current carrying parts (500A and above) of the clamp/connector shall be provided with minimum four numbers of bolts preferably for 132kV & above.

17.9 All current carrying parts shall be designed and manufactured to have minimum contact resistance.

17.10 Power Clamps and connectors shall be designed to control corona as per requirement.

#### **17.11 Tests**

Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for

## **SECTION-2**

approval. Type test once conducted shall hold good. The requirement of test conducted within last ten years, shall not be applicable.

- i) Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient)
  - ii) Short time current test
  - iii) Corona (dry) [for 400kV and above] and RIV (dry) test [for 132kV and above voltage level clamps]
  - iv) Resistance test and tensile test
-

## 7.0 SPACERS

### 7.1 General

Spacers shall conform to IS: 10162. The spacers are to be located at a suitable spacing to limit the short circuit forces as per IEC -60865. Wherever Employer's 765kV, 400 kV, 220kV & 132kV standard gantry structures are being used, the spacer span(s) for different conductor / span configurations and corresponding short circuit forces shall be as per Annexure-D. For strung buses, flexible type spacers shall be used whereas for jumpers and other connections rigid type spacers shall be used. All quad/twin conductors between equipments/ bus shall be provided with at least one spacer.

Wherever Employer's 765kV, 400 kV, 220kV & 132kV standard gantry structures are not being used, necessary spacer span calculation shall be provided by the contractor during detailed engineering for the approval of Employer.

### 7.2 Constructional Features

7.2.1 No magnetic material shall be used in the fabrication of spacers except for GI bolts and nuts.

7.2.2 Spacer design shall be made to take care of fixing and removing during installation and maintenance.

7.2.3 The design of the spacers shall be such that the conductor does not come in contact with any sharp edge.

### 7.3 Tests

Each type of spacers shall be subjected to the following type tests, acceptance tests and routine tests:

7.3.1 **Type Tests: Following type test reports shall be submitted for approval as per clause 9.2 of Section - GTR.**

a) **Clamp slip tests**

The sample shall be installed on test span of twin conductor bundle string or quadruple conductor bundle string (as applicable) at a tension of 44.2 kN. One of the clamps of the sample when subjected to a longitudinal pull of 2.5 kN parallel to the axis of the conductor shall not slip on the conductor. The permanent displacement between the conductor and the clamp of sample measured after removal of the load shall not exceed 1.0 mm. Similar tests shall be performed on the other clamps of the same sample.

b) Fault current test as per Cl 5.14.2 of IS: 10162. Alternately, the same can be carried by simulated short circuit method for which compressive forces shall be based on IEC-60865.

c) Corona Extinction Voltage Test (Dry).

This test shall be performed on 765 kV, 400 kV and 220 kV spacers as per procedure mentioned at Annexure - C, Minimum Corona Extinction voltage shall be as per clause 2.3.2.

d) RIV Test (Dry)

This test shall be performed as per procedure mentioned at Annexure - C, Maximum RIV levels shall be as per clause 2.3.2.

e) Resilience test (if applicable)

f) Tension Test

g) Log decrement test (if applicable)

h) Compression test

i) Galvanising test

**7.3.2 Acceptance Test (As per IS:10162)**

a) Visual examination

b) Dimensional verification

c) Movement test

d) Clamp slip test

e) Clamp bolt torque test (if applicable)

f) Assembly torque test

g) Compression test

h) Tension test

i) Galvanising test

j) Hardness test for neoprene (if applicable)

The shore hardness of different points on the elastometer surface of cushion grip clamp shall be measured by shore hardness meter. It shall be between 65 to 80.

k) Ultimate Tensile Strength Test

The UTS of the retaining rods shall be measured. It shall not be less than 35 kg/Sq. mm.

**7.3.3 Routine test**

a) Visual examination

b) Dimensional verification

**SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.**

**1.0 PROJECT INFORMATION**

- 1.1 Client / Owner: Maharashtra State Power Generation Co. Ltd.
- 1.2 Consultant : DEVELOPMENT CONSULTANTS PRIVATE LIMITED [DCPL]1.3  
Project Title : BHUSAWAL T.P.S. UNIT – 6 : 1X660 MW
- 1.4 Location : Dipnagar, Near Bhusawal, Maharashtra, India
- 1.5 Nearest railway station: Bhusawal
- 1.6 Nearest Airport: Aurangabad
- 1.7 Nearest Harbour: Mumbai
- 1.8 Access Roads: NH 6 (Mumbai-Nagpur Highway)
- 1.9 Elevation above MSL: 210 M
- 1.10 Longitude/Latitude : 75° 51'10" East /21° 02' 30" North
- 1.11 Seismic Zone: Zone III as per IS:1893
- 1.12 AMBIENT TEMPERATURE
- 1.12.1 Mean of daily maximum: 48.25 °C (during May) temperature
- 1.12.2 Mean of daily minimum: 18 °C (during January) temperature
- 1.12.3 Highest temperature: 48.7°C recorded
- 1.12.4 Lowest temperature : 13°C recorded
- 1.13 Wet bulb temperature : 27°C (Maximum)
- 1.14 Rainfall : 112 mm average annually
- 1.15 Wind Speed : 0 to 39 Km/hr
- 1.16 Wind direction : East North East to West South West

**1.17 All electrical equipment shall be designed for the following ambient conditions**

1.17.1 Maximum ambient temperature: 50°C

1.17.2 Minimum ambient temperature: 13°C

**1.18 RATED VOLTAGE**

1.18.1 Rated Voltage : 400kV

1.18.2 Voltage variation : ± 10 %

1.18.3 Frequency Variation : ± 5 %

1.18.4 Rated Short Circuit : 50 kA, FOR 3 SEC

**2.0 GENERAL REQUIREMENT**

2.1 The contractor shall furnish catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification during detailed engineering.

