# TECHNICAL QUALIFICATION REQUIREMENT

Name of Project: POWERGRID Neemuch REZ (Neemuch, Chittorgarh, Mandsaur)

Name of Customer: M/s POWERGRID NEEMUCH TRANSMISSION LTD.

Name of Item: PVC PIPE

| TECHNICAL QUALIFICATION REQUIREMENT |
|---|
| The Bidder should have supplied 50 MM dia or higher PVC Pipes in last 5 years from date of Enquiry. |

| SUPPORTING DOCUMENTS TO BE SUBMITTED BY BIDDER ALONG WITH TECHNICAL BID | | |
|---|---|---|
| **Sr** | **Required Criteria** | **Supporting Documents** |
| 1 | Supply | 1. Purchase order<br>2. Dispatch clearance / LR / Material Receipt certificate at site / etc. establishing bidder as proven supplier of offered item |

PREPARED BY

JINTU GOGOI

(Dy. MANAGER/ TBEM)

REVIEWED & APPROVED BY

S K SHRIVASTAVA

(Sr.DGM/ TBEM)

# BHARAT HEAVY ELECTRICALS LIMITED
## TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **DOCUMENT No.** | TB-418-316-012 | Rev. No. | 00 | | Prepared | Checked | Approved |
| **TYPE OF DOC.** | **TECHNICAL SPECIFICATION** | | | **NAME** | **JG** | **SS** | **SKS** |
| **TITLE** | | | | **SIGN** | | | |
| **PVC PIPE AND ACCESSORIES** | | | | **DATE** | 14.12.22 | 14.12.22 | 14.12.22 |
| | | | | **GROUP** | TBEM | | |

| | |
|---|---|
| **CUSTOMER** | **POWERGRID NEEMUCH TRANSMISSION LIMITED** |
| **PROJECTS** | **POWERGRID NEEMUCH REZ** |
| **NOA NO.** | **TBCB/Neemuch REZ/400kV AIS/SS01/G5/NOA-I/05 dtd. 23/09/2022 & TBCB/Neemuch REZ/400kV AIS/SS01/G5/NOA-II/06 dtd. 23/09/2022** |

COPYRIGHT AND CONFIDENTIALITY
The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD.
It must not be used directly or indirectly in anyway detrimental to the interest of the company

CONTENTS


| Section | Description | No. of Sheets |
|---|---|---|
| | SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & | 4 |
| | BILL OF QUANTITIES | |
| | ANNEXURE- BOQ | 1 |
| | PROJECT DETAILS AND GENERAL SPECIFICATION | 66 |


| Rev No. | Date | Altered | Checked | Approved | REVISION DETAILS | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | **Distribution** | *TBMM* | *TBQM* | *TBCM* | *TBTS* |
| | | | | **Copies** | **1** | **-** | **-** | **-** |

# SCOPE, SPECIFIC TECHNICAL REQUIREMENT AND QUANTITIES

## 1.0 SCOPE

This technical specification covers design, manufacture, testing at works, packing and dispatch of PVC PIPE, its fittings and bends. The material supplied shall fully comply with relevant Indian Standard given below and the product shall be BIS certified. The sizes and types of Pipes shall be as specified below. No Technical Deviations shall be acceptable in this regard.

**2.0** The equipment is required for the following Projects.

**Name of Customer : POWERGRID NEEMUCH TRANSMISSION SYSTEM LIMITED**

**Name of the Project:** Substation Package SS01 for (i) 400/220kV AIS Neemuch New S/S including 400kV class Transformer & Bus Reactor, (ii) Extension of 400kV Chittorgarh S/S and (iii) Extension of 400kV Mandsaur S/S associated with Transmission system for evacuation of power from Neemuch REZ.

Sites name : NEEMUCH, CHITTORGARH, MANDSAUR

Refer Section - 3 for Project Details and General Specifications.

.

Note: The terms used in this specification namely,"Employer/Purchaser" refers to PowerGrid, "Contractor " refers to BHEL & "Sub-contractor" refers to successful bidder.

## 3.0 SPECIFIC TECHNICAL REQUIREMENT

### 3.1.1 UPVC PIPE

The UPVC pipes shall be of nominal diameter 50 mm & 110 mm. The pipe shall be of class-IV grade as per IS 4985:2000 and shall be of standard length of 6 meters. The pipe shall fully comply with specified standard and carry the BIS certification marking.

### 3.1.2 BENDS

The bends shall be of 90° and Tee as specified, for above mentioned pipes.The bends shall, in general, comply with the requirement of IS 10124. The specific requirements and BIS certification marking of these bends shall be as per IS 10124 (part-9) and IS 10124 (part-10) respectively.

## 4.0 BILL OF QUANTITIES:

Refer **ANNEXURE-BOQ.**

**Note:**

1. The bidder to quote for items as per unpriced price schedule attached with NIT. **The quantity as mentioned in the BOQ**
2. Quantity variation as per NIT terms & condition.

## 5.0 TECHNICAL QUALIFYING REQUIREMENT & EXPERIENCE

Technical qualifying requirement shall be as per Annexure-TQR.

## 6.0 INSPECTION & TESTING:

Prior to dispatch, the routine & acceptance tests shall be carried out (if any) in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and POWERGRID in accordance with agreed quality plan with 3 weeks' advance information.

## 7.0 QUALITY PLAN

Bidder/Manufacturer to follow BHEL/POWERGRID approved Quality Plan at contract stage.

2.2.2 *Dimensions* — The dimensions of 45° bends shall comply with Table 1 read with Fig. 1.

2.2.3 The bends may either be plain at both ends or socketed either at one end or at both ends as agreed to between the manufacturer and the purchaser. In the case of socketed bends, the socket measurements shall comply with IS : 10124 ( Part 1 )-1988*.

NOTE 1 — For 0·25 MPa pressure class, fabricated bends should not be made from 0·25 MPa pressure class pipes. For this, bends made from 0·4 MPa pressure class pipe should be used.

NOTE 2 — The drawing is only intended to define the terms used in Table 1 and is not intended to illustrate specific design features.

## 3. MARKING

3.1 Each 45° bend fitting shall be marked with the following information:

a) Manufacturer's name or identification mark,

b) The size of the bend and the appropriate class ( working pressure ) of IS : 4985-1988* to which the pressure rating of the fitting corresponds,

c) The degree of bend, and

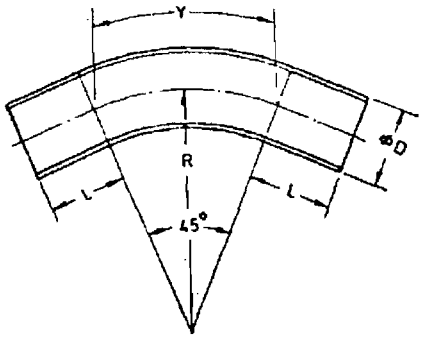


FIG. 1 45° BEND

*Specification for fabricated PVC fittings for potable water supplies: Part 1 General requirements.

*Specification for unplasticized PVC pipes for potable water supplies ( *second revision* ).

TABLE 1 DIMENSIONS OF 45° BENDS

( *Clauses* 2.2.2 and 2.2.3, and *Fig.* 1 )

All dimensions in millimetres.

| SIZE | Y* *Min* | L *Min* ( Only for plain ends ) | R† *Min* | MINIMUM WALL THICKNESS ( *t* ) FOR WORKING PRESSURE | | |
|---|---|---|---|---|---|---|
| | | | | 0·4 MPa ( Class 2 ) | 0·6 MPa ( Class 3 ) | 1·0 MPa ( Class 4 ) |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| 63 | 149 | 63 | 189 | 1·4 | 2·0 | 3·2 |
| 75 | 177 | 75 | 225 | 1·7 | 2·4 | 3·8 |
| 90 | 212 | 90 | 270 | 1·9 | 2·8 | 4·5 |
| 110 | 259 | 110 | 330 | 2·3 | 3·4 | 5·5 |
| 125 | 295 | 125 | 375 | 2·7 | 3·9 | 6·3 |
| 140 | 330 | 140 | 420 | 2·9 | 4·4 | 7·0 |
| 160 | 377 | 160 | 480 | 3·4 | 4·9 | 8·0 |
| 180 | 424 | 180 | 540 | 3·8 | 5·5 | 9·0 |
| 200 | 471 | 200 | 600 | 4·2 | 6·2 | 10·0 |
| 225 | 530 | 225 | 675 | 4·7 | 6·9 | 11·2 |
| 250 | 589 | 250 | 750 | 5·2 | 7·7 | 12·5 |
| 280 | 660 | 280 | 840 | 5·8 | 8·6 | 13·9 |
| 315 | 742 | 315 | 945 | 6·5 | 9·7 | 15·6 |
| 355 | 837 | 355 | 1 065 | 7·3 | 10·8 | 17·7 |
| 400 | 842 | 400 | 1 200 | 8·2 | 12·2 | 19·8 |
| 450 | 1 060 | 450 | 1 350 | 9·3 | 13·7 | 22·4 |
| 500 | 1 178 | 500 | 1 500 | 10·3 | 15·3 | 24·8 |
| 560 | 1 319 | 560 | 1 680 | 11·6 | 17·2 | 27·8 |
| 630 | 1 484 | 630 | 1 890 | 13·0 | 19·2 | 31·3 |

NOTE — Minimum wall thickness if calculated on the basis of 90 percent of the minimum wall thickness of the corresponding size and pressure class of pipe rounded off to the next higher 0·1 mm.

*Y is calculated from $\frac{45°}{360°} \times 2\pi R$.

†*R, radius of the bend, is equal to 3 times the nominal outside diameter ( D ).*

2.2.2 *Dimensions* — The dimensions of 90° bends shall comply with Table 1 read with Fig. 1.

2.2.3 The bends may either be plain at both ends or socketed either at one end or at both ends as agreed between the manufacturer and the purchaser. In the case of socketed bend, the socket measurements shall comply with IS : 10124 ( Part 1 )-1988*.

NOTE — For 0·25 MPa pressure class, fabricated bends should not be made from 0·25 MPa pressure class pipes. For this, bends made from 0·4 MPa pressure class pipe should be used.

NOTE — The drawing is only intended to define the terms used in Table 1 and is not intended to illustrate specific design features.

## 3. MARKING

3.1 Each 90° bend fitting shall be marked with the following information:

a) Manufacturer's name identification mark,

b) The size of the bend and the appropriate class ( working pressure ) of IS : 4985-1988* to which the pressure rating of the fitting corresponds,

c) The degree of bend, and

d) The bend shall be marked in colour as indicated below for different classes of fittings:

| *Class of Fitting* | *Colour* |
|---|---|
| Class 2 ( 0·4 MPa ) | Blue |
| Class 3 ( 0·6 MPa ) | Green |
| Class 4 ( 1·0 MPa ) | Yellow |

*Specification for fabricated PVC fittings for potable water supplies: Part 1 General requirements (*first revision* ).

*Specification for unplasticized PVC pipes for potable water supplies ( *second revision* ).

TABLE 1 DIMENSIONS OF 90° BENDS

( *Clauses* 2.2.2, 2.2.3 and *Fig.* 1 )

All dimensions in millimetres.

| SIZE | *Y** *Min* | *L* *Min* ( Only for plain ends ) | *R*† *Min* | MINIMUM WALL THICKNESS ( *t* ) FOR WORKING PRESSURE | | |
|---|---|---|---|---|---|---|
| | | | | 0·4 MPa ( Class 2 ) | 0·6 MPa ( Class 3 ) | 1·0 MPa ( Class 4 ) |
| ( 1 ) | ( 2 ) | ( 3 ) | ( 4 ) | ( 5 ) | ( 6 ) | ( 7 ) |
| 63 | 297 | 63 | 189 | 1·4 | 2·0 | 3·2 |
| 75 | 354 | 75 | 225 | 1·7 | 2·4 | 3·8 |
| 90 | 424 | 90 | 270 | 1·9 | 2·8 | 4·5 |
| 110 | 519 | 110 | 330 | 2·3 | 3·4 | 5·5 |
| 125 | 589 | 125 | 375 | 2·7 | 3·9 | 6·3 |
| 140 | 660 | 140 | 420 | 2·9 | 4·4 | 7·0 |
| 160 | 754 | 160 | 480 | 3·4 | 4·9 | 8·0 |
| 180 | 848 | 180 | 540 | 3·8 | 5·5 | 9·0 |
| 200 | 942 | 200 | 600 | 4·2 | 6·2 | 10·0 |
| 225 | 1 060 | 225 | 675 | 4·7 | 6·9 | 11·2 |
| 250 | 1 178 | 250 | 750 | 5·2 | 7·7 | 12·5 |
| 280 | 1 319 | 280 | 840 | 5·8 | 8·6 | 13·9 |
| 315 | 1 484 | 315 | 945 | 6·5 | 9·7 | 15·6 |
| 355 | 1 673 | 355 | 1065 | 7·3 | 10·8 | 17·7 |
| 400 | 1 884 | 400 | 1200 | 8·2 | 12·2 | 19·8 |
| 450 | 2 120 | 450 | 1350 | 9·3 | 13·7 | 22·4 |
| 500 | 2 355 | 500 | 1500 | 10·3 | 15·3 | 24·8 |
| 560 | 2 638 | 560 | 1680 | 11·6 | 17·2 | 27·8 |
| 630 | 2 968 | 630 | 1890 | 13·0 | 19·2 | 31·8 |

NOTE — Minimum wall thickness is calculated on the basis of 90 percent of the minimum wall thickness of the corresponding size and pressure class of pipe rounded off to the next higher 0·1 mm.

