## TECHNICAL QUALIFYING REQUIREMENT

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

**Remark:**

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

| PREPARED BY | REVIEWED BY | APPROVED BY |
|---|---|---|
| Soumik Banerjee | 06/10/21 | |

**BHARAT HEAVY ELECTRICALS LIMITED**
**TRANSMISSION BUSINESS ENGINEERING MANAGEMENT**
**NOIDA**

| | | | | |
|---|---|---|---|---|
| **DOCUMENT NO.** | TB-350-316-014A | **REV 00** | **PREPARED** | **CHECKED** | **APPROVED** |
| **TYPE OF DOC.** | TECHNICAL SPECFICATION | **NAME** | SB | DKS | VK |
| **TITLE** 400kV Spacer | | **SIGN** | | | |
| | | **DATE** | 06.10.2021 | 06.10.2021 | 06.10.2021 |
| | | **GROUP** | TBEM | | |
| | | **WO NO.** | | | |

| | |
|---|---|
| **CUSTOMER** | NPGC |
| **PROJECT** | 400/132/33 kV Switchyard for Nabinagar STPP |



**CONTENTS**



**Remarks:** It is to be noted that data and details of Guaranteed Technical Particulars (GTP) shall not be reviewed during Technical Evaluation/ Review, hence compliance of Guaranteed Technical Particulars (GTP) in line with Technical Specification shall be deemed to under complete compliance of bidder.

| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| **REV. NO.** | **DATE** | **ALTERED** | **CHECKED** | **APPROVED** | |
| **DISTRIBUTION** | | | | **TO** | |
| | | | | **COPIES** | |

## SECTION 1:
## CHECKLIST FOR TECHNICAL EVALUATION

Along with the technical offer/ bids, the bidder should submit this checklist confirming the inclusion of the enclosures as listed below,

| Sl. No. | Documents to be enclosed | Bidder to confirm (Please tick "Confirmed") |
|---|---|---|
| 1. | Unpriced BOQ duly mentioning "Quoted" for all the items, signed and sealed. | Confirmed |
| 2. | Annexure-A, B, C & D duly filled, signed and sealed. | Confirmed |
| 3. | Supporting documents for compliance of Technical Qualifying Requirement. | Confirmed |

Note: Any bidder not meeting the above requirement is liable for non-evaluation.

The above checklist is reviewed and verified for,

NIT Reference No.:

Name of Bidder:

Name of Equipment/ Material:

Name of Project:

Date: Bidder's Stamp & Signature

## SECTION 1

## SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES.

1. **SCOPE**

1.1. This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 400Kv & 132kV Clamps & Connectors complete with hardware in complete.

1.2. The Clamps & Connectors are required for the following Project

**Name of Customer :** **Nabinagar Power Generation Co. Pvt. Ltd. (JV between NTPC and Bihar State electricity Board)**

**Name of Project :** **400/132 kV Switchyard at Nabinagar STPP and extn. at 400 kV Nabinagar TPP (BRBCL)**

**2. TECHNICAL PARTICULARS**

2.1. The drawing for the Spacers have been enclosed at Annexure-A to Section-1.
2.2. The Technical Particulars of Clamps and Connectors shall be as per Standard Specification No. TB-235-316-019 & NTPC's Specification Chapter-E12.

**3. QUANTITIES**

3.1. As per Annexure-B to Section-1

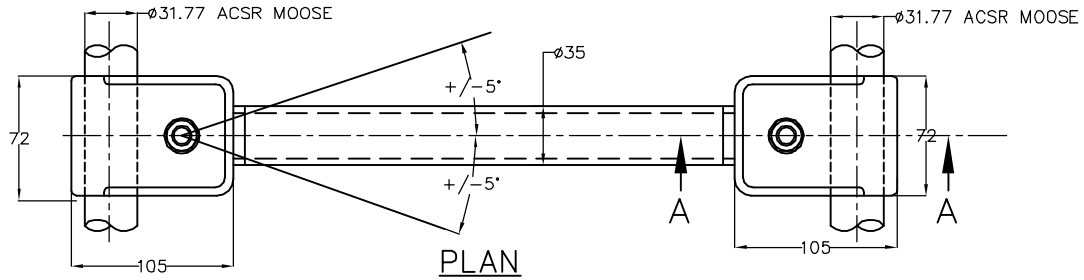
**4. TYPE TESTS**

4.1. The spacers to be supplied shall be of type tested design. During detail engineering, the Bidder / Contractor shall furnish for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