2.2 It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different from those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered provided such proposals meet the specified designs, standard and performance requirements and are acceptable to Owner.

2.3 Wherever a material or article is specified or defined by the name of a particular brand, Manufacturer or Vendor, the specific name mentioned shall be understood as establishing type, function and quality and not as limiting competition.

2.4 Equipment furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications unless

included in the list of exclusions. Materials and components which are minor in nature and incidental to the requirement but not specifically stated in the specification and bid price schedule, which are necessary for commissioning and satisfactory operation of the switchyard/ substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost. All similar standard components/parts of similar standard equipment provided, shall be inter-changeable with one another.

2.5 The Contractor shall also be responsible for the overall co-ordination with internal /external agencies; Supplier of Owner's supplied equipments, project management, training of Owner's manpower, loading, unloading, handling, insurance, moving to final destination for successful erection, testing and commissioning of the substation /switchyard.

2.6 The bidder shall be responsible for safety of human and equipment during the working. It will be the responsibility of the Contractor to co-ordinate and obtain Electrical Inspector's clearance before commissioning. Any additional items, modification due to observation of such statutory authorities shall be provided by the Contractor at no extra cost to the Owner.

### **3.0 STANDARDS**

3.1 The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the originally scheduled date of bid opening) of standard specified under Annexure-C of this section, unless specifically mentioned in the specification.

3.3 The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

3.4 The Contractor shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

3.5 When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.6 Other internationally accepted standards which ensure equivalent or better performance than that specified in the standards specified under Annexure-C/ individual sections for various equipments shall also, be accepted, however the salient points of difference shall be clearly brought out during detailed engineering along with English language version of such standard. The equipment conforming to standards other than specified for various equipments shall be subject to Owner's approval.

#### **4.0 SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED**

4.1 The 420kV system is being designed to limit the switching surge over voltage of 2.5 p.u., respectively and the power frequency over voltage of 1.5 p.u., respectively. In case of the 420kV system, the initial value of the temporary over voltages could be 2.0 p.u. for 1-2 cycles. The equipment furnished under this specification shall perform all its functions and operate satisfactorily without showing undue strain, restriking etc under such over voltage conditions.

4.2 All equipments shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation.

4.3 All equipment shall be able to withstand all external and internal mechanical, thermal and electromechanical forces due to various factors like wind load, temperature variation, ice & snow, (wherever applicable) short circuit etc for the equipment.

4.4 The bidder shall design terminal connectors of the equipment taking into account various forces that are required to withstand.

4.5 The equipment shall also comply to the following:

a) To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

b) All piping, if any between equipment control cabinet/operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.

**4.6 System Parameter**

| <b>SL No</b> | <b>Description of parameters</b>   | <b>400kV System</b>                         |
|--------------|--|---|
| 1.           | System operating voltage   | 400kV                                       |
| 2.           | Maximum operating voltage of the system (rms)                            | 420kV                                       |
| 3.           | Rated frequency  | 50Hz  |
| 4.           | No. of phase   | 3   |
| 5.           | Rated Insulation levels  |   |
| i)           | Full wave impulse withstand voltage (1.2/50 microsec.)                   | 1550kVp                                     |
| ii)          | Switching impulse withstand voltage (250/2500 micro sec.)<br>dry and wet | 1050kVp                                     |
| iii)         | One minute power frequency dry withstand voltage (rms)                   | 630kV                                       |
| iv)          | One minute power frequency dry and wet withstand voltage (rms)           | -   |
| 6.           | Corona extinction voltage  | 320kV                                       |
| 7.           | Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz  | 1000 $\mu$ V<br>at 266kV rms                |
| 8.           | Minimum creepage distance - for Equipment other than Insulator string    | 10500 mm<br>(13020 mm for coastal area)     |
|              | Minimum creepage distance - for Insulator String                         | As specified in Section-Switchyard Erection |
| 9.           | Min. clearances  |   |

|      |   |   |
|------|---|---|
| i.   | Phase to phase                                  | 4000mm (for conductor-conductor configuration)<br>4200mm (for rod -conductor configuration) |
| ii.  | Phase to earth                                  | 3500 mm   |
| iii) | Sectional clearances                            | 6500 mm   |
| 10.  | Rated short circuit current for 1 sec. duration | 40kA/50kA/<br>63 kA<br>(as applicable)  |
| 11.  | System neutral earthing                         | Effectively<br>earthed  |

## 5.0 ENGINEERING DATA AND DRAWINGS

**5.1 The Contractor shall submit 4 (four) sets of drawings/ design documents /data / detailed bill of quantity and 1 (one) set of test reports for the approval of the Owner. The contractor shall also submit the softcopy in two CD/DVD of the above documents in addition to hardcopy.**

### 5.2 Drawings

5.2.1 All drawings submitted by the Contractor shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically requested in the specifications.

5.2.2 Drawings submitted by the Contractor shall be clearly marked with the name of the Owner, the unit designation, the specifications title, the specification number and the name of the Project

5.2.3 The review of these data by the Owner will cover only general conformance of the data to the specifications and documents, interfaces with the equipment provided under the

specifications, external connections and of the dimensions which might affect substation layout. This review by the Owner may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Owner shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

5.4 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Owner. Approval of Contractor's drawing or work by the Owner shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

5.5 All engineering data submitted by the Contractor after final process including review and approval by the Owner shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Owner in Writing.