*$Y$ is calculated from $\frac{90°}{360°} \times 2\pi R$.

†$R$, radius of the bend, is equal to 3 times the nominal outside diameter ( $D$ ).

**Annexure-BOQ**

**Bill of Quantities/ Price Schedule**

| Sl. No. | Description | UNIT | QTY FOR NEEMUCH | QTY FOR CHITTORGARH | QTY FOR MANDSAUR |
|---|---|---|---|---|---|
| 1. | SUPPLY- PVC PIPE : 110 MM DIAMETER CLASS-IV PIPES WITH SOCKET ON ONE END | MTR | 3714 | 648 | 798 |
| 2. | SUPPLY- PVC PIPE : TEE BENDS FOR 110 MM DIAMETER CLASS-IV PIPES | NO | 150 | 26 | 26 |
| 3. | SUPPLY- PVC PIPE : 90 DEGREE BEND FOR 110 MM DIAMETER CLASS IV PIPE | NO | 780 | 130 | 150 |
| 4. | SUPPLY- PVC PIPE : 50 MM DIAMETER CLASS-IV PIPES WITH SOCKET ON ONE END | MTR | 2700 | 456 | 600 |
| 5. | SUPPLY- PVC PIPE : TEE BENDS FOR 50 MM DIAMETER CLASS-IV PIPES | NO | 70 | 10 | 15 |
| 6. | SUPPLY- PVC PIPE : 90 DEGREE BEND FOR 50 MM DIAMETER CLASS IV PIPE | NO | 540 | 85 | 110 |

BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

| DOCUMENT No. | TB-418-316-000 | Rev. No. | 00 | | Prepared | Checked | Approved |
|---|---|---|---|---|---|---|---|
| TYPE OF DOC. | **TECHNICAL SPECIFICATION** | | | SIGN | Satyaki Chowdhury | | |
| TITLE | **GENERAL TECHNICAL REQUIREMENTS-SECTION 3** | | | NAME | SC | NK | SKS |
| | | | | DATE | 15.10.22 | 15.10.22 | 15.10.22 |
| | | | | GROUP | TBEM | W.O. | **Awaited** |

| | |
|---|---|
| CUSTOMER | Powergrid Corporation of India Ltd. (POWERGRID) |
| PROJECT | **Substation Package SS01 for (i) 400/220kV AIS Neemuch New S/S including 400kV class Transformer & Bus Reactor, (ii) Extension of 400kV Chittorgarh S/S and (iii) Extension of 400kV Mandsaur S/S associated with Transmission system for evacuation of power from Neemuch REZ through TBCB route** |
| NOA NO. | **TBCB/Neemuch REZ/400kV AIS/SS01/G5/NOA-I/05 dtd. 23/09/2022 & TBCB/Neemuch REZ/400kV AIS/SS01/G5/NOA-II/06 dtd. 23/09/2022** |
| Station | **400/220kV AIS Neemuch New S/S, Madhya Pradesh**<br>**Extension of 400kV Chittorgarh S/S, Rajasthan**<br>**Extension of 400kV Mandsaur S/S , Madhya Pradesh** |


| S.No. | Description | Sheet |
|---|---|---|
| 1 | General Technical Requirements – Site Information | 2,3 |
| 2 | General Technical Requirements | 4-32 |
| 3 | Annexure -A | 2 Sheets |
| 4 | Annexure -B | 1 Sheets |
| 5 | Annexure -C | 23 Sheets |
| 6 | Annexure -G | 6 Sheets |
| 7 | Annexure -K | 2 Sheets |


| RevNo. | Date | Altered | Checked | Approved | REVISION DETAILS |
|---|---|---|---|---|---|
| | | | | | |

| Distribution | To | TBEM | TBMM | TBQM | Supplier |
|---|---|---|---|---|---|
| | Copies | 1 | 1 | 1 | 4 |


COPYRIGHT AND CONFIDENTIALITY

The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD.

It must not be used directly or indirectly in anyway detrimental to the interest of the company

# GENERAL TECHNICAL REQUIREMENTS-SECTION 3

## Site Information

| S.No. | Particular | Details |
|---|---|---|
| a) | Owner | Neemuch Transmission Limited - a 100% wholly owned subsidiary of Power Grid Corporation of India Limited |
| b) | Customer | Neemuch Transmission Limited - a 100% wholly owned subsidiary of Power Grid Corporation of India Limited |
| c) | Project Title | Substation Package SS01 for (i) 400/220kV AIS Neemuch New S/S including 400kV class Transformer & Bus Reactor, (ii) Extension of 400kV Chittorgarh S/S and (iii) Extension of 400kV Mandsaur S/S associated with Transmission system for evacuation of power from Neemuch REZ through TBCB route |
| d) | Location | Neemuch, MP<br>Chittorgarh, Rajasthan<br>Mandsaur, MP |
| e) | Transport Facilities | Road/Train<br>Nearest Rail Head For Neemuch: Neemuch<br>Nearest Rail Head For Chittorgarh: Chittorgarh<br>Nearest Rail Head For Mandsaur: Mandsaur<br>Nearest Airport : Udaipur |
| | SITE CONDITIONS | |
| a) | Max. ambient air temp. | 50°C |
| b) | Min. ambient air temp. | 0°C |
| c) | Max. design ambient temp. | 50°C |
| d) | Design reference temp. | 50°C |
| e) | Average Humidity | Max. 100% |
| f) | Special corrosion conditions | No |
| g) | Solar Radiation | 2 kW/sqmtr |
| h) | Atmospheric UV radiation | High |
| i) | Altitude above sea level | Less than 1000 meter above mean sea level (MSL) |
| j) | Pollution Severity | High Pollution level |

| | | |
|---|---|---|
| k) | Seismic Zone | Zone-II |
| **WIND DATA** | | |
| | Wind Zone | 47m/sec |
| | Average No. of thunderstorm days per annum | As per IS |
| | Main Electrical Parameters: | |
| | Fault Levels: | 400kV: 63kA for 1 sec.<br>220kV : 50kA for 1 sec. |
| | Creepage Distance | 25mm/kV for All Equipment i.e BPI/Bushings, CB, Isolator, CT, CVT, LA, WT etc.<br>31mm/kV for string insulators |

# GENERAL TECHNICAL REQUIREMENTS-SECTION 3

## 1.0 FOREWORD

The provisions under this section are intended to supplement requirements for the materials, equipment's and services covered under other sections of tender documents and are not exclusive.

The Supplier shall note that the standards mentioned herein are not mutually exclusive or complete in themselves, but are intended to complement each other, with minimum repetition, to define the requirements of the Specification. In the event of a conflict between requirements of any two clauses of the Specification/ documents or requirements of different codes/ standards specified, the more stringent requirement as per the interpretation of the owner shall apply, unless confirmed otherwise by the owner in writing based on a written request from the Supplier.

In case of conflicting requirements between this document (General Technical Requirement Section 3) and equipment specification (Section 1 & Section 2), equipment specification shall prevail.

When specific requirements stipulated in the Specification exceed or change those required by the applicable standards, the stipulations of the Specification shall take precedence.

Unless specifically agreed to by the Purchaser prior to Award of Contract, the Work shall be in accordance with the standards indicated and the requirements of the Specification. The Supplier shall be held responsible for any deviation.

In case of conflict between the various standards, the decision of owner shall be binding & final.

The following words and expressions shall have the meanings hereby assigned to them throughout this document

"Employer/Owner" means Power Grid Corporation of India Ltd.

"Purchaser" means Bharat Heavy Electricals Limited

"Supplier/Manufacturer/Bidder" means the person or persons, firm or company assigned to execute the works as defined by the scope of supply, described here.

"Specification" refers to this document.

The supplier should be approved by Power Grid. If not, it is the responsibility of the vendor to be assessed and approved by Power Grid, before placement of order by BHEL. Any cost involved in vendor assessment/approval must be borne by the vendor himself.

## 2.0 GENERAL REQUIREMENT

2.1 a) All equipment/materials/items, as per Annexure-K, as applicable under present scope of works, shall be supplied by domestic manufacturers only.

Any imported equipment/material/item/parts/component (comprising of embedded systems) to be supplied under the contract shall be tested in the certified laboratories to check for any kind of embedded malware/trojans/cyber threats and for adherence to Indian Standards as per the directions issued by Ministry of Power/Govt. of India from time to time. In case of such import from specified "prior reference" countries, the requirement of prior permission from the Govt. of India including protocol for testing in certified and designated laboratories by Ministry of Power/Govt. of India shall also be complied with by the Bidder.

The bidder/contractor shall list out the products and components producing Toxic e-waste under the contract and shall furnish to the Employer the procedure of safe disposal at the time of closing of the contract.

2.1 b) The Supplier/Manufacturer 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 recognised that the Bidder may have standardised 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 Employer.

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, 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 Deleted.

2.6 Deleted.

## 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 offered by the Bidder shall at least conform to the requirements specified under relevant IS standard. In case of discrepancy between IS and other international standard, provisions of IS shall prevail. The Bidder shall also note that the list of standards presented in Annexure-C is not complete. Whenever necessary, the list of standards shall be considered in conjunction with specific IS. If the IS standard is not available for an equipment/material, then other applicable International standard (IEC/Equivalent), as per the specification, shall be accepted.

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 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.

3.5 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 under Annexure-C /individual sections for various equipments shall be subject to Employer's approval.

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

4.1 Switching surge over voltage and power frequency over voltage is specified in the system parameters below. In case of the 400kV system, the initial value of the temporary overvoltages 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, restrike 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 as above at Sl.No.4.3 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**

**400kV & 220kV System**

| SL No | Description of parameters | 400kV System | 220kV System |
|---|---|---|---|
| 1. | System operating voltage | 400kV | 220kV |
| 2. | Maximum operating voltage of the system (rms) | 420kV | 245kV |
| 3. | Rated frequency | 50Hz | 50Hz |
| 4. | No. of phase | 3 | 3 |
| 5. | Rated Insulation levels | | |
| i) | Full wave impulse withstand voltage (1.2/50 microsec.) | 1550kVp | 1050 kVp |
| ii) | Switching impulse withstand voltage (250/2500 micro sec.) 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) | - | 460kV |
| 6. | Corona extinction voltage | 320kV | - |
| 7. | Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz | 1000 μV at 266kV rms | 1000 μV at 156kV rms |
| 8. | Minimum creepage distance - for Equipment other than Insulator string | 10500 mm | 6125 mm |
| | Minimum creepage distance - for Insulator String | 13020 mm | 7595 mm |
| 9. | Min. clearances | | |

| | | | |
|---|---|---|---|
| i. | Phase to phase | 4000mm (for conductor conductor configuration)<br>4200mm (for rod - conductor configuration) | 2100 mm |
| ii. | Phase to earth | 3500 mm | 2100 mm |
| iii) | Sectional clearances | 6500 mm | 5000 mm |
| 10. | Rated short circuit current for 1 sec. duration | 63 kA | 50kA |
| 11. | System neutral earthing | Effectively earthed | Effectively earthed |

**66kV, 52kV , 33kV System**

| SL No | Description of parameters | 66kV System | 52 kV System | 33 kV System |
|---|---|---|---|---|
| 1. | System operating voltage | 66kV | 52kV | 33kV |
| 2. | Maximum operating voltage of the system(rms) | 72.5kV | 52kV | 36kV |
| 3. | Rated frequency | 50Hz | 50Hz | 50Hz |
| 4. | No. of phase | 3 | 3 | 3 |
| 5. | | | | |
| i) | Full wave impulse withstand voltage (1.2/50 microsec.) | 325 kVp | 250 kVp | 170 kVp |
| ii) | One minute power frequency dry and wet withstand voltage (rms) | 140kV | 95kV | 70kV |

| | | | | |
|---|---|---|---|---|
| 6. | Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz | - | - | - |
| 7. | Minimum creepage distance | 1813 mm (2248mm for coastal area) | 1300mm (1612 mm for coastal area) | 900 mm (1116m m for coastal area) |
| 8. | Min. Clearance | | | |
| i. | Phase to phase | 750 mm | 530mm | 320 mm |
| ii. | Phase to earth | 630 mm | 480mm | 320 mm |
| iii. | Sectional clearances | 3100 mm | 3100mm | 2800 mm |
| 9. | Rated short circuit current | 25kA for 3 Sec* | 25kA for 1 Sec | 25 kA for 3 sec |
| 10. | System neutral earthing | Effectively earthed | Effectively earthed | Effectively earthed |

Notes:

1. The above parameters are applicable for installations up to an altitude of 1000m above mean sea level. For altitude exceeding 1000m, necessary altitude correction factor shall be applicable as per relevant IEC/IS.
2. The insulation and RIV levels of the equipments shall be as per values given in the Technical Specification of respective equipment.
3. Corona and radio interference voltage test and seismic withstand test procedures for equipments shall be in line with the procedure given at **Annexure-A** and **Annexure-B** respectively.
4. "*" For tertiary loading Equipment's fault level shall be 25kA for 3 Sec.

## 5.0 ENGINEERING DATA AND DRAWINGS

5.1 Deleted.

5.2 Deleted.

## 5.3 Drawings

5.3.1 All drawings submitted by the Bidder 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.

5.3.2 Drawings submitted by the Bidder shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. POWERGRID has standardized a large number of drawings/documents of various make including type test reports which can be used for all projects having similar requirements and in such cases no project specific approval (except for list of applicable drawings alongwith type test reports) is required. However, distribution copies of standard drawings/documents shall be submitted as per provision of the contract. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in SI units.