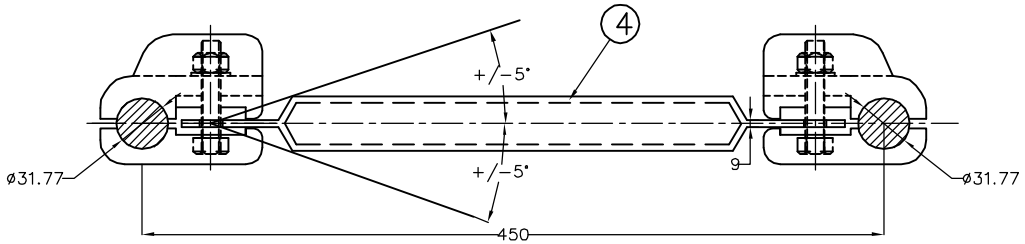
4.2. However if contractor is not able to submit report of type test(s) conducted in last ten years from the date of bid opening, or in case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client/owners representative and submit the reports for approval.

4.3. All acceptance and routine tests as per specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

4.4. The type test reports once approved for any projects shall be treated as reference. For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

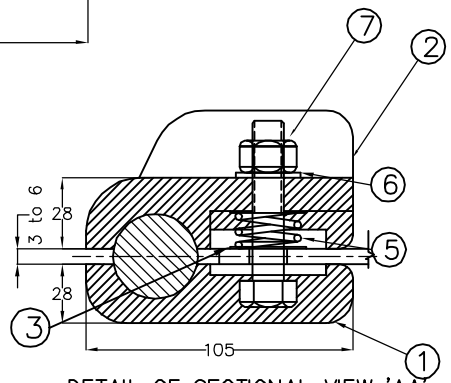



PLAN




ELEVATION

400kV Flexible Spacers (For Main Stringing) for Twin Moose ACSR with 450 mm Sub Conductor spacing




DETAIL OF SECTIONAL VIEW 'AA'

NOTES:

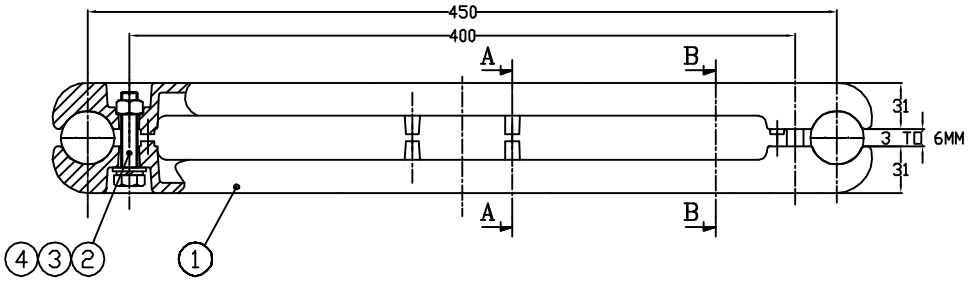
| | |
|---|---|
| 1. APPLICABLE STDS. | : IS:10162-1982 |
| 2. RATED VOLTAGE | : 400 KV |
| 3. RATED CURRENT | : N.A |
| 4. S.C. LEVEL | : 50kA / 1 Sec. |
| 5. RIV AT 266 KV | : < 1000 MICRO VOLTS |
| 6. CORONA EXTINCTION VOLT | : 320kV RMS |
| 7. APPROX WEIGHT | : 1.6 Kgs. |
| 8. BOLT TIGHTENING TORQUE | : 3.5 Kg M FOR M12 |
| 9. TEMPERATURE RISE | : 35°C ABOVE 50°C AMBIENT |