### **5.6 Approval Procedure**

The following schedule shall be followed generally for approval and for providing final documentation.

- |      |   |  |
|------|---|--|
| i)   | Approval/comments/                                | As per L2 schedule by Owner on initial submission  |
| ii)  | Resubmission                                      | Within 1 (one) weeks (whenever from date of comments required)   |
| iii) | Approval or comments                              | Within 1 (three) weeks of receipt of resubmission.   |
| iv)  | Furnishing of distribution                        | 2 weeks from the date copies (2 hard copies to each of approval substation and one scanned copy (pdf format) |
| v)   | Furnishing of distribution copies of test reports |  |

- |                                |   |
|--------------------------------|---|
| (a) Type test reports          | 2 weeks from the date (one scanned softcopy in pdf format to each substation plus one for corporate centre & one hardcopy per substation) |
| (b) Routine Test Reports       | -do- (one copy for each substation)   |
| vi) Furnishing of instruction/ | On completion of Engineering operation manuals (2 copies per substation and two softcopies (pdf format)                                   |
| (vii) As built drawings        | (two sets of On completion of entire works hardcopy per substation & two softcopies (pdf format)  |

NOTE :

- (1) The contractor may please note that all resubmissions must incorporate all comments given in the earlier submission by the Owner or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.
- (2) All drawings should be submitted in softcopy form, however substation design drawings like SLD, GA, all layouts etc. shall also be submitted in AutoCAD Version. SLD, GA & layout drawings shall be submitted for the entire substation in case of substation extension also.
- (3) The instruction Manuals shall contain full details of drawings of all equipment being supplied under this contract, their exploded diagrams with complete instructions for storage, handling, erection, commissioning, testing, operation, trouble shooting, servicing and overhauling procedures.
- (4) If after the commissioning and initial operation of the substation, the instruction manuals require any modifications/additions/changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Owner.

- (5) The Contractor shall furnish to the Owner catalogues of spare parts if any .
- (6) All As-built drawings/documents shall be certified by site indicating the changes before final submission.

## **6.0 MATERIAL/ WORKMANSHIP**

### **6.1 General Requirement**

6.1.1 Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is essential that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

6.1.2 In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard, the Owner shall decide upon the question of similarity. When required by the specification or when required by the Owner the Contractor shall submit, for approval, all the information concerning the materials or components to be used in manufacture. Machinery, equipment, materials and components supplied, installed or used without such approval shall run the risk of subsequent rejection, it is to be understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

6.1.3 The design of the Works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned and restrained to fulfill their required function. In general, screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Owner.

6.1.4 Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

6.1.5 All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits suitable guards shall be provided for the protection of personnel on all exposed rotating and / or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

6.1.6 The Contractor shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Contractor shall apply all operational lubricants to the equipment installed by him.

6.1.7 All oil, grease and other consumables used in the Works/Equipment shall be purchased in India unless the Contractor has any special requirement for the specific application of a type of oil or grease not available in India. If such is the case, he shall declare in the proposal, where such oil or grease is available. He shall help Owner in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

## **6.2 Provisions for Exposure to Hot and Humid climate**

Outdoor equipment supplied under the specification shall be suitable for service and storage under tropical conditions of high temperature, high humidity, heavy rainfall and environment favorable to the growth of fungi and mildew. The indoor equipments located in non-air conditioned areas shall also be of same type.

### **6.2.1 Space Heaters**

6.2.1.1 The heaters shall be suitable for continuous operation at 240V as supply voltage. On- off switch and fuse shall be provided.

6.2.1.2 One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

### **6.2.2 FUNGI STATIC VARNISH**

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

### **6.2.3 Ventilation opening**

Wherever ventilation is provided, the compartments shall have ventilation openings with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust.

### **6.2.4 Degree of Protection**

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall comply with following degree of protection as detailed here under:

- a) Installed out door: IP- 55
- b) Installed indoor in air conditioned area: IP-31
- c) Installed in covered area: IP-52
- d) Installed indoor in non-air conditioned area where possibility of entry of water is limited: IP-41.
- e) For LT Switchgear (AC & DC distribution Boards): IP-52
- f) For Surge monitors: IP 67

The degree of protection shall be in accordance with IS:2147, IS:13947 (Part-I)/IEC-60947 (Part-I)/IS 12063/IEC-60529. Type test report for IP-55 or higher degree of protection test, shall be submitted for approval.

### **6.3 RATING PLATES, NAME PLATES AND LABELS**

6.3.1 Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Owner. The rating plate of each equipment shall be according to IEC requirement.

6.3.2 All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

### **6.4 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS**

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

### **7.0 DESIGN IMPROVEMENTS / COORDINATION**

7.1 The bidder shall offer the equipment meeting the requirement of the technical specification. However, the Owner or the Contractor may propose changes in the specification of the equipment or quality thereof and if the contractor & Owner agree upon any such changes, the specification shall be modified accordingly.

7.2 If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

7.3 The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best coordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

7.4 The Contractor has to coordinate designs and terminations with the agencies (if any) who are Consultants/Contractor for the Owner. The names of agencies shall be intimated to the successful bidders.

7.5 The Contractor will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Owner (if any) during the period of Contract.

## **8.0 QUALITY ASSURANCE PROGRAMME**

8.1 To ensure that the equipment and services under the scope of this Contract, whether manufactured or performed within the Contractor's Works or at his Sub-Contractor's premises or at the Owner's site or at any other place of Work as applicable, are in accordance with the specifications, the Contractor shall ensure suitable quality assurance programme to control such activities at all points necessary. A quality assurance programme of the Contractor shall be in line with ISO requirements & shall generally cover the following:

- b) System for Document and Data Control.
- c) Qualification and Experience data of Bidder's key personnel.