5.3.3 The review of these data by the Employer 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 Employer 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 Employer 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.

5.5 All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Bidder's risk. The Bidder 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 Employer. Approval of Bidder's drawing or work by the Employer shall not relieve the bidder of any of his responsibilities and liabilities under the Contract.

5.6 All engineering data submitted by the Bidder after final process including review and approval by the Employer 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 Employer in Writing.

## 5.7 Approval Procedure

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

| | | |
|---|---|---|
| i) | Approval/comments/ by Employer on initial submission | 15 days |
| ii) | Resubmission (whenever required) | Within 3 (three) weeks from date of comments |
| iii) | Approval or comments | Within 3 (three) weeks of receipt of resubmission |
| iv) | Furnishing of distribution copies (2 hard copies to each substation and one scanned copy (pdf format) | Within 3 (three) weeks of receipt of resubmission |
| v) | Furnishing of distribution copies of test reports | |
| | a) Type test reports (one scanned softcopy in pdf format to each substation plus one for corporate centre & one hardcopy per substation) | 2 weeks from the date of final approval |
| | b) Routine Test Reports (one copy for each substation) | -do- |
| vi) | Furnishing of instruction/ operation manuals (2 copies per substation and one softcopy (pdf format) for corporate centre & per substation) | On completion of Engineering |

| | | |
|---|---|---|
| vii) | As built drawings (two sets of hardcopy per substation & one softcopy (pdf format) for corporate centre & per substation) | On completion of entire works |

**NOTE :**

(1) The bidder may please note that all resubmissions must incorporate all comments given in the earlier submission by the Employer or adequate justification for not incorporating the same must be submitted failing which the submission of documents is likely to be returned.

(2) Deleted.

(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 Employer.

(5) The Bidder shall furnish to the Employer catalogues of spare parts.

(6) Deleted.

5.8 Deleted.

## 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 Employer shall decide upon the question of similarity. When required by the specification or when required by the Employer 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 Bidder.

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 fulfil 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 Employer.

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 Deleted.

6.1.6 The Bidder 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 Bidder 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 Bidder 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 source of oil/grease /other consumables in the GTP/Drawings, where such oil or grease is available. He shall help Employer 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 favourable 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. Onoff 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

The degree of protection shall be in accordance with IS/IEC60947; IS/IEC/60529 . Type test report for of relevant 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, Customer 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 Employer. The rating plate of each equipment shall be according to IS/ 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 Bidder unless specifically excluded under the exclusions in these specifications and documents.

# 7.0 DESIGN IMPROVEMENTS / COORDINATION

7.1 Deleted.

7.2 Deleted.

7.3 The Bidder shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated 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 Bidder has to coordinate designs and terminations with the agencies (if any) who are Consultants/Bidder for the Employer. The names of agencies shall be intimated to the successful bidders.

7.5 The Bidder will be called upon to attend design co-ordination meetings with the Engineer, other Contractor's and the Consultants of the Employer (if any) during the period of Contract. The Bidder shall attend such meetings at his own cost at POWERGRID Corporate Centre, Gurgaon (Haryana) or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

## 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 Bidder's Works or at his Sub-Bidder's premises or at the Employer'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:

a) The organisation structure for the management and implementation of the proposed quality assurance programme.

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-Bidder'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 authorising release of manufactured product to the Employer.

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 Employer 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 Employer or his duly authorised representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Bidder/his vendor's quality management and control activities.

8.2 **Quality Assurance Documents**

The Bidder 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 The responsibility and the basis of inspection for various items & equipment is placed at **Annexure-G** along with the requirement of MQP (Manufacturing Quality Plan), ITP(Inspection & Test Plan), FAT(Factory Acceptance Test) which should be valid & POWERGRID approved and Level of inspection envisaged against each item.

Bidder shall ensure that order for items where MQP/ITP/FAT is required will be placed only on vendors having valid MQP/ITP/FAT and where the supplier's MQP/ITP/FAT is either not valid or has not been approved by POWERGRID, MQP shall be generally submitted as per POWERGRID format before placing order.

Items not covered under MQP/ITP/FAT shall be offered for inspection as per POWERGRID LOA/technical Specifications/POWERGRID approved data sheets/ POWERGRID approved drawings and relevant Indian/International standards.

Inspection **Levels**: For implementation of projects in a time bound manner and to avoid any delay in deputation of POWERGRID or its authorized representative, involvement of POWERGRID for inspection of various items / equipment will be based on the level below:

**Level –I**: Bidder to raise all inspection calls and review the report of tests carried out by the manufacturer, on his own, as per applicable standards/ POWERGRID specification, and submit to concerned POWERGRID inspection office/Inspection Engineer. CIP/MICC will be issued by POWERGRID based on review of test reports/certificates of manufacturers.

**Level – II**: Bidder to raise all inspection calls and carry out the inspection on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during inspection, the same would be intimated to Bidder and CIP/MICC will be issued by POWERGRID. Else, Bidder would submit their test reports/certificates to POWERGRID. CIP/MICC will be issued by POWERGRID based on review of test reports/ certificates.

**Level - III**: Bidder to raise inspection calls for both, stage (as applicable) & final inspection and carry out the stage inspections (if applicable) on behalf of POWERGRID on the proposed date of inspection as per applicable standards/specification. However, in case POWERGRID wishes to associate itself during stage inspection, the same would be intimated to Bidder and CIP will be issued by POWERGRID. Else, Bidder would submit the test reports / certificates of stage inspection after their own review and CIP will be issued by POWERGRID based on review of test reports / certificates. Final inspection will be carried out by POWERGRID and CIP/MICC will be issued by POWERGRID.

**Level – IV**: Bidder to raise inspection calls for both, stage (as applicable) & final inspections. POWERGRID will carry out the inspection for both stage & final inspection as per applicable standards/specification and CIP/MICC will be issued by POWERGRID.

8.3.2 Bidder shall ensure that to implement the above inspection levels, particularly for the quality control and inspection at sub-vendor's works, they would depute sufficient qualified & experienced manpower in their Quality Control and Inspection department. Further, to assure quality of construction, Bidder shall have a separate workforce having appropriate qualification & experience and deploy suitable tools and plant for maintaining quality requirement during construction in line with applicable Field Quality Plan (FQP).

8.3.3 The Employer, his duly authorised representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times access to the Bidder's premises or Works and shall have the power at all reasonable times to ensure that proper Quality Management practices / norms are adhered to, inspect and examine the materials & workmanship of the Works, to carry out Quality/Surveillance Audit during manufacture or erection and if part of the Works is being manufactured or assembled at other premises or works. The Bidder shall obtain for the

Employer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works. The item/equipment, if found unsatisfactory with respect to workmanship or material is liable to be rejected. The observations for improvements during product/ process inspection by POWERGRID shall be recorded in Quality Improvement Register (available & maintained at works) for review & timely compliance of observations.

8.3.4 Bidder shall submit inspection calls over internet through POWERGRID website. The required vendor code and password to enable raising inspection call will be furnished to the main Contractor within 30 days of award of contract on submission of documents by Contractor. After raising the inspection calls, Contractor shall then proceed as per the message of that particular call which is available on the message board.

8.3.5 The Employer reserves the right to witness any or all type, acceptance and routine tests specified for which the Bidder shall give the Employer/Inspector Twenty one (21) days written notice of any material being ready for testing for each stage of testing as identified in the approved quality plan as customer inspection point (CIP) for indigenous inspections. All inspection calls for overseas material shall be given at least forty five (45) days in advance. Such tests shall be to the Bidder's account except for the expenses of the Inspection Engineer. The Employer/inspector, unless witnessing of the tests is waived by Employer, will attend such tests within Twenty one (21) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Bidder may proceed with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector three copies of tests, duly certified. Bidder shall ensure, before giving notice for type test, that all drawings and quality plans have been got approved. The equipment shall be dispatched to site only after approval of Routine and Acceptance test results and Issuance of Dispatch Clearance in writing by the Employer. CIP/Material Inspection clearance certificate (MICC) shall be issued by the Employer after inspection of the equipment or review of test reports as applicable. Employer may waive off the presence of Employer's inspecting engineer. In that case test will be carried out as per approved QP and test certificate will be furnished by the supplier for approval. CIP/MICC will be issued only after review and approval of the test reports.

8.3.6 Bidder shall generally offer material for inspection as per supply bar chart approved by POWERGRID and not before 30 days from schedule indicated in the bar chart. In case Bidder offers material(s) for inspection prior to 30 days from the scheduled date with necessary approval of POWERGRID, POWERGRID shall inspect the material and issue CIP only. However, in such an exceptional case, MICC shall be issued only as per provision of original / revised approved supply schedule.

8.3.7 Bidder shall minimize the number of inspection calls by offering optimum quantities in each inspection call at the respective manufacturer's works.

8.3.8 Bidder shall inspect the material themselves and only after they are fully convinced about the Quality, they shall offer the material for POWERGRID inspection and shall also ensure that relevant portion of LOA/NOA, approved drawing and data sheets along with applicable Quality Plans are available at the works of Contractor or their Sub-vendor before the material is offered for inspection.

8.3.9 Bidder shall ensure that material which has been cleared for dispatch after inspection will be dispatched within 30 days in case of domestic supplies and within 60 days in case of Off-shore supplies from the date of issuance of CIP. Material which is not dispatched within stipulated time as above will be reoffered for POWERGRID inspection or specific approval of POWERGRID QA&I shall be obtained for delayed dispatch.

8.3.10 The Employer or IE shall give notice in writing to the Bidder, of any objection either to conformance to any drawings or to any equipment and workmanship which in his opinion is not in accordance with the Contract. The Bidder shall give due consideration to such objections and shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer/Inspection Engineer giving reasons therein, that no modifications are necessary to comply with the Contract.

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

8.3.12 When the factory tests have been completed at the Bidder's or Sub-Bidder's works, the Employer/Inspection Engineer(IE) shall issue a certificate to this effect within fifteen (15) days after completion of tests & submission of documents by Bidder/manufacturer but if the tests are not witnessed by the Employer/IE, the certificate shall be issued within fifteen (15) days of receipt of the Bidder's Test certificate by the Employer/IE. Bidder shall, on completion of all tests, submit test reports within Ten (10) days to POWERGRID IE. Failure of the Employer/IE to issue such a certificate shall not prevent the Contractor from proceeding with the Works. The completion of these tests or the issue of the certificate shall not bind the Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract.

8.3.13 In all cases, where the Contract provides for tests whether at the premises or works of the Bidder or of any Sub-Bidder, the Bidder, except where otherwise specified, shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Employer/Inspector or his authorised representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspection Engineer or to his authorised representative to accomplish testing.

8.3.14 The inspection and acceptance by Employer and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract, or if such equipment is found to be defective at a later stage.

8.3.15 The Employer will have the right of having at his own expenses any other test(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests, to satisfy that the material comply with the specification.

8.3.16 The Employer reserves the right for getting any additional field tests conducted on the completely assembled equipment at site to satisfy that material complies with specifications.

8.3.17 Rework/ Re-engineering, if any, on any item/equipment shall be carried out only after mutual discussions and in accordance with mutually agreed procedure. Bidder shall submit Joint Inspection Report of equipments under Re-Work/Re-Engineering alongwith procedure for the

same to POWERGRID for approval, before taking up the Re-Work/Re-Engineering, failing which POWERGRID reserves the right to reject the equipment.

8.3.18 Bidder may establish a field test Laboratory to execute Civil Construction testing requirements at site with the condition that all testing equipment shall be calibrated from POWERGRID approved accredited Testing laboratories, with calibration certificates kept available at site and all testing personnel employed in the Field Testing Laboratories to be qualified and experienced Engineers or testing to be carried out at POWERGRID approved Third Party Laboratories.

8.3.19 Bidder shall ensure that all possible steps are taken to avoid damages to the equipment during transport, storage and erection.

8.3.20 Deleted.

8.3.21 Bidder shall ensure commissioning of all CSDs along with Circuit Breakers wherever applicable.

**8.3.22 For EHV transformers/reactors**:

Insulation oil shall be as per POWERGRID Technical specifications and same grade shall be used for impregnation of the active part & testing at the works of Transformer/Reactor Manufacturer and as well as for filling the Transformer/Reactors at site. Bidder to ensure that windings for Transformer/Reactors are made in air conditioned environment. Core-coil assembly shall be performed in positive pressurized dust controlled environment. Dust measurements shall be monitored regularly at Transformer / Reactor Manufacturer works. Contractor shall ensure that respective civil foundations & Fire walls for Transformer/Reactors units to be commissioned, shall be made ready at concerned sites before receipt of Transformer/Reactors units.

8.3.23 The Employer reserves the right to increase or decrease their involvement in inspections at Bidder's Works or at his Sub-Bidder's premises or at the Employer's site or at any other place of Work based on performance of Bidder/sub-bidder.