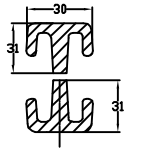
10. ALL DIMENSIONS ARE IN mm
11. ALL SHARP CORNERS SHALL BE ROUNDED OFF TO AVOID RIV AND CORONA
12. MANUFACTURING TOLERANCE
    UPTO 50mm : ±5% ; FROM 31 TO 100mm : ±4%;
    FROM 101 TO 300mm :±3% ; Above 300mm : ±2.5%
13. THE MINIMUM THICKNESS OF ANY CURRENT CARRYING PART OF THE CLAMP IS 10 mm
14. THE BOLTS, NUTS, AND PLAIN WHASHER SHALL BE MS HOT DIP GALVANISED AS PER IS:2629 AND TESTED AS PER IS:2633
15. THE SPRING WAHSER SHALL BE ELECTRO GALVANISED TO SUIT SERVICE CONDITION 3 OF IS:1573.
16. THE OUTER SURFACE OF THE CONNECTOR SHALL BE BUFFED

NOTES:(Parameters in line with IS:10162-1982)

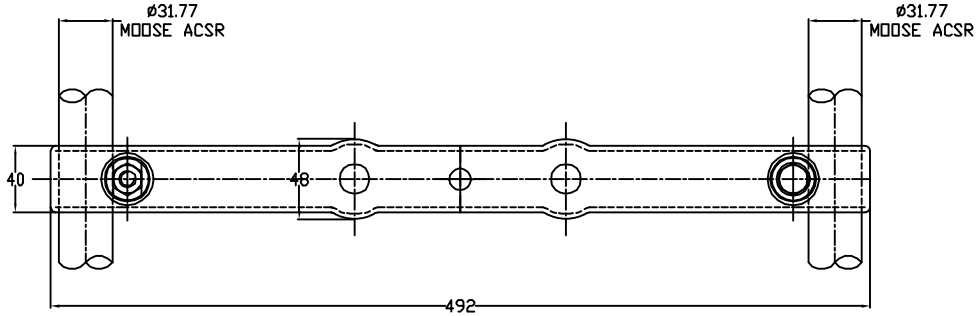
| | |
|---|---|
| 1. TENSILE STRENGTH | : 938 Kgs |
| 2. COMPRESSION STRENGTH | : 1875 Kgs |
| 3. MAGNETIC POWER LOSS | : < 1 WATT AT 600A |

4. LONGITUDINAL MOVEMENT PARALLEL TO THE CONDUCTOR IS ±50MM
5. VERTICAL MOVEMENT IN A VERTICAL DIRECTION AT RIGHT ANGLE TO THE CONDUCTOR IS ±25MM
6. TORSIONAL MOVEMENT/ANGULAR MOVEMENT IN A VERTICAL PLANE PARALLEL TO THE CONDUCTOR IS ±5°.

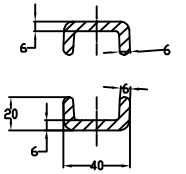



Section A–A




ELEVATION




Section B–B

400kV Rigid Spacers (For Jumpers) for Twin Moose ACSR conductor with 450 mm Sub Conductor spacing

NOTES:

1. APPLICABLE STDS. : IS:10162–1982
2. RATED VOLTAGE : 400 KV
3. RATED CURRENT : N.A
4. S.C. LEVEL : 50kA / 1 Sec.
5. RIV AT 266 KV : < 1000 MICRO VOLTS
6. CORONA EXTINCTION VOLT : 320kV RMS
7. APPROX WEIGHT : 1.6 Kgs.
8. BOLT TIGHTENING TORQUE : 3.5 Kg M FOR M12
9. TEMPERATURE RISE : 35°C ABOVE 50°C AMBIENT
10. ALL DIMENSIONS ARE IN mm
11. ALL SHARP CORNERS SHALL BE ROUNDED OFF TO AVOID RIV AND CORONA
12. MANUFACTURING TOLERANCE
    UPTO 50mm : ±5% ; FROM 31 TO 100mm : ±4%
    FROM 101 TO 300mm :±3% ; Above 300mm : ±2.5%
13. THE MINIMUM THICKNESS OF ANY CURRENT CARRYING PART OF THE CLAMP IS 10 mm
14. THE BOLTS, NUTS, AND PLAIN WHASHER SHALL BE MS HOT DIP GALVANISED AS PER IS:2629 AND TESTED AS PER IS:2633
15. THE SPRING WAHSER SHALL BE ELECTRO GALVANISED TO SUIT SERVICE CONDITION 3 OF IS:1573.
16. THE OUTER SURFACE OF THE CONNECTOR SHALL BE BUFFED

NOTES: (Parameters in line with IS:10162–1982)

1. TENSILE STRENGTH : 938 Kgs
2. COMPRESSION STRENGTH : 1875 Kgs
3. MAGNETIC POWER LOSS : < 1 WATT AT 600A

| | | | |
|---|---|---|---|
| **Project:** NPGC Nabinagar | | | |
| **Customer:** NPGCL | | | |
| | | | |
| **BOQ for Spacers for 400/132/33 kV Switchyard for Nabinagar STPP** | | | |
| | | | |
| **BOQ Item No.** | **Connnector Type** | **Unit** | **Qty** |
| | | | |
| 1 | 400kV Rigid Spacers Twin Moose ACSR (ACSR Moose Conductor Overall Diameter = 31.77mm) | No. | 30 |
| 2 | 400kV Flexible Spacers for Twin Moose ACSR (ACSR Moose Conductor Overall Diameter = 31.77mm) | No. | 328 |
| | | | |
| | | | |
| | | | |
| | | | |

# SECTION 2

## EQUIPMENT SPECIFICATION

The Technical Particulars of Clamps and Connectors shall be as per attached Standard Specification No. TB-235-316-019 (11 sheets) & NTPC's specification Chapter E-12 (4-Pages).

| | |
|---|---|
| 5.00.00 | **SPACERS** |
| 5.01.00 | Spacers shall conform to IS:10162. They shall be of non-magnetic material except nuts and bolts, which shall be of hot dip galvanised mild steel. |

| | |
|---|---|
| 5.02.00 | Spacers shall generally meet the requirements of clamps and connectors as specified above. Its design shall take care of fixing and removing during installation and maintenance. |
| 5.03.00 | In addition to the type tests as per IS:10162, clamp slip test should have been conducted. In this test the sample shall be installed on test span of twin/quad bundle string at a tension of 44.2 kN (4500 kg). One of the clamps when subjected to a longitudinal pull of 2.5 kN (250 kg) parallel to the axis of conductor shall not slip, i.e. permanent displacement between conductor and clamp after the test shall not exceed 1.0 mm. This test should have been performed on all other clamps of the sample. |

# SECTION 2

# STANDARD SPECIFICATION

## 2.1 GENERAL

This section covers the general technical requirements of spacers and clamps & connectors. In case of any discrepancies between the requirements mentioned in this section and those specified in other section of this specification, the latter shall prevail and shall be treated as binding requirements.