- d) The procedure for purchases of materials, parts, components and selection of sub-Contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- e) System for shop manufacturing and site erection controls including process controls, fabrication and assembly control.
- f) System for Control of non-conforming products including deviation dispositioning, if any and system for corrective and preventive actions based on the feedback received from the Customers and also internally documented system for Customer complaints.
- g) Inspection and test procedure both for manufacture and field activities.
- h) System for Control of calibration of testing and measuring equipment and the indication of calibration status on the instruments.
- i) System for indication and appraisal of inspection status.
- j) System of Internal Quality Audits, Management review and initiation of corrective and Preventive actions based on the above.
- k) System for authorizing release of manufactured product to the Owner.
- l) System for maintenance of records.
- m) System for handling, storage and delivery.
- n) A quality plan detailing out the specific quality control measures and procedure adopted for controlling the quality characteristics relevant to each item of equipment furnished and /or service rendered.
  
- o) System for various field activities i.e. unloading, receipt at site, proper storage, erection, testing and commissioning of various equipment and maintenance of records. In this regard, the Owner has already prepared Standard Field Quality Plan for transmission line/substation equipments as applicable, Civil/erection Works which is required to be followed for associated works.

The Owner or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

## **8.2 Quality Assurance Documents**

The Contractor shall ensure availability of the following Quality Assurance Documents:

- i) All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication, and reports including radiography interpretation reports.
- ii) Welder and welding operator qualification certificates.
- iii) Welder's identification list, welding operator's qualification procedure and welding identification symbols.
- iv) Raw Material test reports on components as specified by the specification and in the quality plan.
- v) The Manufacturing Quality Plan(MQP) indicating Customer Inspection Points (CIPs) at various stages of manufacturing and methods used to verify that the inspection and testing points in the quality plan were performed satisfactorily.
- vi) Factory test results for testing required as per applicable quality plan/technical specifications/GTP/Drawings etc.
- vii) Stress relief time temperature charts/oil impregnation time temperature charts, wherever applicable.

### **8.3 INSPECTION, TESTING & INSPECTION CERTIFICATE**

8.3.1 No surge arrester shall be dispatched without inspection and testing. The inspection may be carried out by the Owner's representative at any stage of manufacture. The bidder shall grant free access to the Owner's representative at a reasonable time when the work is in progress.

8.3.2 Inspection and acceptance of any equipment under this specification by the MSETCL shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective.

8.3.11 All Test Reports and documents to be submitted in English during final inspection of equipment by Owner or as and when required for submission.

### **9.0 TYPE TESTING & CLEARANCE CERTIFICATE**

9.1 All equipment being supplied shall conform to type tests as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections.

9.2 The reports for all type tests as per technical specification shall be furnished by the Contractor along with equipment / material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO / IEC Guide 25 / 17025 or EN 45001 by the national accreditation body of the country where laboratory is located).

**Unless otherwise specified elsewhere, the type test reports submitted shall be of the tests conducted within last 05 (five) years from the NOA (Notification of award) date i.e. 17.01.2018 of this project.** In case the test reports are of the test conducted earlier than **05 (five)** years from the date of NOA, the contractor shall repeat these test(s) at no extra cost to the Employer.

Further, in the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification or any/all type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

The Contractor shall intimate the Employer the detailed program about the type tests at least two (2) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

9.4 The Employer reserves the right to witness any or all the type tests. The Employer shall bear all expenses for deputation of Employer's representative(s) for witnessing the type tests.

## **10.0 TESTS**

### **10.1 Pre-commissioning Tests**

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

## **10.2 Commissioning Tests**

10.2.1 The available instrumentation and control equipment will to be used during such tests and the Employer will calibrate, all such measuring equipment and devices as far as practicable.

10.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be arranged by the Contractor at his own cost.

10.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.

## **10.3 PRECOMMISSIONING, COMMISSIONING, TRIAL-RUN & COMPLETION**

As soon as the Facilities covered by these specifications are physically completed in all respects, the Pre commissioning, Commissioning, Trial-run and Completion of the Facilities, as mentioned below, shall be attained in accordance with the procedure given in the Conditions of Contract, Vol.-I of the Bidding Documents.

(i) Pre commissioning : As per relevant Sections

(ii) Commissioning : Charging of the Facilities at rated voltage.

Further, wherever appearing in these specifications, the words–‘commissioning checks’, ‘installation checks’, ‘site tests’, ‘performance guarantee tests for fire protection system’, are to be considered as ‘pre commissioning checks’.

(iii) Trial-run : Operation of the Facilities or any part thereof by the Contractor immediately after the Commissioning for a continuous period of 72 (Seventy two) hours continuously. In case of interruption due to problem/ failure in the respective equipment, the contractor shall rectify the problem and after rectification, continuous 72 (Seventy two) hours period start after such rectification.

(iv) Completion : Upon successful completion of Trial-run.

‘Guarantee Test(s)’ and/or ‘Functional Guarantees’ are applicable only for Substation Automation System as specified in Section-‘Substation Automation System.’

## **11.0 PACKAGING & PROTECTION**

11.1 All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. On request of the Employer, the Contractor shall also submit packing details/associated drawing for any equipment/material under his scope of supply, to facilitate the Employer to repack any equipment/material at a later date, in case the need arises. While packing all the materials, the limitation from the point of view of availability of Railway wagon sizes in India should be taken into account. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Employer takes no responsibility of the availability of the wagons.