## 9.0 TYPE TESTING & CLEARANCE CERTIFICATE

9.1 Deleted.

9.2 Deleted.

9.3 The Employer intends to repeat those type tests which are indicated in the price schedule and the same shall be payable as per provision of contract. The price of conducting type tests shall be included in Bid price and break up of these shall be given in the relevant schedule of Bid Proposal Sheets. These Type test charges would be considered in bid evaluation. In case Bidder does not indicate charges for any of the type tests or does not mention the name of any test in the price schedules, it will be presumed that the particular test has been offered free of charge. Further, in case any Bidder indicates that he shall not carry out a particular test, his offer shall be considered incomplete and shall be liable to be rejected. The Employer reserves the right to waive the repeating of type tests partly or fully and in case of waival, test charges for the same shall not be payable.

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 except in the case of re-deputation if any, necessitated due to no fault of the Employer.

9.5 Deleted

**10.0** Deleted.

## 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 Bidder 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 Bidder 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/BHEL 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. 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.

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 IS6005 “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 Hot Phosphating shall be done for phosphating process under pretreatment of sheets 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.

12.3.6 The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

| S.No. | PIPE LINE | Base colour | Band colour |
|---|---|---|---|
| **Fire Protection System** | | | |
| 1 | Hydrant and Emulsifier system pipeline/NIFPS | FIRE RED | - |
| 2 | Emulsifier system detection line – water | FIRE RED | Sea Green |
| 3 | Emulsifier system detection line –Air | FIRE RED | Sky Blue |
| 4 | Pylon support pipes | FIRE RED | |
| **Air Conditioning Plant** | | | |
| 5 | Refrigerant gas pipeline – at compressor suction | Canary Yellow | - |
| 6 | Refrigerant gas pipeline – at compressor discharge | Canary Yellow | Red |
| 7 | Refrigerant liquid pipeline | Dark Admiralty Green | - |
| 8 | Chilled water pipeline | Sea Green | - |
| 9 | Condenser water pipeline | Sea Green | Dark Blue |

The direction of flow shall be marked by → (arrow) in black colour.

Base Colour Direction of flow Band Colour

12.3.7 For aluminium casted surfaces, the surface shall be with smooth finish. Further, in case of aluminium enclosures, the surface shall be coated with powder (coating thickness of 60 microns) after surface preparation for painting. For stainless steel surfaces, no painting is envisaged.

12.3.8 Band colour is required for Emulsifier system detection line only if both water and air detection lines are present at the same substation. Further, band colour shall be applied at an interval of 2 meters approx. along the length and minimum width of band shall be 25mm.

**13.0** Deleted.

## 14.0 TOOLS

**14.1 Deleted.**

**14.2 SPECIAL TOOLS AND TACKLES**

The bidder shall supply all special tools and tackles required for Operation and maintenance of equipment. The special tools and tackles shall only cover items which are specifically required for the equipment offered and are proprietary in nature. The list of special tools and tackles, if any, shall be finalized during detail engineering and the same shall be supplied without any additional cost implication to the Employer.

**14.3** Deleted.

## 15.0 AUXILIARY SUPPLY

15.1 The auxiliary power for station supply, including the equipment drive, cooling system of any equipment, air-conditioning, lighting etc shall be designed for the specified Parameters as under. The DC supply for the instrumentation and PLCC system shall also conform the parameters as indicated in the following table:

| Normal Voltage | Variation in Voltage | Frequency in HZ | Phase/Wire | Neutral connection |
|---|---|---|---|---|
| 415V | ± 10% | 50 ± 5% | 3/4 Wire | Solidly Earthed. |
| 240V | ± 10% | 50 ± 5% | 1/2 Wire | Solidly Earthed. |
| 220V | 190V to 240V | DC | Isolated 2 wire System | - |
| 110V | 95V to 120V | DC | Isolated 2 wire System | - |
| 48V | -- | DC | 2 wire system (+) earthed | - |

Combined variation of voltage and frequency shall be limited to ± 10%.

15.2 Pickup value of binary input modules of Intelligent Electronic Devices, Digital protection couplers, Analog protection couplers shall not be less than 50% of the specified rated station auxiliary DC supply voltage level.

## 16.0 SUPPORT STRUCTURE (ONLY OF CIRCUIT BREAKER)

16.1 The equipment support structures shall be suitable for equipment connections at the first level i.e 14.0 meter, 8.0 meter, 5.9 meter and 4.6 meter from plinth level for 765kV, 400kV, 220kV and 132kV substations respectively. All equipment support structures shall be supplied alongwith brackets, angles, stools etc. for attaching the operating mechanism, control cabinets & marshalling box (wherever applicable) etc.

16.2 The minimum vertical distance from the bottom of the lowest porcelain/polymer part of the bushing, porcelain/polymer enclosures or supporting insulators to the bottom of the equipment base, where it rests on the foundation pad shall be 2.55 metres.

## 17.0 CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS (For Lightning Arrester & Wave Trap only)

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 :

| Sl. No. | Description | Materials |
|---|---|---|
| a) | For connecting ACSR conductors/AAC conductors/ Aluminium tube | Aluminum alloy casting, conforming to designation **4600** 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 **4600** 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 and 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 on minimum three samples as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for 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) and RIV (dry) test [for 132kV and above voltage level clamps]

iv) Resistance test and Pullout strength test

v) Cantilever Strength test on bus support clamps & connectors

vi)

## 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/IEC 61439-0, as applicable, and the clauses given below:

18.2 Control cabinets, junction boxes, Marshalling boxes & terminal boxes, Out door ACDB cum DCDB panels 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.

Control cabinets, junction boxes, marshalling boxes & terminal boxes, out-door ACDB cum DCDB panels shall have adequate space/clearance as per guidelines/technical specifications to access/replace any component. Necessary component labelling to be also done on non-conducting sheet.

For CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES MARSHALLING BOXES FOR OUTDOOR EQUIPMENT Junction Box, wire should be as per IS or equivalent IEC with FRLS grade

Machine laid PU Foam gasket may be permitted for use in Control Cabinets etc.

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 with width more than 700 mm 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 ingression 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/IEC60947 including application of 1kV rms for 1 (one) minute, after IP-55 test.

**19.0** Deleted.

## 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, nondeteriorating 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 Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

| | | |
|---|---|---|
| a) | All circuits except CT/PT circuits | Minimum of two of 2.5 sq mm copper flexible. |
| b) | All CT/PT circuits | Minimum of 4 nos. of 2.5 sq mm copper flexible. |

20.10 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.

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

20.12 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.

20.13 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

## 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 relevant IS 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.

## 22.0 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS:

22.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621.The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable.

The bidder may also offer composite hollow insulators, conforming to IEC-61462.

22.2 Support insulators, bushings and hollow column insulators shall be manufactured from high quality porcelain. Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

22.3 Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.

22.4 Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.

22.5 When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.

22.6 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.

22.7 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.

22.8 Void

22.9 Deleted.

## 23.0 MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

### 23.1 Enclosures

a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691. For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust proof equivalent to IP-44 as per IS: 4691.

b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.

c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.

d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

### 23.2 Operational Features

a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.

b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

### 23.3 Starting Requirements:

a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.

b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.

c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.

d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.

e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft

which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

**23.4 Running Requirements:**

a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3-phase induction motors) after adjustment due to increased ambient temperature specified.

b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.

c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

**23.5 TESTING AND COMMISSIONING**

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Employer for approval.

(a) Insulation resistance.

(b) Phase sequence and proper direction of rotation.

(c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected

ANNEXURE-A

## 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 3 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 three values at which visible corona (negative or positive polarity) disappears.

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

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.

## SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 400kV and above) shall be carried out along with supporting structure. Seismic Withstand Test carried out using either lattice or pipe structure is acceptable." **Seismic Calculations certified by NABL Labs shall also be acceptable**

The Bidder shall arrange to transport the structure from his Contractor's premises/ POWERGRID sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Employer. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Employer.

The frequency range for the earthquake spectra shall be as per IEC–62271-300.

ANNEXURE-C

## LIST OF GENERAL STANDARDS AND CODES

| CODES | TITLE |
|---|---|
| -- | 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, 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. |
| 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 Hexafloride |
| 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 |

| CODES | TITLE |
|---|---|
| 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 | Techniquest 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 |
| ANSI-Z55.11 | Gray Finishes for Industrial Apparatus and Equipment No. 61 Light Gray |
| NEMA-107T | Methods of Measurements of RIV of High Voltage Apparatus |
| NEMA-ICS-II | General Standards for Industrial Control and Systems Part ICSI-109 |
| CISPR-1 | Specification for CISPR Radio Interference Measuring Apparatus 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 |
| **TRANSFORMERS AND REACTORS** | |
| IS:10028 (Part 2 & 3) | Code of practice for selection, installation & maintenance of Transformers (P1:1993), (P2:1991), (P3:1991) |
| IS-2026 (P1 to P4) | Power Transformers |
| IS-3347 (part 1 to Part 8) | Dimensions for Porcelain transformer Bushings for use in lightly polluted atmospheres |
| IS-3639 | Fittings and Accessories for Power Transformers |
| IS-6600 | Guide for Loading of oil immersed Transformers |
| IEC-60076 (Part 1 to 5) | Power Transformers |
| IEC-60214 | On-Load Tap-Changers |
| IEC-60289 | Reactors |
| IEC- 60354 | Loading Guide for Oil - Immersed power transformers |
| IEC-60076-10 | Determination of Transformer and Reactor Sound Levels |
| ANSI-C571280 | General requirements for Distribution, Power and Regulating Transformers |
| ANSI-C571290 | Test Code for Distribution, Power and Regulation Transformers |
| ANSI-C5716 | Terminology & Test Code for Current Limiting Reactors |
| ANSI-C5721 | Requirements, Terminology and Test Code for Shunt Reactors Rated Over 500 KVA |
| ANSI-C5792 | Guide for Loading Oil-Immersed Power Transformers upto and including 100 MVA with 55 deg C or 65 deg C Winding Rise |

| CODES | TITLE |
|---|---|
| ANSI-CG,1EEE-4 | Standard Techniques for High Voltage Testing |
| IEC 60076 | Power transformers |
| IEC 60076-1 | Part 1: General |
| IEC 60076-2 | Part 2: Temperature rise |
| IEC 60076-3 | Part 3: Insulation levels, dielectric tests and external clearances in air |
| IEC 60076-4 | Part 4: Guide to the lightning impulse and switching impulse testing - Power transformers and reactors |
| IEC 60076-3-1 | Part 3-1: Insulation Levels and Dielectric Tests –External Clearances in Air |
| IEC 60076-5 | Part 5: Ability to withstand short circuit |
| IEC 60076-6 | Part 6: Reactors |
| IEC 60076-7 | Part 7: Loading guide for oil-immersed power transformers |
| IEC 60076-8 | Part 8: Application guide |
| IEC 60076-10 | Part 10: Determination of sound levels |
| IEC 60076-10-1 | Part 10-1: Determination of sound levels - Application guide |
| IEC 60076-11 | Part 11: Dry-type transformers |
| IEC 60076-12 | Part 12: Loading guide for dry-type power transformers |
| IEC 60076-13 | Part 13: Self-protected liquid-filled transformers |
| IEC 60076-14 | Part 14: Design and application of liquid-immersed power transformers using high-temperature insulation materials |
| IEC 60076-15 | Part 15: Gas-filled power transformers |
| IEC 60076-16 | Part 16: Transformers for wind turbine applications |
| IEC 60076-18 | Part 18: Measurement of frequency response |
| IEC 60076-19 | Part 19: Rules for the determination of uncertainties in the measurement of losses in power transformers and reactors |
| IEC 60076-21 | Part 21: Standard requirements, terminology, and test code for step-voltage regulators |
| IEC 60044, BS 3938 | Current transformers |
| IEC 60050 | International Electrotechnical Vocabulary |
| IEC 60050(421) | International Electrotechnical vocabulary- Chapter 421 : Power Transformers and Reactors |
| IEC 60060 | High Voltage test techniques |
| IEC 60060-1 | General definitions and test requirements |
| IEC 60060-2 | Measuring systems |
| IEC 60071 | Insulation co-ordination |
| IEC 60071-1 | Part 1: Definitions, principles and rules |
| IEC 60071-2 | Part 2 : Application guide |
| IEC 60137 | Bushing for alternating voltage above 1000V |
| IEC 60214 | On-Load Tap changers |
| IEC 255-21-3 | Relays vibration |

| CODES | TITLE |
|---|---|
| IEC 60270 | Partial discharge measurements |
| IEC 60296 | Specification for Unused Mineral Oil for Transformers and Switchgear |
| IEC 60422 | Supervision and Maintenance guide for Mineral Insulating Oil in Electrical Equipment |
| IEC 60475 | Method of Sampling Liquid dielectrics |
| IEC 60529 | Classification of Degrees of Protection provided by Enclosures |
| IEC 60542 | Application Guide for On-Load Tap-Changers |
| IEC 60567 | Guide for the Sampling of Gases and of Oil from Oil-filled Electrical Equipment for the Analysis of Free and Dissolved Gases |
| IEC 60651 | Sound Level Meters |
| IEC 61083 | Digital Recorders and Software for High Voltage Impulse testing |
| IEC 61083-1 | Part 1: Requirements for digital recorders in high voltage impulse tests |
| IEC 61083-2 | Part 2: Evaluation of software used for the determination of the parameters of impulse waveforms |
| CISPR 16 | Specification for radio disturbance and immunity measuring apparatus |
| CISPR 16-1 | Radio disturbance and immunity measuring apparatus |
| CISPR-18 | Radio Interference Characteristics of Power Lines and High Voltage Equipment |
| ISO 9001 | Quality system-Model for Quality Assurance in Design /development |
| Cigre Publication 202 | Guidelines for conducting design reviews for transformers 100 MVA and 123 kV and above. August 2002-Cigre Working Group 12.22 |
| WG 12-15 | Guide for Customers Specifications for Transformers 100 MVA and 123 kV and above |
| WG 12 19 | Short Circuit Performance of Transformers. |
| BS-4360 | Specification for weldable structural steel |
| BS-5135 | Specification for arc welding of carbon and carbon manganese steels |
| BS-5500 | Specification for unfired fusion welded pressure vessels |
| IS-3618 | Specification for phosphate treatment of iron & steel for protection against corrosion |
| IS-6005 | Code of practice for phosphating of Iron and Steel |
| ISO-8501 | Preparation of steel surface before application of Paints and related product |
| IEC-60599 | Mineral oil impregnated electrical equipment in service – guide to the interpretation of dissolved and free gases analysis |
| IS-10593 | Method of evaluating the analysis of gases in oil filled electrical equipment in service |
| IS-2099 | Bushings for alternating voltages above 1000 volts |