### 2.1.1 Technical Particulars for spacers and Clamp & Connectors

| | | | | |
|---|---|---|---|---|
| Nominal system voltage | : | 400kV | 132 kV | 33kV |
| Highest system voltage | : | 420kV | 145 kV | 36kV |
| Current Rating | : | Compatible With Conductor rating | | |
| Short circuit current for | : | 50kA for 1sec | 31.5kA for 1sec | 25kA for 1sec |
| Frequency | : | 50 Hz +5% | 50 Hz +5% | 50 Hz +5% |
| Basic insulation level (1.2/50 microsecond wave) | : | 1425kVp | 650 kVp | 250kVp |
| Switching surge withstand | : | 1050 | --- | --- |
| System Earthing | : | | --- Effectively earthed --- | |
| Spacing between sub-conductors of the bus | : | 450mm | 250mm | |
| Maximum working tension : | | | | |
| a) Twin Conductor (kg per phase): | | 4000 | 4000 | 400 |
| b) Quad Conductor (kg per phase): | | 6000 | 4000 | 800 |
| Visual Corona withstand V | : | 320 kV | --- | --- |

## 2.2 Applicable Standards

The spacers and clamps & connectors shall strictly conform to the following Indian and International standards as appropriate **(latest standard shall be followed) :**

**List of Standards :**

| | |
|---|---|
| IS 617 | Aluminium and aluminium alloy ingots and castings for general engineering purposes. |
| IS 1363 (All Parts) | Hexagon head bolts, screws and nuts of product grade C |
| IS 1364 (All Parts) | Hexagon head bolts, screws and nuts of product grades A and B |
| IS 1367 (Part I) | Technical Supply Conditions for threaded fasteners. |
| IS 1367 (Part 2) | Technical Supply Conditions for threaded fasteners. |
| IS 1367 (Part 3) | Technical Supply Conditions for threaded fasteners. |
| IS 1367 (Part 13) | Technical Supply Conditions for threaded fasteners. |
| IS 2121 (Part -1 & 2) | Specification for conductors and earthwire accessories for overhead power lines |
| IS 2121 (Part -3) | Specification for conductors and earthwire accessories for overhead power lines. |
| IS 2121 (Part -4) | Specification for conductors and earthwire accessories for overhead power lines |
| IS 5561 | Electric power connectors. |

| | |
|---|---|
| IS 2633 | Methods for testing uniformity of coating of zinc coated articles. |
| IS 1573 | Electroplated coating of Zinc on Iron and Steel |
| IS 3138 | Hexagonal Bolts & Nuts (M42 to M150) |
| IS 4218 (Parts 1,2 & 4) | Metric Screw Threads |
| IS 4218:(Part 3) | Metric Screw Threads |
| IS 4218:(Part 6) | Metric Screw Threads |
| IS 10162 | Spacers & spacer dampers for twin horizontal bundle conductors |
| ISO 272 | Fasteners: Hexagonal Products -Width across Flats. |
| ISO 898 | Fasteners, Screws & Studs |
| NEMA CC1 | Electric power connectors for sub-station |
| NEMA CC3 | Connectors for use between Aluminium or Aluminium-Copper Overhead Conductors. |
| IS 816 | Code of practice for use of metal arc welding for general construction in mild steel. |
| IS 4759 | Hot dip zinc coatings on structural steel and other allied products. |
| IS 2629 | Recommended practice for hot dip galvanising of iron and steel. |

## 2.3 Clamps and Connectors

2.3.1 All the current carrying parts shall be designed and manufactured to have minimum resistance. Maximum tension per conductor is expected to be 2000 kg for twin bundle and 1500 kg per conductor in case of quad bundle for 400 kV & 132 kV. Clamps and fittings shall be so designed that the equipment shall not be subject to any abnormal stresses due to thermal changes in conductor. All the clamps and fittings shall enable the connection to be as short as possible. Wherever possible they shall be in two separate halves. No U bolts shall be used. Corona control ring shall be of such design and shape that they will prevent visual discharge forming on the hardware assemblies. They shall have minimum thickness of 2.5mm. All similar parts, particularly the removable one shall be interchangeable with one another.