11.2 All coated surfaces shall be protected against abrasion, impact, discolouration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

## **12.0 FINISHING OF METAL SURFACES**

12.1 All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. All steel conductors including those used for earthing/grounding (above ground level) shall also be galvanized according to IS: 2629.

### **12.2 HOT DIP GALVANISING**

12.2.1 The minimum weight of the zinc coating shall be 610 gm/sq.m and minimum average thickness of coating shall be 86 microns for all items having thickness 6mm and above and 900 gm/sq.m for coastal area (30km from sea shore approximately) or as specified in Section-Project. For items lower than 6mm thickness requirement of coating thickness shall

be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq.m minimum and 900 gm/sq.m for coastal area as specified in Section-Project.

12.2.2 The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

12.2.3 After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate or alternate approved treatment shall be provided to avoid formation of white rust after hot dip galvanization.

12.2.4 The galvanized steel shall be subjected to four numbers of one minute dips in copper sulphate solution as per IS-2633.

12.2.5 Sharp edges with radii less than 2.5 mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness
- Uniformity of zinc
- Adhesion test
- Mass of zinc coating

12.2.6 Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of touch-up zinc rich paint at site shall be allowed with approval of Engineer Incharge.

### **12.3 PAINTING**

12.3.1 All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS- 6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require

corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

12.3.2 After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

12.3.3 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.

12.3.4 The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards /panels/junction boxes is also acceptable. The exterior colour for panels shall be matching with the existing panels in case of extension of a substation. Each coat of primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.

12.3.5 In case the contractor proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted during detailed engineering for Employer's review & approval.

## **18.0 CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES & MARSHALLING BOXES FOR OUTDOOR EQUIPMENT**

18.1 All types of boxes, cabinets etc. shall generally conform to & be tested in accordance with IS-5039/IS-8623, IEC-60439, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes shall be made of stainless steel of atleast 1.5 mm thick or aluminum enclosure of atleast 1.6 mm thick and shall be dust, water and vermin proof. Stainless steel used shall be of grade SS304 (SS316 for coastal area) or better. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.

18.3 A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes / Control cabinets to prevent ingress of rain water.

18.4 Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere.

18.5 All doors, removable covers and plates shall be gasketed all around with suitably profiled EPDM/Neoprene/PU gaskets. The gasket shall be tested in accordance with approved quality plan, IS:11149 and IS:3400. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

Further, the gasketing arrangement shall be such that gaskets are pasted in slots (in door fabrication/gasket itself) in order to prevent ingress of dust and moisture inside the panels so that no internal rusting occurs in panels during the operation of the equipment.

18.6 All boxes/cabinets shall be designed for the entry of cables by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required. The Nickel plated glands shall be dust proof, screw on & double compression type and made of brass. The gland shall have provision for securing armour of the cable separately and shall be provided with earthing tag. The glands shall conform to BS:6121.

18.7 A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of industrial grade.

18.8 LED based illumination of minimum 9 watts shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

18.9 All control switches shall be of MCB/rotary switch type and Toggle/piano switches shall not be accepted.

18.10 Earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

18.11 The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/feruling by pasting the same on the inside of the door.

18.12 The following routine tests alongwith the routine tests as per IS:5039 shall also be conducted:

- i) Check for wiring
- ii) Visual and dimension check

18.13 The enclosure of bay marshalling kiosk, junction box, terminal box and control cabinets shall conform to IP-55 as per IS:13947 including application of 2KV rms for 1 (one) minute, insulation resistance and functional test after IP-55 test.

### **19.0 DISPOSAL OF PACKING MATERIAL & WASTE FROM CONSTRUCTION SITE**

After completion of the work, Contractor shall dispose-off all the packing & waste materials including empty conductor drums, cable drums, wooden containers, oil drums, gas cylinders and other waste/scrapped materials from construction site at his own cost and shall make the substation area properly cleaned.

## **20.0 TERMINAL BLOCKS AND WIRING**

20.1 Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

20.2 Terminal blocks shall be 650V grade and have continuous rating to carry the maximum expected current on the terminals and non-breakable type. These shall be of moulded piece, complete with insulated barriers, stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But the terminal blocks shall be non-disconnecting stud type except for the secondary junction boxes of Current Transformer and Voltage Transformer.

20.3 Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.

20.4 The terminal shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.

20.5 The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable.

20.6 The terminal blocks shall be of extensible design, multilayer terminal arrangement is not allowed in any junction box (Common MB, Individual MB, JB etc.). There should be sufficient space at both sides of terminals so that ferrule number of wires / TB numbers are clearly visible during wire removal or insertion.

20.7 The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

20.8 The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.

20.9 The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.

20.10 Atleast 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

20.11 There shall be a minimum clearance of 250 mm between the First/bottom row of terminal block and the associated cable gland plate for outdoor ground mounted marshalling box and the clearance between two rows of terminal blocks shall be a minimum of 150 mm.

20.12 The Contractor shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets. For equipments rated for 400 kV and above the wiring required in these items shall be run in metallic ducts or shielded cables in order to avoid surge overvoltages either transferred through the equipment or due to transients induced from the EHV circuits.

20.14 All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Contractor shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

## **21.0 LAMPS & SOCKETS**

### 21.1 Lamps & Sockets

All lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

### 21.2 Hand Lamp:

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON-OFF Switch for connection of hand lamps.

### 21.3 Switches and Fuses:

21.3.1 Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signaling, lighting and space

heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker / switch fuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

21.3.2 All fuses shall be of HRC cartridge type conforming to IS:9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints of the fuse rating and voltage.

## **ANNEXURE- CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST**

### **1. General**

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132kV and above.