| CODES | TITLE |
|---|---|
| IS-3347 Part I to 8 | Dimension for porcelain transformer bushing |
| DIN-42530 | Bushing up to 1000kV from 250A-5000A for liquid filled Transformer |
| IS-2026 Part 1 to 5 | Power transformer |
| IS-4691 | Degrees of protection provided by enclosure for rotating electrical machinery |
| IEC-60034-5 | Degrees of protection provided by integral design of rotating electrical machines(IP Code) classification |
| IS:325 / IEC -60034 | Performance of cooling fan / oil pump motor |
| IS-13947 part 1 to 5 | Specification for low voltage switchgear and control gear |
| IS:3400 | Methods of test for vulcanised rubber |
| IS:7016 part 1 to 14 | Methods of test for coated and treated fabrics |
| IS:803 | Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks. |
| IS:3637 | Gas operated Relays |
| IS:335 | New Insulating oils – Specification |
| IEC-62271-203 | Gas insulated metal enclosed switchgear for rated voltage above 52kV |
| IEC-61639 | Direct connection between power transformers and gas-insulated metal enclosed switchgear for rated voltages of 52.5 kV and above. |
| IS:3400 / BS 903 / IS:7016 | Air cell ( Flexible Air Separator) |
| IEC 60529 / IP : 55 | Degree of protection for cooler control cabinet , MOLG, Cooling fan , oil pump, Buchholz Relay |
| IEC 60529 / IP : 56 | Degree of protection for Pressure Relief Device |
| IEC 60529 / IP : 43 | Degree of protection for Remote tap Changer cubicle (RTCC) |
| | |
| **CIRCUIT BREAKERS** | |
| IEC-62271-100 | High-voltage switchgear and control gear - Part 100: Alternating current circuit-breakers |
| IEC-62271-101 | High-voltage switchgear and control gear - Part 101: Synthetic testing |
| IEC-62155 | Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1000 V |
| IEC-62271-110 | High-voltage switchgear and control gear - Part 110: Inductive load switching |
| IEC-62271-109 | High-voltage switchgear and control gear - Part 110: Inductive load switching |
| **CURRENT TRANSFORMERS, VOLTAGE TRANSFORMERS AND COUPLING CAPACITOR VOLTAGE TRANSFORMERS** | |
| IS-2705- (P1 to P4) | Current Transformers |

| CODES | TITLE |
|---|---|
| IS:3156- (P1 to P4) | Voltage Transformers |
| IS-4379 | Identification of the Contents of Industrial Gas Cylinders |
| IEC-61869 (Part-1) | Instrument transformers - Part 1: General requirements |
| IEC-61869 (Part-2) | Instrument transformers - Part 2: Additional requirements for current transformers |
| IEC-61869 (Part-3) | Instrument transformers - Part 3: Additional requirements for inductive voltage transformers |
| IEC-61869 (Part-4) | Instrument transformers - Part 4: Additional requirements for combined transformers |
| IEC-61869 (Part-5) | Instrument transformers - Part 5: Additional requirements for capacitor voltage transformers |
| IEC-61869 (Part-6) | Instrument transformers - Part 6: Additional general requirements for low-power instrument transformers |
| IEC-61869 (Part-9) | Instrument transformers - Part 9: Digital interface for instrument transformers |
| IEC-61869 (Part-102) | Instrument transformers - Part 102: Ferroresonance oscillations in substations with inductive voltage transformers |
| IEC-61869 (Part-103) | Instrument transformers - The use of instrument transformers for power quality measurement |
| **BUSHING** | |
| IS-2099 | Bushings for Alternating Voltages above 1000V |
| IEC-60137 | Insulated Bushings for Alternating Voltages above 1000V |
| **SURGE ARRESTERS** | |
| IS-3070 (PART2) | Lightning arresters for alternating current systems : Metal 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 |
| **CUBICLES AND PANELS & OTHER RELATED EQUIPMENTS** | |
| 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 heat |
| IEC-60529 | Degree of Protection provided by enclosures |
| 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 |

| CODES | TITLE |
|---|---|
| | Circuit Breakers |
| ANSI-C39 | Electric Measuring instrument |
| ANSI-C83 | Components for Electric Equipment |
| IS: 8623: (Part I to 3) | Specification for Switchgear & Control Assemblies |
| NEMA-AB | Moulded Case Circuit and Systems |
| NEMA-CS | Industrial Controls and Systems |
| NEMA-PB-1 | Panel Boards |
| NEMA-SG-5 | Low voltage Power Circuit breakers |
| NEMA-SG-3 | Power Switchgear Assemblies |
| NEMA-SG-6 | Power switching Equipment |
| NEMA-5E-3 | Motor Control Centers |
| 1248 (P1 to P9) | Direct acting indicating analogue electrical measuring instruments & their accessories |
| **Disconnecting switches** | |
| IEC-62271-102 | High-voltage switchgear and control gear - Part 102: Alternating current disconnectors and earthing switches |
| IEC-60265 (Part 1 & 2) | High Voltage switches |
| ANSI-C37.32 | Schedule of preferred Ratings, Manufacturing Specifications and Application Guide for high voltage Air Switches, Bus supports and switch accessories |
| ANSI-C37.34 | Test Code for high voltage air switches |
| NEMA-SG6 | Power switching equipment |
| **PLCC and line traps** | |
| IS-8792 | Line traps for AC power system |
| IS-8793 | Methods of tests for line traps |
| IS-8997 | Coupling devices for PLC systems |
| IS-8998 | Methods of test for coupling devices for PLC systems |
| IEC-60353 | Line traps for A.C. power systems |
| IEC-60481 | Coupling Devices for power line carrier systems |
| IEC-60495 | Single sideboard power line carrier terminals |
| IEC-60683 | Planning of (single Side-Band) power line carrier systems |
| CIGRE | Teleprotection report by Committee 34 & 35 |
| CIGRE | Guide on power line carrier 1979 |
| CCIR | International Radio Consultative Committee |
| CCITT | International Telegraph & Telephone Consultative Committee |
| EIA | Electric Industries Association |
| **Protection and control equipment** | |
| IEC-60051: (P1 to P9) | Recommendations for Direct Acting indicating analogue electrical measuring instruments and their accessories |
| IEC-60255 (Part 1 to 23) | Electrical relays |
| IEC-60297 (P1 to P4) | Dimensions of mechanical structures of the 482.6mm (19 inches) |

| CODES | TITLE |
|---|---|
| | series |
| IEC-60359 | Expression of the performance of electrical & electronic measuring equipment |
| IEC-60387 | Symbols for Alternating-Current Electricity meters |
| IEC-60447 | Man machine interface (MMI) - Actuating principles |
| IEC-60521 | Class 0.5, 1 and 2 alternating current watt hour metres |
| IEC-60547 | Modular plug-in Unit and standard 19-inch rack mounting unit based on NIM Standard (for electronic nuclear instruments) |
| ANSI-81 | Screw threads |
| ANSI-B18 | Bolts and Nuts |
| ANSI-C37.1 | Relays, Station Controls etc |
| ANSI-C37.2 | Manual and automatic station control, supervisory and associated telemetering equipment |
| ANSI-C37.2 | Relays and relay systems associated with electric power apparatus |
| ANSI-C39.1 | Requirements for electrical analog indicating instruments |
| **MOTORS** | |
| 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) NEMA-MGI | Motors and Generators |
| **Electronic equipment and components** | |
| MIL-21B, MIL-833 & MIL-2750 | Environmental testing |
| 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 |
| ASTM | Specification and tests for materials |
| **Clamps & connectors** | |
| 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 |
| **Bus hardware and insulators** | |
| IS: 2121 | Fittings for Aluminum and steel cored Al conductors for overhead |

| CODES | TITLE |
|---|---|
| | 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 Characteristics of String Insulator Units of the cap and pin type |
| 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 |
| | |
| **Strain and rigid bus-conductor** | |
| 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 |

| CODES | TITLE |
|---|---|
| ASTM-B 231-81 | Concentric - lay - stranded, aluminum 1350 conductors |
| ASTM-B 221 | Aluminum - Alloy extruded bar, road, 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) |
| | |
| **Batteries** | |
| IS:1651 | Stationary Cells and Batteries, Lead-Acid Type (with Tubular Positive Plates) |
| IS:1652 | Stationary Cells and Batteries, Lead-Acid Type (with Plante Positive Plates) |
| IS:1146 | Rubber and Plastic Containers for Lead-Acid Storage Batteries |
| IS:6071 | Synthetic Separators for Lead-Acid Batteries |
| IS:266 | Specification for Sulphuric Acid |
| IS:1069 | Specification for Water for Storage Batteries |
| IS:3116 | Specification for Sealing Compound for Lead-Acid Batteries |
| IS:1248 | Indicating Instruments |
| IS:10918 | Vented type nickel Cadmium Batteries |
| IEC:60896-21&22 | Lead Acid Batteries Valve Regulated types – Methods of Tests & Requirements |
| IEC: 60623 | Vented type nickel Cadmium Batteries |
| IEC:60622 | Secondary Cells & Batteries – Sealed Ni-Cd rechargeable single cell |
| IEC:60623 | Secondary Cells & Batteries – Vented Ni-Cd rechargeable single cell |
| IEC:60896-11 | Stationary Lead Acid Batteries – Vented Type – General requirements & method of tests |
| IEEE-485 | Recommended practices for sizing of Lead Acid Batteries |
| IEEE-1115 | Sizing of Ni-Cd Batteries |
| IEEE-1187 | Recommended practices for design & installation of VRLA Batteries |
| IEEE-1188 | Recommended practices for design & installation of VRLA Batteries |
| IEEE-1189 | Guide for selection of VRLA Batteries |
| | |
| **Battery Charger** | |
| IS:3895 | Mono-crystalline Semiconductor Rectifier Cells and Stacks |
| IS:4540 | Mono-crystalline Semiconductor Rectifier Assemblies and Equipment |
| IS:6619 | Safety Code for Semiconductor Rectifier Equipment |
| IS:2026 | Power Transformers |

| CODES | TITLE |
|---|---|
| IS:2959 | AC Contactors for Voltages not Exceeding 1000 Volts |
| IS:1248 | Indicating Instruments |
| IS:2208 | HRC Fuses |
| IS:13947 (Part-3) | Air break switches, air break disconnectors & fuse combination units for voltage not exceeding 1000V AC or 1200V DC |
| IS:2147 | Degree of protection provided by enclosures for low voltage switchgear and control gear |
| IS:6005 | Code of practice for phosphating of Iron and Steel |
| IS:3231 | Electrical relays for power system protection |
| IS:3842 | Electrical relay for AC Systems |
| IS:5 | Colours for ready mix paint |
| IEEE-484 | Recommended Design for installation design and installation of large lead storage batteries for generating stations and substations |
| IEEE-485 | Sizing large lead storage batteries for generating stations and substations |
| **Wires and cables** | |
| ASTMD-2863 | Measuring the minimum oxygen concentration to support candle like combustion of plastics (oxygen index) |
| IS-694 | PVC insulated cables for working voltages upto and including 1100 Volts |
| IS-1255 | Code of practice for installation and maintenance of power cables, upto and including 33 kV rating |
| IS-1554 (P1 and P2) | PVC insulated (heavy duty) electric cables (part 1) for working voltage upto and including 1100 V<br>Part (2) for working voltage from 3.3 kV upto and including 11kV |
| IS:1753 | Aluminium conductor for insulated cables |
| IS:2982 | Copper Conductor in insulated cables |
| IS-3961 (P1 to P5) | Recommended current ratings for cables |
| IS-3975 | Mild steel wires, formed wires and tapes for armouring of cables |
| IS-5831 | PVC insulating and sheath of electric cables |
| IS-6380 | Elastometric insulating and sheath of electric cables |
| IS-7098 | Cross linked polyethylene insulated PVC sheathed cables for working voltage upto and including 1100 volts |
| IS-7098 | Cross-linked polyethyle insulated PVC sheathed cables for working voltage from 3.3kV upto and including 33 kV |
| IS-8130 | Conductors for insulated electrical cables and flexible cords |
| IS-1753 | Aluminum Conductors for insulated cables |
| IS-10418 | Specification for drums for electric cables |
| IEC-60096 (part 0 to p4) | Radio Frequency cables |
| IEC-60183 | Guide to the Selection of High Voltage Cables |