2.3.2 The clamps and connectors shall be made of materials listed below:-

a) For connecting ACSR conductor material designation A6 of IS 617: [illegible] for bolted type.

b) For connecting equipment terminals made of copper or brass to ACSR/AAC conductor, Bimetallic connector made from aluminium alloy casting with 2mm thick bimetallic liner shall be provided.

c) For connecting GI shield wire : Galvanised steel.

d) Bolts, nuts, plan washers shall be hot dip galvanized & spring washers of spring steel (E.G.)

e) Wherever crimping is involved , such clamps shall be forged /extruded.

f) For copper to copper and copper to brass or brass connectors- copper alloy of the following composition shall be used:

| | |
|---|---|
| Zinc | 2 to 3% |
| Lead | 2 to 2.5% |
| Tin | 0.6 to 1.5% |
| Iron | 0.5 to 1.0% |
| Copper | 92% to 94% |

The impurities if present shall not exceed the limits as indicated, below:

| | |
|---|---|
| Nickel | 0.03% |
| Antimony | 0.03% |
| Manganese | 0.04% |
| Silicon | 0.04% |
| Phosphorous | 0,04% |

g) All casting shall be free from below holes surface blisters and shall be rounded off.

h) All sharp edges and corners hall be blurred and rounded off.

i) Thickness of the clamps and connectors shall not be less than 10mm.

j) Bolts and nuts shall have hexagonal heads and threads as per Indian standard. Rated torque of the nuts shall be indicated on drawing.

k) For bimetallic clamps or connectors copper alloy liner of minimum thickness 2mm shall be cast integral with the aluminium alloy body. Equivalent bimetallic sleeve/ strips can also be provided.

k) For flexible connectors, braids or laminated straps shall be made from tinned copper strips or aluminium laminates depending upon the clamp. All Aluminium conductors of adequate current, mechanical stability & flexibility can also be provided.

l) Each clamp/ connector shall be identified with respective BOM & Drawing number.

m) The clamp shall be designed to carryout the same current as the conductor as specified in the specification. The temperature rise when carrying full load current shall not exceed 75°C for site ambient temperature.

n) Clamps and connectors shall be designed to be corona controlled. Corona extinction voltage for 400KV class clamps shall not be less than 320KV (rms) & and R.I.V. level shall not be more than 1000 micro volts at the test voltage specified in respective sections.

p) There should not be any significant change in Radio interference of associated conductor with & without clamps & fittings.

q) **Designs:**

Responsibility of satisfactory design of the clamps/connectors to safely withstand the specified mechanical stresses and carry the rated current without exceeding the temperature rise specified, shall solely rest with the bidder.

2.3.3 **Clamps and Connectors-Tests**

**A. Type Tests**

The clamps and connectors shall be subject to type tests as per IS-5561 . Type tests shall be carried out on three clamps and connectors of each type and design. All clamps and connectors shall also be type tested as per applicable clause no. as indicated against each test for the following in addition to the other tests indicated in IS-5561.

i) Temperature Rise test (Clause 12)

ii) Short time current test (Cl.No.13)

iii) Resistance test (Cl.No. 11)

iv) Tensile test (Cl. No. 10)

v) Dimensional Check (Cl. No. 14)

vi) Galvanization Test (Where applicable)(Cl. 15)

vii) Visual Corona & RIV test ( for 400 kV systems )

**B. Acceptance Test**

Following acceptance tests shall be carried out as per applicable clause no. of IS:5561:1970 indicated against each test :

i) Resistance test (Cl.No. 11)

ii) Tensile test (Cl.No. 10)

iii) Dimensional Check (Cl.No. 14)

iv) Galvanization Test (Where applicable) (Cl.15)

**C. Routine Test**

Following Routine tests shall be carried out as per applicable clause no. of IS:5561:~~1970~~ indicated against each test :

i) Visual Check

ii) Dimensional Check (Cl.No.14)

## 2.4 SPACERS

### 2.4.1 General :

Spacer shall conform to IS : 10162. The spacers are to be located at a suitable spacing to limit the short circuit forces and also to avoid snapping of sub conductors during short circuit conditions. Necessary spacer span calculation shall be provided by the contractor during engineering for the approval

### 2.4.2 Constructional Features

a) No magnetic material shall be used in the fabrication of spacers except for GI bolts and Nuts.

b) Spacer design shall be made to take care of fixing and removing during installation and maintenance

c) The design of the spacers shall be such that the conductor dose not come in contact with any sharp edge.