2. Test Levels:

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3. Test Methods for RIV:

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 Mhz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be carried out in accordance with relevant IEC of respective equipment or NEMA standard Publication No. 107-1964.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 765kV, 400 kV, 220 KV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4. Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.

4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Employer's inspector, after determining the best camera locations by trial energization of test object at a voltage which results in corona.

4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.

4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Employer's inspector if, in his opinion, it will not prejudice other test.

5. Test Records:

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.
- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

The frequency range for the earthquake spectra shall be as per IEC-6227-300.

**LIST OF GENERAL STANDARDS AND CODES**

| <b>CODES</b>                  | <b>TITLE</b>  |
|-------------------------------|---|
| --                            | India Electricity Rules   |
| --                            | Indian Electricity Act  |
| --                            | Indian Electricity (Supply) Act   |
| --                            | Indian Factories Act  |
| IS-5                          | Colors for Ready Mixed Paints and Enamels   |
| IS-335                        | New Insulating Oils   |
| IS-617                        | Aluminium and Aluminium Alloy Ingots and Castings for General Engineering Purposes        |
| IS-1448 (P1 to P 145)         | Methods of Test for Petroleum and its Products  |
| IS-2071 (P1 to P3)            | Methods of High Voltage Testing   |
| IS-12063                      | Classification of degrees of protection provided by enclosures of electrical equipment    |
| IS-2165 ; P1:1997,<br>P2:1983 | Insulation Coordination   |
| IS-3043                       | Code of Practice for Earthing   |
| IS-6103                       | Method of Test for Specific Resistance (Resistivity) of Electrical Insulating Liquids     |
| IS-6104                       | Method of Test for Interfacial Tension of Oil against Water by the Ring Method            |
| IS-6262                       | Method of test for Power factor & Dielectric Constant of Electrical Insulating Liquids    |
| IS-6792                       | Method for determination of electric strength of insulating oils                          |
| IS-5578                       | Guide for marking of insulated conductors   |
| IS-11353                      | Guide for uniform system of marking & identification of conductors & apparatus terminals. |

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|--------------------------|--|
| IS-8263                  | Methods for Radio Interference Test on High voltage Insulators                             |
| IS-9224 (Part 1,2&4)     | Low Voltage Fuses  |
| IEC-60060 (Part 1 to P4) | High Voltage Test Techniques   |
| IEC 60068                | Environmental Test   |
| IEC-60117                | Graphical Symbols  |
| IEC-60156                | Method for the Determination of the Electrical Strength of Insulation Oils                 |
| IEC-60270                | Partial Discharge Measurements   |
| IEC-60376                | Specification and Acceptance of New Sulphur Hexafluoride                                   |
| IEC-60437                | Radio Interference Test on High Voltage Insulators   |
| IEC-60507                | Artificial Pollution Tests on High Voltage Insulators to be used on AC Systems             |
| IEC-62271-1              | Common Specification for High Voltage Switchgear & Control gear Standards                  |
| IEC-60815                | Guide for the Selection of Insulators in respect of Polluted Conditions                    |
| IEC-60865 (P1 & P2)      | Short Circuit Current - Calculation of effects   |
| ANSI-C.1/NFPA.70         | National Electrical Code   |
| ANSI-C37.90A             | Guide for Surge Withstand Capability (SWC) Tests   |
| ANSI-C63.21, C63.3       | Specification for Electromagnetic Noise and Field Strength Instrumentation 10 KHz to 1 GHZ |
| C36.4ANSI-C68.1          | Technique for Dielectric Tests   |
| ANSI-C76.1/EEE21         | Standard General Requirements and Test Procedure for Outdoor Apparatus Bushings            |
| ANSI-SI-4                | Specification for Sound Level Meters   |
| ANSI-Y32-2/C337.2        | Drawing Symbols  |

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|---|--|
| ANSI-Z55.11   | Gray Finishes for Industrial Apparatus and Equipment No. 61<br>Light Gray                                    |
| NEMA-107T   | Methods of Measurements of RIV of High Voltage Apparatus   |
| NEMA-ICS-II   | General Standards for Industrial Control and Systems Part<br>ICSI- 109                                       |
| CISPR-1   | Specification for CISPR Radio Interference Measuring Apparatus<br>for the frequency range 0.15 MHz to 30 MHz |
| CSA-Z299.1-1978h  | Quality Assurance Program Requirements   |
| CSA-Z299.2-1979h  | Quality Control Program Requirements   |
| CSA-Z299.3-1979h  | Quality Verification Program Requirements  |
| CSA-Z299.4-1979h  | Inspection Program Requirements  |
| <b>SURGE ARRESTERS</b>                                    |  |
| IS-3070 (PART2)   | Lightning arresters for alternating current systems : Metal<br>oxide lightning arrestors without gaps        |
| IEC-60099-4   | Metal oxide surge arrestors without gaps   |
| IEC-60099-5   | Selection and application recommendation   |
| ANSI-C62.1  | IEE Standards for S A for AC Power Circuits  |
| NEMA-LA 1   | Surge Arresters  |
| <b>CUBICLES AND PANELS &amp; OTHER RELATED EQUIPMENTS</b> |  |
| IS-722, IS-1248   | Electrical relays for power system   |
| IS-3231, 3231 (P-3)                                       | Protection   |
| IS:5039   | Distributed pillars for Voltages not Exceeding 1000 Volts  |
| IEC-60068.2.2   | Basic environmental testing procedures Part 2: Test B: Dry<br>heat   |
| IEC-60529   | Degree of Protection provided by enclosures  |