| CODES | TITLE |
|---|---|
| IEC-60189 (P1 to P7) | Low frequency cables and wires with PVC insulation and PVC sheath |
| IEC-60227 (P1 to P7) | Polyvinyl Chloride insulated cables of rated voltages up to and including 450/750V |
| IEC-60228 | Conductors of insulated cables |
| IEC-60230 | Impulse tests on cables and their accessories |
| IEC-60287 (P1 to P3) | Calculation of the continuous current rating of cables (100% load factor) |
| IEC-60304 | Standard colours for insulation for low-frequency cables and wires |
| IEC-60331 | Fire resisting characteristics of Electric cables |
| IEC-60332 (P1 to P3) | Tests on electric cables under fire conditions |
| IEC-60502 | Extruded solid dielectric insulated power cables for rated voltages from 1 kV upto to 30 kV |
| IEC-754 (P1 and P2) | Tests on gases evolved during combustion of electric cables |
| **AIR conditioning and ventilation** | |
| IS-659 | Safety code for air conditioning |
| IS-660 | Safety code for Mechanical Refrigeration |
| ARI:520 | Standard for Positive Displacement Refrigeration Compressor and Condensing Units |
| IS:4503 | Shell and tube type heat exchanger |
| ASHRAE-24 | Method of testing for rating of liquid coolers |
| ANSI-B-31.5 | Refrigeration Piping |
| IS:2062 | Steel for general structural purposes |
| IS:655 | Specification for Metal Air Dust |
| IS:277 | Specification for Galvanised Steel Sheets |
| IS-737 | Specification for Wrought Aluminium and Aluminium Sheet & Strip |
| IS-1079 | Hot rolled cast steel sheet & strip |
| IS-3588 | Specification for Electrical Axial Flow Fans |
| IS-2312 | Propeller Type AC Ventilation Fans |
| BS-848 | Methods of Performance Test for Fans |
| BS-6540 Part-I | Air Filters used in Air Conditioning and General Ventilation |
| BS-3928 | Sodium Flame Test for Air Filters (Other than for Air Supply to I.C. Engines and Compressors) |
| US-PED-2098 | Method of cold DOP & hot DOP test |
| MIL-STD-282 | DOP smoke penetration method |
| ASHRAE-52 | Air cleaning device used in general ventilation for removing particle matter |
| IS:3069 | Glossary of Terms, Symbols and Units Relating to Thermal Insulation Materials |

| CODES | TITLE |
|---|---|
| IS:4671 | Expanded Polystyrene for Thermal Insulation Purposes |
| IS:8183 | Bonded Mineral Wool |
| IS:3346 | Evaluation of Thermal Conductivity properties by means of guarded hot plate method |
| ASTM-C-591-69 | Standard specification for rigid preformed cellular urethane thermal insulation |
| IS:4894 | Centrifugal Fans |
| BS:848 | Method of Performance Test for Centrifugal Fans |
| IS:325 | Induction motors, three-phase |
| IS:4722 | Rotating electrical machines |
| IS:1231 | Three phase foot mounted Induction motors, dimensions of |
| IS:2233 | Designations of types of construction and mounting arrangements of rotating electrical machines |
| IS:2254 | Vertical shaft motors for pumps, dimensions of |
| IS:7816 | Guide for testing insulation resistance of rotating machines |
| IS:4029 | Guide for testing three phase induction motors |
| IS: 4729 | Rotating electrical machines, vibration of, Measurement and evaluation of |
| IS:4691 | Degree of protection provided by enclosures for rotating electrical machinery |
| IS:7572 | Guide for testing single-phase ac motors |
| IS:2148 | Flame proof enclosure for electrical apparatus |
| BS:4999(Part-51) | Noise levels |
| **Galvanizing** | |
| IS-209 | Zinc Ingot |
| IS-2629 | Recommended Practice for Hot-Dip galvanizing on iron and steel |
| IS-2633 | Methods for testing uniformity of coating of zinc coated articles |
| ASTM-A-123 | Specification for zinc (Hot Galavanizing) Coatings, on products Fabricated from rolled, pressed and forged steel shapes, plates, bars and strips |
| ASTM-A-121-77 | Zinc-coated (Galvanized) steel barbed wire |
| **Painting** | |
| IS-6005 | Code of practice for phosphating of iron and steel |
| ANSI-Z551 | Gray finishes for industrial apparatus and equipment |
| SSPEC | Steel structure painting council |
| **Fire protection system** | |
| -- | Fire protection manual issued by tariff advisory committee (TAC) of India |
| **HORIZONTAL CENTRIFUGAL PUMPS** | |
| IS:1520 | Horizontal centrifugal pumps for clear, cold and fresh water |
| IS:9137 | Code for acceptance test for centrifugal & axial pumps |

| CODES | TITLE |
|---|---|
| IS:5120 | Technical requirement – Rotodynamic special purpose pumps |
| API-610 | Centrifugal pumps for general services<br>Hydraulic Institutes Standards |
| BS:599 | Methods of testing pumps |
| PTC-8.2 | Power Test Codes - Centrifugal pumps |
| **DIESEL ENGINES** | |
| IS:10000 | Methods of tests for internal combustion engines |
| IS:10002 | Specification for performance requirements for constant speed compression ignition engines for general purposes (above 20 kW) |
| BS:5514 | The performance of reciprocating compression ignition (Diesel) engines, utilizing liquid fuel only, for general purposes |
| ISO:3046 | Reciprocating internal combustion engines performance |
| IS:554 | Dimensions for pipe threads where pressure tight joints are required on threads |
| ASME Power Test Code | Internal combustion engine PTC-17 |
| -- | Codes of Diesel Engine Manufacturer's Association, USA |
| **PIPING VALVES & SPECIALITIES** | |
| IS:636 | Non percolating flexible fire-fighting delivery hose |
| IS:638 | Sheet rubber jointing and rubber inserting jointing |
| IS:778 | Gun metal gate, globe and check valves for general purpose |
| IS:780 | Sluice valves for water works purposes (50 to 300 mm) |
| IS:901 | Couplings, double male and double female instantaneous pattern for fire fighting |
| IS:902 | Suction hose couplings for fire-fighting purposes |
| IS:903 | Fire hose delivery couplings branch pipe nozzles and nozzle spanner |
| IS:1538 | Cast iron fittings for pressure pipes for water, gas and sewage |
| IS:1903 | Ball valve (horizontal plunger type) including floats for water supply purposes |
| IS:2062 | SP for weldable structural steel |
| IS:2379 | Colour Code for the identification of pipelines |
| IS:2643 | Dimensions of pipe threads for fastening purposes |
| IS:2685 | Code of Practice for selection, installation and maintenance of sluice valves |
| IS:2906 | Sluice valves for water-works purposes (350 to 1200 mm size) |
| IS:3582 | Basket strainers for fire-fighting purposes (cylindrical type) |
| IS:3589 | Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter) |
| IS:4038 | Foot valves for water works purposes |
| IS:4927 | Unlined flax canvas hose for fire fighting |

| CODES | TITLE |
|---|---|
| IS:5290 | Landing valves (internal hydrant) |
| IS:5312 (Part-I) | Swing check type reflex (non-return) valves |
| IS:5306 | Code of practice for fire extinguishing installations and equipment on premises |
| Part-I | Hydrant systems, hose reels and foam inlets |
| Part-II | Sprinkler systems |
| BS:5150 | Specification for cast iron gate valves |
| **MOTORS & ANNUNCIATION PANELS** | |
| 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 (Part-I) | Classification of hazardous areas for electrical 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 (Control Office) 432 | Three Phase Induction Motor |
| 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 |

| CODES | TITLE |
|---|---|
| IS:2147 | Degree of protection |
| IS:5 | Colour Relay and timers |
| IS:2959 | Contactors |
| **PG Test Procedures** | |
| NFPA-13 | Standard for the installation of sprinkler system |
| NFPA-15 | Standard for water spray fixed system for the fire protection |
| NFPA-12A | Standard for Halong 1301 Fire Extinguishing System |
| NFPA-72E | Standard on Automatic Fire Detectors |
| -- | Fire Protection Manual by TAC (Latest Edition) |
| NFPA-12 | Standard on Carbon dioxide extinguisher systems |
| IS:3034 | Fire of industrial building |
| -- | Electrical generating and distributing stations code of practice |
| IS:2878 | CO2 (Carbon dioxide) Type Extinguisher |
| IS:2171 | DC (Dry Chemical Powder) type |
| IS:940 | Pressurised Water Type |
| **D.G. SET** | |
| IS:10002 | Specification for performance requirements for constant speed compression ignition (diesel engine) for general purposes |
| IS:10000 | Method of tests for internal combustion engines |
| IS:4722 | Rotating electrical machines-specification |
| IS:12063 | Degree of protection provided by enclosures |
| IS:12065 | Permissible limit of noise levels for rotating electrical machines |
| -- | Indian Explosive Act 1932 |
| **Steel structures** | |
| 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 |
| IS-817 | Code of practice for training and testing of metal arc welders. 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 |

| CODES | TITLE |
|---|---|
| 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 |
| 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 |

| CODES | TITLE |
|---|---|
| **Piping and pressure vessels** | |
| IS-1239 (Part 1 and 2) | Mild steel tubes, tubulars and other wrought steel fittings |
| IS -3589 | Seamless Electrically welded steel pipes for water, gas and sewage |
| IS-6392 | Steel pipe flanges |
| ASME | Boiler and pressure vessel code |
| ASTM-A120 | Specification for pipe steel, black and hot dipped, zinc-coated (Galvanized) welded and seamless steel pipe for ordinary use |
| ASTM-A53 | Specification for pipe, steel, black, and hot-dipped, zinc coated welded and seamless |
| ASTM-A106 | Seamless carbon steel pipe for high temperature service |
| ASTM-A284 | Low and intermediate tensile strength carbon-silicon steel plates for machine parts and general construction |
| ASTM-A234 | Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures |
| ASTM-S181 | Specification for forgings, carbon steel for general purpose piping |
| ASTM-A105 | Forgings, carbon steel for piping components |
| ASTM-A307 | Carbon steel externally threated standard fasteners |
| ASTM-A193 | Alloy steel and stainless steel bolting materials for high temperature service |
| ASTM-A345 | Flat rolled electrical steel for magnetic applications |
| ASTM-A197 | Cupola malleable iron |
| ANSI-B2.1 | Pipe threads (Except dry seal) |
| ANSI-B16.1 | Cast iron pipe flangesand glanged fitting. Class 25, 125, 250 and 800 |
| ANSI-B16.1 | Malleable iron threaded fittings, class 150 and 300 |
| ANSI-B16.5 | Pipe flanges and flanged fittings, steel nickel alloy and other special alloys |
| ANSI-B16.9 | Factory-made wrought steel butt welding fittings |
| ANSI-B16.11 | Forged steel fittings, socket-welding and threaded |
| ANSI-B16.14 | Ferrous pipe plug, bushings and locknuts with piple threads |
| ANSI-B16.25 | Butt welding ends |
| ANSI-B18.1.1 | Fire hose couplings screw thread |
| ANSI-B18.2.1 | Inch series square and hexagonal bolts and screws |
| ANSI-B18.2.2 | Square and hexagonal nuts |
| NSI-B18.21.1 | Lock washers |
| ANSI-B18.21.2 | Plain washers |
| ANSI-B31.1 | Power piping |
| ANSI-B36.10 | Welded and seamless wrought steel pipe |
| ANSI-B36.9 | Stainless steel pipe |
| **Other civil works standards** | |

| CODES | TITLE |
|---|---|
| IS-269 | 33 grade ordinary portland cement |
| IS2721 | Galvanized steel chain link fence fabric |
| IS-278 | Galvanized steel barbed wire for fencing |
| IS-383 | Coarse and fine aggregates from natural sources for concrete |
| IS-432 (P1 and P2) | Mild steel and medium tensile steel bars and hard-dawn steel wire for concrete reinforcement |
| IS-456 | Code of practice for plain and reinforced concrete |
| IS-516 | Method of test for strength of concrete |
| IS-800 | Code of practice for general construction in steel |
| IS-806 | Steel tubes for structural purposes |
| IS-1172 | Basic requirements for water supply, drainage and sanitation |
| IS-1199 | Methods of sampling and analysis of concrete |
| IS-1566 | Hard-dawn steel wire fabric for concrete reinforcement |
| IS-1742 | Code of Practice for Building drainage |
| IS-1785 | Plain hard-drawn steel wire for pre-stressed concrete |
| IS-1786 | High strength deformed Steel Bars and wires for concrete reinforcement |
| IS-1811 | Methods of sampling Foundry sands |
| IS-1893 | Criteria for earthquake resistant design of structures |
| IS-2062 | Steel for general structural purposes |
| IS-2064 | Selection, installation and maintenance of sanitary appliances-code of practices |
| IS-2065 | Code of practice for water supply in buildings |
| IS-2090 | High tension steel bars used in pre-stressed concrete |
| IS-2140 | Standard Galvanized steel wire for fencing |
| IS-2470 (P1 & P2) | Code of practice for installation of septic tanks |
| IS-2514 | Concrete vibrating tables |
| IS-2645 | Integral cement waterproofing compounds |
| IS-3025 (Part 1 to Part 48) | Methods of sampling and test (Physical and chemical) for water and waste water |
| IS-4091 | Code of practice for design and construction of foundations for transmission line towers and poles |
| IS-4111 (Part 1 to P5) | Code of practice for ancillary structures in sewerage system |
| IS-4990 | Plywood for concrete shuttering work |
| IS-5600 | Sewage and drainage pumps |
| **National building code of India 1970** | |
| USBR E12 | Earth Manual by United States Department of the interior Bureau of Reclamation |
| ASTM-A392-81 | Zinc/Coated steel chain link fence fabric |
| ASTM-D1557-80 | test for moisture-density relation of soils using 10-lb (4.5 kg) |