### 2.4.3 Tests

Each type of spacer shall be subjected to at least the following type tests, acceptance tests and routine tests in addition to all other tests specified in IS 10162:

A. **Type Tests**

a) **Clamp slip tests**

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

b) Fault current test as per CI 5.14.2 of IS : 10162

**c) Corona Extinction Voltage test (Dry)**

This test shall be performed as per procedure mentioned at **Annexure-A, section –3.** Minimum corona extinction voltage shall be 320kV (rms) line to ground for 400 kV

**d) RIV Test (Dry)**

This test shall be performed as per procedure mentioned at **Annexure-A, Section-3.** Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz at 320KV rms for 400KV system (1000 micro volts)

e) Resilience test ( where applicable )

f) Log decrement test (applicable only for spacer dampers )

g) Compression test.

h) Galvanising test.

i) Movement test

j) Clamp bolt torque test

k) Assembly torque test

l) Tensile load test

m) Compression and pull off test.

n) Vibration test

o) Magnetic power loss test

**B. Acceptance Test (As per IS : 10162 (Latest Version)**

a) Visual examination

b) Dimensional verification

c) Movement test

d) Clamp slip test

e) Clamp bolt torque test (if applicable)

f) Assembly torque test

g) Compression test

h) Tension test

i) Galvanising test

j) Hardness test for neoprene (if applicable)

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

k) Ultimate Tensile Strength Test ( where applicable )

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

**C Routine test**

a) Visual examination

b) Dimensional verification

**ANNEXURE - A1**

# GALVANIZING

## PROCEDURE

If the steel surfaces are contaminated with marking paint, or welding slag, these must first be removed by mechanical means such as abrasive blasting or grinding.

Moulding sand on the surfaces of cast goods is removed by means of sand/shot blasting.

Grease and oil is usually removed in an alkaline degreasing solution. After washing in water, rust and mill scale are removed from the steel surfaces by pickling in diluted hydrochloric/sulphuric acid.

When dipping into the molten zinc, a fluxing agent must be used. The purpose of the fluxing agent is to dissolve oxides on both the steel and zinc to make pure metallic contact with each other.
In dry galvanizing the steel components are first pickled and then washed with water. They are then dipped in a flux solution of zinc-ammonium chloride in water and then dried at a temperature not greater than 120 deg. C. A thin layer of flux salts remains on the surfaces of the components. Dipping in molten zinc can therefore take place without further addition of fluxing agent.

Before the components are dipped into and withdrawn from the bath, the surface of the molten zinc is skimmed to remove oxides and flux residue. After withdrawl from the zinc bath, the components are cooled in water or air. They are then ready for touching-up, inspection and dispatch.

## HOT-DIP GALVANIZING OF SMALL COMPONENTS-CENTRIFUGING

Small components such as nails, nuts, bolts, washers and fittings are cleaned as described above and placed in perforated baskets, which are then dipped into the molten zinc. Upon withdrawl from the zinc bath, the basket is placed in a centrifuge. Rotation has the effect of throwing some of the zinc off the coated surfaces, leaving the components free from drop concentration and uneven deposits of zinc. As a result, the zinc layer is somewhat thinner, with a more matt- like surface, compared with individual dipping (which would in any case be far too expensive for small objects). Individual dipping also makes it difficult to avoid obtaining uneven deposits of zinc on certain sensitive areas, such as threads.

## WIRE AND TUBE GALVANIZING

Wire, strip material and tubing are hot-dip galvanized according to the dry or wet methods-or a combination of both-in continuously operating production lines. Immediately after withdrawl from the zinc bath excess zinc is wiped from wire (or blown off tubes) to give a smooth and uniform coating. The thickness of the zinc coating can be varied to some extent during the wiping or air blowing procedures.