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| IEC-60947-4-1                              | Low voltage switchgear and control gear                                      |
| IEC-61095                                  | Electromechanical Contactors for household and similar purposes              |
| IEC-60439 (P1 & 2)                         | Low Voltage Switchgear and control gear assemblies                           |
| ANSI-C37.20                                | Switchgear Assemblies, including metal enclosed bus                          |
| ANSI-C37.50                                | Test Procedures for Low Voltage Alternating Current Power                    |
| <b>MOTORS</b>                              |  |
| IS-325                                     | Three phase induction motors   |
| IS-4691                                    | Degree of protection provided by enclosure for rotating electrical machinery |
| IEC-60034 (P1 to P19:)                     | Rotating electrical machines   |
| IEC-Document 2                             | Three phase induction motors   |
| (Central Office)                           | Motors and Generators  |
| NEMA-MGI                                   |  |
| <b>Electronic equipment and components</b> |  |
| MIL-21B, MIL-833                           | Environmental testing  |
| & MIL-2750                                 |  |
| EC-60068 (P1 to P5)                        | Printed boards   |
| IEC-60326 (P1 to P2)                       | Material and workmanship standards   |
| IS-1363 (P1 to P3)                         | Hexagon head bolts, screws and nuts of product grade C                       |
| IS-1364 (P1 to P5)                         | Hexagon head bolts, screws and nuts of products grades A and B               |
| IS-3138                                    | Hexagonal Bolts and Nuts (M42 to M150)                                       |
| ISO-898                                    | Fasteners: Bolts, screws and studs   |

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|------------------------------------|--|
| ASTM                               | Specification and tests for materials  |
| <b>Clamps &amp; connectors</b>     |  |
| IS-5561                            | Electric power connectors  |
| NEMA-CC1                           | Electric Power connectors for sub station  |
| NEMA-CC 3                          | Connectors for Use between aluminium or aluminum-Copper Overhead Conductors  |
| <b>Bus hardware and insulators</b> |  |
| IS: 2121                           | Fittings for Aluminum and steel cored Al conductors for overhead power lines   |
| IS-731                             | Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V   |
| IS-2486 (P1 to P4)                 | Insulator fittings for overhead power lines with a nominal voltage greater than 1000 V   |
| IEC-60120                          | Dimensions of Ball and Socket Couplings of string insulator units  |
| IEC-60137                          | Insulated bushings for alternating voltages above 1000 V   |
| IEC-60168                          | Tests on indoor and outdoor post insulators of ceramic material or glass for Systems with Nominal Voltages Greater than 1000 V   |
| IEC-62155                          | Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V   |
| IEC-60273                          | Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1000V   |
| IEC-61462                          | Pressurized and un-pressurized insulator for use in electrical equipment with rated voltage greater than 1000V – Definitions, Test methods, acceptance criteria and design recommendations |
| IEC-60305                          | Insulators for overhead lines with nominal voltage above 1000V- ceramic or glass insulator units for ac systems<br>Characteristics of String Insulator Units of the cap and pin type       |

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|---------------------------------------|---|
| IEC-60372 (1984)                      | Locking devices for ball and socket couplings of string insulator units : dimensions and tests        |
| IEC-60383 (P1 and P2)                 | Insulators for overhead lines with a nominal voltage above 1000 V                                     |
| IEC-60433                             | Characteristics of string insulator units of the long rod type  |
| IEC-60471                             | Dimensions of Clevis and tongue couplings of string insulator units                                   |
| ANSI-C29                              | Wet process porcelain insulators  |
| ANSI-C29.1                            | Test methods for electrical power insulators  |
| ANSI-C92.2                            | For insulators, wet-process porcelain and toughened glass suspension type                             |
| ANSI-C29.8                            | For wet-process porcelain insulators apparatus, post-type   |
| ANSI-G.8                              | Iron and steel hardware   |
| CISPR-7B                              | Recommendations of the CISPR, tolerances of form and of Position, Part 1                              |
| ASTM A-153                            | Zinc Coating (Hot-Dip) on iron and steel hardware   |
| <b>Strain and rigid bus-conductor</b> |   |
| IS-2678                               | Dimensions & tolerances for Wrought Aluminum and Aluminum Alloys drawn round tube                     |
| IS-5082                               | Wrought Aluminum and Aluminum Alloy Bars. Rods, Tubes and Sections for Electrical purposes            |
| ASTM-B 230-82                         | Aluminum 1350 H19 Wire for electrical purposes  |
| ASTM-B 231-81                         | Concentric - lay - stranded, aluminum 1350 conductors   |
| ASTM-B 221                            | Aluminum - Alloy extruded bar, rod, wire, shape   |
| ASTM-B 236-83                         | Aluminum bars for electrical purpose (Bus-bars)   |
| ASTM-B 317-83                         | Aluminum-Alloy extruded bar, rod, pipe and structural shapes for electrical purposes (Bus Conductors) |

| <b>MOTORS &amp; ANNUNCIATION PANELS</b> |   |
|---|---|
| IS: 325                                 | Three phase induction motors  |
| IS: 900                                 | Code of practice for installation and maintenance of induction motors                                       |
| IS: 996                                 | Single phase small AC and universal electric motors   |
| IS: 1231                                | Dimensions of three phase foot mounted induction motors   |
| IS: 2148                                | Flame proof enclosure of electrical apparatus   |
| IS: 2223                                | Dimensions of flange mounted AC induction motors  |
| IS: 2253                                | Designations for types of construction and mounting arrangements of rotating electrical machines            |
| IS: 2254                                | Dimensions of vertical shaft motors for pumps   |
| IS: 3202                                | Code of practice for climate proofing of electrical equipment   |
| IS: 4029                                | Guide for testing three phase induction motors  |
| IS: 4691                                | Degree of protection provided by enclosure for rotating electrical machinery                                |
| IS: 4722                                | Rotating electrical machines  |
| IS: 4729                                | Measurement and evaluation of vibration of rotating electrical machines                                     |
| IS: 5572                                | Classification of hazardous areas for electrical<br>(Part-I) installations (Areas having gases and vapours) |
| IS: 6362                                | Designation of methods of cooling for rotating electrical machines  |
| IS: 6381                                | Construction and testing of electrical apparatus with type of protection 'e'                                |
| IS: 7816                                | Guide for testing insulation for rotating machine   |
| IS: 4064                                | Air break switches  |