| CODES | TITLE |
|---|---|
| | rame land 18-in. (457 mm) Drop |
| ASTM-D1586(1967) | Penetration Test and Split-Barrel Sampling of Soils |
| ASTM-D2049-69 | Test Method for Relative Density of Cohesionless Soils |
| ASTM-D2435 | Test method for Unconsolidated, (1982)<br>Undrained Strengths of Cohesive Soils in Triaxial Compression |
| BS-5075 | Specification for accelerating Part I Admixtures, Retarding Admixtures and Water Reducing Admixtures |
| CPWD | Latest CPWD specifications |
| **ACSR MOOSE CONDUCTOR** | |
| IS:6745<br>BS:443-1969 | Methods for Determination of<br>Mass of zinc coating on zinc<br>coated Iron and Steel Articles |
| IS:8263 | Methods for Radio Interference |
| IEC:437-1973<br>NEMA:107-1964<br>CISPR | Test on High Voltage Insulators |
| IS:209, BS:3436-1961 | Zinc Ingot |
| IS:398 Part - V<br>IEC:209-1966 | Aluminum Conductors for Overhead Transmission Purposes |
| BS:215(Part-II),<br>IEC:209-1966 | Aluminium Conductors galvanized steel reinforced extra high voltage (400 kV and above) |
| IS:1778, BS:1559-1949 | Reels and Drums for Bare Conductors |
| IS:1521, ISO/R89-1959 | Method for Tensile Testing of steel wire |
| IS:2629 | Recommended practice for Hot dip Galvanising on Iron and Steel |
| IS:2633 | Method for Testing Uniformity of coating of zinc Coated Articles |
| IS:4826/<br>ASTMA-472-729 | Hot dip galvanised coatings on round steel wires |
| **GALVANISED STEEL EARTHWIRE** | |
| IS:1521, ISO/R:89-1959 | Method for Tensile Testing of Steel Wire |
| IS:1778 | Reels and Drums for Bare Conductors |
| IS:2629 | Recommended practice for Hot Dip Galvanising on Iron and Steel |
| IS:2633 | Methods for testing Uniformity of Coating of Zinc Coated Articles |
| IS:4826/ ASTM:<br>A 475-72a<br>BS:443-1969 | Hot dip Galvanised Coatings on Round Steel Wires |
| IS:6745/ BS:443-1969 | Method for Determination of mass of Zinc Coating on Zinc coated Iron and Steel Articles. |
| IS:209/ BS:3463-1961 | Zinc ingot |
| IS:398 (Pt. I to P5:1992)/<br>BS:215 (Part-II | Aluminum Conductors for overhead transmission purposes |

| CODES | TITLE |
|---|---|
| **Lighting Fixtures and Accessories** | |
| IS:1913 | General and safety requirements for electric lighting fittings |
| IS:3528 | Water proof electric lighting fittings |
| IS:4012 | Dust proof electric lighting fittings |
| IS:4013 | Dust tight proof electric lighting fittings |
| IS:10322 | Industrial lighting fittings with metal reflectors |
| IS:10322 | Industrial lighting fittings with plastic reflectors |
| IS:2206 | Well glass lighting fittings for use under ground in mines (non-flameproof type) |
| IS:10322 | Specification for flood light |
| IS:10322 | Specification for decorative lighting outfits |
| IS:10322 | Luminaries for street lighting |
| IS:2418 | Tubular fluorescent lamps |
| IS:9900 | High pressure mercury vapour lamps |
| IS:1258 | Specification for Bayonet lamp fluorescent lamp |
| IS:3323 | Bi-pin lamp holder tubular fluorescent lamps |
| IS:1534 | Ballasts for use in fluorescent lighting fittings.<br>(Part-I) |
| IS:1569 | Capacitors for use in fluorescent lighting fittings |
| IS:2215 | Starters for fluorescent lamps |
| IS:3324 | Holders for starters for tubular fluorescent lamps |
| IS:418 | GLS lamps |
| IS:3553 | Water tight electric fittings |
| IS:2713 | Tubular steel poles |
| IS:280 | MS wire for general engg. Purposes |
| **Conduits, Accessories and Junction Boxes** | |
| IS:9537 | Rigid steel conduits for electrical wiring |
| IS:3480 | Flexible steel conduits for electrical wiring |
| IS:2667 | Fittings for rigid steel conduits for electrical wiring |
| IS:3837 | Accessories for rigid steel conduits for electrical wiring |
| IS:4649 | Adaptors for flexible steel conduits |
| IS:5133 | Steel and Cast Iron Boxes |
| IS:2629 | Hot dip galvanising of Iron & Steel |
| **Lighting Panels** | |
| IS:13947 | LV Switchgear and Control gear(Part 1 to 5) |
| IS:8828 | Circuit breakers for over current protection for house hold and similar installations |
| IS:5 | Ready mix paints |
| IS:2551 | Danger notice plates |
| IS:2705 | Current transformers |

| CODES | TITLE |
|---|---|
| IS:9224 | HRC Cartridge fuse links for voltage above 650V(Part-2) |
| IS:5082 | Wrought aluminium and Al. alloys, bars, rods, tubes and sections for electrical purposes |
| IS:8623 | Factory built Assemblies of Switchgear and Control Gear for voltages upto and including 1000V AC and 1200V DC |
| IS:1248 | Direct Acting electrical indicating instruments |
| **Electrical Installation** | |
| IS:1293 | 3 pin plug |
| IS:371 | Two to three ceiling roses |
| IS:3854 | Switches for domestic and similar purposes |
| IS:5216 | Guide for safety procedures and practices in electrical work |
| IS:732 | Code of practice for electrical wiring installation (system voltage not exceeding 650 Volts.) |
| IS:3043 | Code of practice for earthing |
| IS:3646 | Code of practice of interior illumination part II & III |
| IS:1944 | Code of practice for lighting of public through fares |
| IS:5571 | Guide for selection of electrical equipment for hazardous areas |
| IS:800 | Code of practice for use of structural steel in general building construction |
| IS:2633 | Methods of Testing uniformity of coating on zinc coated articles |
| IS:6005 | Code of practice for phosphating iron and steel |
| | INDIAN ELECTRICITY ACT |
| | INDIAN ELECTRICITY RULES |
| **LT SWITCHGEAR** | |
| IS:8623 (Part-I) | Specification for low voltage switchgear and control gear assemblies |
| IS:13947 (Part-I) | Specification for low voltage switchgear and control gear, Part 1 General Rules |
| IS:13947 (part-2) | Specification for low voltage switchgear and control gear, Part 2 circuit breakers |
| IS:13947 (part-3) | Specification for low voltage switchgear and control gear. Part 3 Switches, Disconnectors, Switch-disconnectors and fuse combination units |
| IS:13947 (part-4) | Specification for low voltage switchgear and control gear. Part 4 Contactors and motors starters |
| IS:13947 (part-5) | Specification for low voltage switchgear and control gear. Part 5 Control-circuit devices and switching elements |
| IS:13947 (part-6) | Specification for low voltage switchgear and control gear. Part 6 Multiple function switching devices |
| IS:13947 (part-7) | Specification for low voltage switchgear and control gear. Part 7 Ancillary equipments |
| IS:12063 | Degree of protection provided by enclosures |

| CODES | TITLE |
|---|---|
| IS:2705 | Current Transformers |
| IS:3156 | Voltage Transformers |
| IS:3231 | Electrical relays for power system protection |
| IS:1248 | Electrical indicating instruments |
| IS:722 | AC Electricity meters |
| IS:5578 | Guide for Marking of insulated conductors of apparatus terminals |
| IS:13703 (part 1) | Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 1 General Requirements |
| IS:13703 (part 2) | Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC Part 2 Fuses for use of authorized persons |
| IS:6005 | Code of practice of phosphating iron and steel |
| IS:5082 | Wrought Aluminum and Aluminum alloys for electrical purposes |
| IS:2633 | Hot dip galvanising |

Note: If any standard is expired or does not exist anymore than other standard which has substituted it, shall be applicable.

**Annexure-G**

## MQP & INSPECTION LEVEL REQUIREMENT

| Sl. No | Item / Equipment | Reference document for inspection | Inspection Level |
|---|---|---|---|
| A.01 | LT Transformer /Power Transformer/ Reactor/ Converter Transformer/ Filter Reactor | MQP/ITP | IV |
| A.02 | Bushing | MQP | IV |
| A.03 | Insulating Oil | POWERGRID TS | III |
| A.04 | Oil storage tank for transformers | MQP | III |
| A.05 | Nitrogen injection based explosion prevention system | FAT/ITP | III |
| A.06 | On Line oil drying system for transformers | POWERGRID TS | II** |
| A.07 | On Line DGA and moisture monitoring system | POWERGRID TS | II** |
| A.08 | Flow sensitive conservator isolation valve | POWERGRID TS | II** |
| A.09 | Oil Filtration Machine | MQP | III |
| B.01 | Circuit Breakers | MQP | IV |
| B.02 | Current Transformers | MQP/ITP | IV |
| B.03 | CVT/PT/IVT | MQP | IV |
| B.04 | Isolators | MQP/ITP | IV |
| B.05 | Surge Arrestors | MQP/ITP | III |
| B.06 | Line Trap & Air Core Reactor | MQP/ITP | III |
| B.07 | Point On switching device (CSD) for Circuit Breaker (wherever required) | FAT/ITP | IV |
| C.01 | STATCOM including Valve, valve base electronics, DC capacitor, series reactor and all accessories | ITP | IV |
| C.02 | Mechanically switched Reactor bank (3-ph) including all accessories (MSR Branches) | ITP | IV |
| C.03 | Mechanically switched Capacitor bank (3-ph) including all accessories (MSC Branches) | ITP | IV |
| C.04 | Harmonic Pass filters | ITP | IV |
| C.05 | HT Capacitor | MQP | IV |
| D.01 | Thyristor Valve | FAT/ITP | III |
| D.02 | PLC Capacitors for HVDC | FAT/ITP | III |
| D.03 | Valve Cooling system for | FAT/ITP | III |

**Annexure-G**

| Sl. No | Item / Equipment | Reference document for inspection | Inspection Level |
|---|---|---|---|
| | HVDC | | |
| D.04 | AC/DC Filter Resistors | ITP | III |
| D.05 | DC Current and Voltage measuring device for HVDC | FAT/ITP | III |
| D.06 | Maintenance platform for valve hall | POWERGRID TS | II |
| D.07 | Optical signal column for FSC | FAT/ITP | II |
| E.01 | GIS including spares | MQP/ITP | IV |
| E.02 | Dew Point Meter for GIS | POWERGRID TS | I* |
| E.03 | Portable Partial Discharge monitoring system for GIS | POWERGRID TS | I* |
| E.04 | Partial Discharge Monitoring System (Online) for GIS | ITP | III |
| E.05 | PEB Structure and Puf Panels | MQP | III |
| F.01 | Substation Automation system | FAT/MQP | III |
| F.02 | Event Logger | POWERGRID TS | III |
| F.03 | PLCC equipment Viz PLCC Terminal ,Carrier equipment, Protection Coupler , Coupling Device but excluding EPAX / HF Cable | MQP | III |
| F.04 | Control & Relay Panels | MQP | III |
| G.01 | EHV Cables | MQP/ITP | III |
| G.02 | Power Cables & Control Cables | MQP | III |
| G.03 | Cable Joints (11 kV and above) | POWERGRID TS | II |
| G.04 | Cable Lugs & Glands / Clamps/Terminations | POWERGRID TS | I |
| H.01 | LT Switchgear & ACDB/DCDB/MLDB/ELDB | MQP | III |
| H.02 | Battery | POWERGRID TS | II |
| H.03 | Battery Charger | MQP | III |
| H.04 | UPS & Voltage Stablizer | MQP/FAT | III |
| H.05 | D. G. Set | FAT/ITP | III |
| H.06 | Lighting Panel | POWERGRID TS | II |
| H.07 | Lighting Poles | POWERGRID TS | II |
| H.08.1 | Lighting Fixtures, Lighting Earthwire, Switches / sockets, Conduits, Lamps & fans including exhaust fans | POWERGRID TS | I |
| H.8.2 | Solar based LEDs System including street light/pole solar panel, Inverter controller/LED fixture | FAT | III |
| H.09 | MS/GI /PVC Pipes for cable | POWERGRID TS | I |

**Annexure-G**

| Sl. No | Item / Equipment | Reference document for inspection | Inspection Level |
|---|---|---|---|
| | trenches and lighting | | |
| H.10 | Outdoor Receptacle | POWERGRID TS | I |
| H.11 | Split A.C/window A.C./ precision AC/ Kiosk AC/ Cascade AC/ Tower AC | POWERGRID TS | I |
| H.12 | Occupancy sensors for control of lighting | POWERGRID TS | I |
| H.13 | Solar based street lighting pole including Solar Panel, Inverter, Controller, etc. | POWERGRID TS | III |
| H.14 | Junction Box / Lighting Switch Boards / Bay MB / Portable Flood Light Panel | POWERGRID TS | II |
| H.15 | Lighting transformer | POWERGRID TS | II |
| I.01 | SF6 gas processing unit, SF6 gas Leakage detector, SF6 gas Analyzer | POWERGRID TS | I* |
| I.02 | SF6 Gas | POWERGRID TS | I |
| I.03 | Spark Gap | FAT/ITP | III |
| I.04 | Time synchronizing Equipment (GPS Clock) | POWERGRID TS | I |
| I.05 | Galvanized Cable trays | POWERGRID TS | II |
| I.06 | Video Monitoring System | FAT/ITP | I |
| I.07 | Public Address System (All Components) | POWERGRID TS | I |
| I.08 | Building Management System (All components) | POWERGRID TS | I |
| I.09 | Access Control System (All Components) | POWERGRID TS | I |
| I.10 | Video Display system/ Video Projection system | POWERGRID TS | I |
| I.11 | VESDA (smoke detector) | POWERGRID TS | I |
| I.12 | High Mast Pole | MQP | III |
| J.01 | Aluminium ladder | POWERGRID TS | I |
| J.02 | Hume Pipes | POWERGRID TS | I |
| J.03 | Castle Key | POWERGRID TS | I |
| J.04 | Water Treatment plant (All components). | POWERGRID TS | I |
| J.05 | Furniture | POWERGRID TS | I |
| J.06 | DOL Starter | POWERGRID TS | I |
| J.07 | Oil Sample Bottles and Syringe | POWERGRID TS | I |
| J.08 | Test & Measuring Equipment, T&P | POWERGRID TS | I* |
| K.01 | EOT Crane | POWERGRID TS | II |

**Annexure-G**

| Sl. No | Item / Equipment | Reference document for inspection | Inspection Level |
|---|---|---|---|
| K.02 | Boom Crane/Golf Cart/Platform Truck/Man Lift/ Fork Lift/ Lifts | POWERGRID TS | II |
| L.00 | Fire Protection System | | |
| L.001 | Panels, Hydro pneumatic tank for fire protection system. | POWERGRID TS | III |
| L.002 | Deluge valve, Strainers, MS/GI pipes, Pumps, motors, air compressor, and other valves, Diesel Engines | POWERGRID TS | II |
| L.003 | Others | POWERGRID TS | I |
| M.00 | HVAC SYSTEM | | |
| M.001 | Air Cooled Chiller | POWERGRID TS | III |
| M.002 | Pump | POWERGRID TS | II |
| M.003 | Air Handling Unit | POWERGRID TS | II |
| M.004 | Fan Filter Unit With Centrifugal Blower | POWERGRID TS | II |
| M.005 | Axial Flow Fan | POWERGRID TS | II |
| M.006 | Main Climate Control Unit (Dehumidifier) | POWERGRID TS | I |
| M.007 | Dampers | POWERGRID TS | II |
| M.008 | Fire Dampers | POWERGRID TS | II |
| M.009 | Pressure Gauge, Thermometers, Other Instruments / Sensors | POWERGRID TS | I |
| M.010 | Grill, Diffuser, Jet Nozzle, Louvers etc | POWERGRID TS | I |
| M.011 | Ducting | POWERGRID TS | III |
| M.012 | M S Pipe | POWERGRID TS | II |
| M.013 | Pipe Insulation Material | POWERGRID TS | I |
| M.014 | Duct Insulation Material | POWERGRID TS | I |
| M.015 | Underdeck Insulation Material | POWERGRID TS | I |
| M.016 | Gate Valve & Non Return valve | POWERGRID TS | I |
| M.017 | Y Strainer | POWERGRID TS | II |
| M.018 | Ball Valve/ Motorised Butterfly Valve/ Balancing Valve | POWERGRID TS | I |
| M.019 | Closed Expansion Tank | POWERGRID TS | II |
| M.020 | Air Separator | POWERGRID TS | I |
| M.021 | MCC /PLC /Electrical Panels | POWERGRID TS | III |
| M.022 | Propeller Fan/ Conduit | POWERGRID TS | II |
| M.023 | Air Filter/ Mixing Valve with Thermostat | POWERGRID TS | I |

**Annexure-G**

| Sl. No | Item / Equipment | Reference document for inspection | Inspection Level |
|---|---|---|---|
| N.01 | SDH Equipment | FAT/ITP | IV |
| N.02 | Termination Equipment Primary/ DI Multiplexer | FAT/ITP | IV |
| N.03 | DACS | FAT/ITP | IV |
| N.04 | Optical Amplifier | FAT/ITP | IV |
| N.05 | FODP including pigtail, Joint Box, FDMS | FAT/ITP | II |
| N.06 | IMPS | FAT/ITP | IV |
| N.07 | Optical bypass switch | FAT/ITP | IV |
| N.08 | Air Purifier | FAT/ITP | I |
| N.09 | Patch cord & connector | FAT/ITP | I |
| N.10 | NMS | FAT/ITP | IV |
| N.11 | OPGW Cable | MQP/ITP/FAT | III |
| N.12 | Hardware Fittings for OPGW cable | MQP/ITP | III |
| N.13 | DCPS | FAT/ITP | III |
| N.14 | Radio Links | FAT/ITP | III |
| N.15 | SMPS based DC Power Supply (DCPS) system | FAT/ITP | III |
| N.16 | WAMS (PMU & Accessories) | FAT/ITP | III |
| N.17 | PUF Shelter | FAT/ITP | III |
| N.18 | Aerial OFC/UGOFC/ADSS/FO Cable | FAT/ITP | III |
| N.19 | DWDM | FAT/ITP | III |
| N.20 | OTN | FAT/ITP | III |
| N.21 | MPLS-TP Equipment | FAT/ITP | III |
| N.22 | L2 Switch | FAT/ITP | III |
| N.23 | IP-MPLS Router | FAT/ITP | III |
| N.24 | HDPE Pipes | POWERGRID TS | II |
| N.25 | Equipment Cabinets | POWERGRID TS | II |
| N.26 | Main Distribution Frame | POWERGRID TS | I |
| N.27 | Telephone system, EPAX, Telephone wires, Telephone sockets | POWERGRID TS | I |
| N.28 | Fibre Optic Cable | MQP | III |
| N.29 | Hardware Fittings for Fibre Optic cable | MQP | III |
| O.01 | Re-rollers of MS/HT Angle Section and galvanized tower parts. | MQP | IV |
| O.02 | Conductor | MQP | IV |
| O.03 | Hardware fittings and Conductor & Earthwire Accessories | MQP | IV |
| O.04 | Earth wire | MQP | IV |

**Annexure-G**

| Sl. No | Item / Equipment | Reference document for inspection | Inspection Level |
|---|---|---|---|
| O.05 | Insulator | MQP | IV |
| O.06 | Bolts & Nuts of Gr 8.8 / 8 | MQP | IV |
| O.07 | Mono Pole | MQP | IV |
| O.08 | Foundation Bolts & Anchor Bolts | POWERGRID TS | III |
| O.09 | D-shackle/ Hanger / Links and associated Special bolt/nuts | MQP | III |
| O.10 | Span Marker, Obstruction lights and Wind Measuring Equipment | POWERGRID TS | III |
| O.11 | MS ROD rolled by Approved Re-roller of POWERGRID | MQP | III |
| O.12 | MS ROD rolled by Approved steel producers of POWERGRID | POWERGRID TS | I |
| O.13 | Spring Washers & Pack washers | POWERGRID TS | II |
| O.14 | Bolts & Nuts Gr up to 5.6/5 | POWERGRID TS | II |
| O.15 | ACD & Barbed wire for ACD/Bird guard | POWERGRID TS | II |
| O.16 | Danger Plate /Phase Plate / Number Plate / Circuit plate | POWERGRID TS | I |
| O.17 | Sub Station Structure (lattice/pipe type) | MQP | III |
| O.18 | Clamps & Connecters (including equipment connectors) | MQP | III |
| O.19 | MS/ GI Flat, rod type, pipe type and other earthing material. | POWERGRID TS | II |
| O.20 | Aluminium Tube & Busbar materials | POWERGRID TS | II |
| O.21 | Pipe Type & Counter Poise Earthing | POWERGRID TS | II |
| O.22 | DTS System | POWERGRID TS | II |

For Equipment where requirement of MQP is envisaged, ITP/FAT will be followed If sourced from off shore. For items required in S/S or T/L or TELECOM/LD&C , same inspection level as specified shall be followed for all the cases.

*MICC for test and measuring equipment (inspection level I or II) shall be issued only after actual verification/ demonstration of satisfactory performance at site.

** Though level-2 items, CIP/MICC can be issued also on review of TCs and visual inspection of these item.

| Sl. No. | Power System Equipment | Minimum Local Content (%) |
|---|---|---|
| | | |
| 1 | Power Transformers (up to 765 kV, including Generator Transformers) | 60 |
| 2 | Instrument Transformer (up to 765 kV) | 60 |
| 3 | Transformer Oil Dry Out System (TODOS) | 60 |
| 4 | Reactors up to 765 kV | 60 |
| 5 | Oil Impregnated Bushing (Up to 400kV) | 60 |
| 6 | Resin Insulated Paper (RIP) bushings (up to 145 kV) | 50 |
| 7 | Circuit Breakers (up to 765kV AC-Alternating Current) | 60 |
| 8 | Disconnectors/ Isolators (up to 765kV AC) | 60 |
| 9 | Wave Trap (up to 765kV AC) | 60 |
| 10 | Oil Filled Distribution Transformers up to & including 33kV [Cold Rolled Grain Oriented (CRGO)/Amorphous, Aluminium/Copper wound] | 60 |
| 11 | Dry type Distribution Transformers up to & including 33kV (CRGO/Amorphous, Aluminium/Copper wound) | 60 |
| 12 | Conventional conductor | 60 |
| 13 | Accessories for conventional conductors | 60 |
| 14 | High Temperature/High Temperature Low Sag (HTLS) conductors (such as Composite core, GAP, ACSS, INVAR, AL59) and accessories | 60 |
| 15 | Optical ground wire (OPGW)- all designs | 60 |
| 16 | Fiber Optic Terminal Equipment (FOTE) for OPGW | 50 |
| 17 | OPGW related Hardware and accessories | 60 |
| 18 | Remote Terminal Unit (RTU) | 50 |
| 19 | Power Cables and accessories up to 33kV | 60 |
| 20 | Control cables including accessories | 60 |
| 21 | XLPE cables up to 220kV | 60 |
| 22 | Substation Structures | 60 |
| 23 | Transmission Line Towers | 60 |
| 24 | Porcelain (Disc/Long Rod) Insulators | 60 |
| 25 | Bus Post Insulators (Porcelain) | 60 |
| 26 | Porcelain Disc Insulators with Room Temperature Vulcanisation (RTV) coating | 50 |
| 27 | Porcelain Long Rod Insulators with Room temperature Vulcanisation (RTV) coating | 50 |
| 28 | Hardware Fittings for porcelain Insulators | 60 |
| 29 | Composite/Polymeric Long Rod Insulators | 60 |
| 30 | Hardware Fittings for Polymer Insulators | 60 |
| 31 | Bird Flight Diverter (BFD) | 60 |
| 32 | Power Line Carrier Communication (PLCC) system (up to 800kV) | 60 |
| 33 | Gas Insulated Switchgear (up to 400kV AC) | 60 |
| 34 | Gas Insulated Switchgear (above 400kV AC) | 50 |
| 35 | Surge/Lightning Arrester (up to 765kV AC) | 60 |
| 36 | Power Capacitors | 60 |
| 37 | Packaged Sub-station (6.6kV to 33kV) | 60 |
| 38 | Ring Main Unit (RMU) (up to 33kV) | 60 |

| | | |
|---|---|---|
| 39 | Medium Voltage (MV) GIS panels (up to 33kV) | 60 |
| 40 | Automation and Control system/Supervisory Control and Data Acquisition (SCADA) system in Power system | 50 |
| 41 | Control and Relay panel (including Digital/Numerical relays) | 50 |
| 42 | Electrical motors 0.37kW to 1MW | 60 |
| 43 | Energy meters excluding smart meters | 50 |
| 44 | Control and Power cables and accessories (up to 1.1kV) | 60 |
| 45 | Diesel Generating (DG) set | 60 |
| 46 | DC system (DC Battery & Battery Charger) | 60 |
| 47 | AC and DC Distribution board | 60 |
| 48 | Indoor Air Insulated Switchgear (AIS) up to 33kV | 60 |
| 49 | Poles (PCC, PSCC, Rolled Steel Joist, Rail Pole, Spun, Steel Tubular) | 60 |
| 50 | Material for Grounding/earthing system | 60 |
| 51 | Illumination system | 60 |
| 52 | Overhead Fault Sensing Indicator (FSI) | 50 |
| 53 | Power Quality Meters | 50 |
| 54 | Auxiliary Relays | 50 |
| 55 | Load Break Switch | 50 |
| 56 | Cranes, EOT cranes, gantry crane & chain pulley blocks, etc | 60 |
| 57 | Elevator | 60 |
| Fire Protection and Detection system | | |
| 58 | Motor driven fire water pumps | 60 |
| 59 | Diesel engine driven fire water pumps | 60 |
| 60 | Hydrant system | 60 |
| 61 | High velocity water spray system | 60 |
| 62 | Medium velocity water spray system | 60 |
| 63 | Foam Protection system | 60 |
| 64 | Inert gas flooding system | 60 |
| 65 | Fire tenders | 60 |
| 66 | Portable fire-extinguishers | 60 |