|                         |   |
|-------------------------|---|
| IEC DOCUMENT 2          | Three Phase Induction Motor   |
| (Control Office) 432    |   |
| VDE 0530 Part I/66      | Three Phase Induction Motor   |
| IS: 9224 (Part-II)      | HRC Fuses   |
| IS: 6875                | Push Button and Control Switches  |
| IS: 694                 | PVC Insulated cables  |
| IS: 1248                | Indicating instruments  |
| IS: 375                 | Auxiliary wiring & busbar markings  |
| IS: 2147                | Degree of protection  |
| IS: 5                   | Colour Relay and timers   |
| IS: 2959                | Contactors  |
| <b>Steel structures</b> |   |
| IS-228 (1992)           | Method of Chemical Analysis of pig iron, cast iron and plain carbon and low alloy steels. |
| IS-802 (P1 to 3)        | Code of practice for use of structural steel in overhead transmission line towers         |
| IS-806                  | Code of practice for use of steel tubes in general building                               |
|                         | construction  |
| IS-808                  | Dimensions for hot rolled steel beam, column channel and angle                            |
|                         | sections  |
| IS-814                  | Covered electrodes for manual arc welding of carbon of carbon manganese steel             |
| IS-816                  | Code of Practice for use of metal arc welding for general construction in Mild steel      |

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|---------------------|--|
| IS-817              | Code of practice for training and testing of metal arc welders.<br>Part 1 : Manual Metal arc welding |
| IS-875 (P1 to P4)   | Code of practice for design loads (other than earthquake) for buildings and structures               |
| IS-1161             | Steel tubes for structural purposes  |
| IS-1182             | Recommended practice for radiographic examination of fusion welded butt joints in steel plates       |
| IS-1363 (P1 to P3)  | Hexagonal head bolts, screws & nuts of products grade C  |
| IS-1364             | Hexagon head bolts, screws and nuts of product grades A and B  |
| IS-1367 (P1 to P18) | Technical supply condition for threaded steel fasteners  |
| <b>CODES</b>        | <b>TITLE</b>   |
| IS-1599             | Methods for bend test  |
| IS-1608             | Method for tensile testing of steel products   |
| IS-1893             | Criteria for earthquake resistant design of structures   |
| IS-1978             | Line Pipe  |
| IS-2062             | Steel for general structural purposes  |
| IS-2595             | Code of practice for Radiographic testing  |
| IS-3063             | Single coil rectangular section spring washers for bolts, nuts and screws                            |
| IS-3664             | Code of practice for ultrasonic pulse echo testing by contact and immersion methods                  |
| IS-7205             | Safety code for erection of structural steel work  |
| IS-9595             | Recommendations for metal arc welding of carbon and carbon manganese steels                          |
| ANSI-B18.2.1        | Inch series square and Hexagonal bolts and screws  |
| ANSI-B18.2.2        | Square and hexagonal nuts  |

|            |  |
|------------|--|
| ANSI-G8.14 | Round head bolts   |
| ASTM-A6    | Specification for General Requirements for rolled steel plates, shapes, sheet piling and bars of structural use                  |
| ASTM-A36   | Specifications of structural steel   |
| ASTM-A47   | Specification for malleable iron castings  |
| ASTM-A143  | Practice for safeguarding against embilement of Hot Galvanized structural steel products and procedure for detaching embrilement |
| ASTM-A242  | Specification for high strength low alloy structural steel   |
| ASTM-A283  | Specification for low and intermediate tensile strength carbon steel plates of structural quality                                |
| ASTM-A394  | Specification for Galvanized steel transmission tower bolts and nuts   |
| ASTM-441   | Specification for High strength low alloy structural manganese vanadium steel  |
| ASTM-A572  | Specification for High strength low alloy colombium-Vanadium steel of structural quality   |
| AWS D1-0   | Code for welding in building construction welding inspection   |
| AWS D1-1   | Structural welding code  |
| AISC       | American institute of steel construction   |
| NEMA-CG1   | Manufactured graphite electrodes   |

**ANNEXURE-A**

**COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION**

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation(s) with respect to specification other than those furnished in the 'schedule of technical deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date:

Bidder's Stamp & Signature

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**ANNEXURE - B**

**SCHEDULE OF TECHNICAL DEVIATIONS**

Bidder shall list below all technical deviation clause wise w.r.t. tender specifications:

| <u>S.No.</u> | <u>Section/ Page No.</u> | <u>Clause No.</u> | <u>Deviation</u> | <u>Reason / Justification</u> |
|--------------|--------------------------|-------------------|------------------|-------------------------------|
|--------------|--------------------------|-------------------|------------------|-------------------------------|

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**Any deviation not specifically brought out in this section shall not be admissible for any commercial implication at later stage. Except to the technical deviations listed in this schedule, bidder's offer shall be considered in full compliance to the tender specifications irrespective of any such deviation indicated / taken elsewhere in the submitted offer.**

Date:

Tenderer's Stamp & Signature