## SHEET GALVANIZING:

Sheet metal is hot-dip galvanized on continuous production lines in which all the processes are linked together. The base material consists of cold-rolled sheet in coils. One coil welded to another to form an endless strip.

After degreasing the strip is pickled or oxidized. Oxides are then removed from the surfaces by reduction at 9500 C. At the same time the strip is soft-annealed. The surfaces of the strip, now chemically clean, are moved through a protective gas atmosphere and directly down into the zinc bath.

The strip is withdrawn from the bath vertically and passed through "air knives". Fine jets of air or steam are blown through the knives, wiping the zinc coating to he desired thickness.

After cooling, straightening and treatment against wet storage stain, the strip is cut into suitably sized sheets or rolled into coils for delivery or subsequent plastic coating, painting and/or profiling.

Thin sheet is galvanized with microlloyed, low-alloyed or high-alloyed zinc. The most important alloy additive is in all cases aluminium.

## INSPECTION AND TEST

Presence of any defect noticed on inspection shall render the material liable for testing or rejection. The supplier shall supply all samples and equipment and carry out the tests without any extra cost. 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 can be performed.

- Coating thickness as per IS 2633
- Uniformity of zinc as per IS 2633
- Adhesion test as per IS 2629
- Mass of zinc coating as per IS 6745

Galvanized material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall be subject to approval of BHEL, Transmission Projects.

# SECTION- 3

## PROJECT DETAILS & GENERAL TECHNICAL REQUIREMENTS

### 3.0 GENERAL

This section stipulates the General Technical Requirements under the Contract and will form an integral part of the Technical Specification.

The provisions under this section are intended to supplement general requirements for the materials, equipment and services covered under other sections of tender documents and are not exclusive. However in case of conflict between the requirements specified in this section and requirements specified under other sections, the requirements specified under respective sections shall prevail.

### 3.1 PROJECT INFORMATION:

| | Particular | Details | |
|---|---|---|---|
| a) | Customer | **Nabinagar Power Generating Company Ltd. (NPGC)** (A joint venture of NTPC Ltd. and Bihar State Electricity Board) | |
| b) | Project Title | 400/132 kV Switchyard including 400 kV & 33 kV Transmission Lines for Nabinagar Super Thermal Power Project (3X660 MW) at Nabinagar Bihar and extension of two line bays at 4X250MW Nabinagar TPP. | |
| c) | Location | **Nabinagar STPP**<br>(i.) Place : Nabinagar<br>(ii) District :Aurangabad<br>(iii.) State :Bihar | **Nabinagar TPP (BRBCL)**<br>(i.) Place : Nabinagar<br>(ii) District :Aurangabad<br>(iii.) State :Bihar |
| d) | Nearest Road Head | National Highway-2 (Approximately 25 kms from National highway) | |
| e) | Nearest Rail Head | Dehri-On-Sone (Approximately 30 kms from Railway Station) | |
| **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 RH | 100 % | |
| e) | Altitude | <500 MSL | |
| f) | Pollution Severity | High Pollution level (25mm/kV) | |
| g) | Seismic Zone | Zone-III | |
| **WIND DATA** | | | |
| a) | Basic Wind speed | 47m/sec | |
| b) | The risk co-efficient (K1) | 1.07 | |
| c) | Category of terrain | Category-2 | |

| | | |
|---|---|---|
| d) | Maximum wind pressure on steel members | 1500 N/m2 |

### 3.1.1 SYSTEM PARAMETERS:

| Sl.No. | Parameters | **400 kV** | **132 kV** | **33 kV** |
|---|---|---|---|---|
| 1 | Highest system voltage | 420 kV rms | 145 kVrms | 36 kVrms |
| 2 | Lightning Impulse voltage | ±1425kVp | ± 650kVp | ± 170kVp |
| 3 | Switching impulse voltage | ±1050kVp | -- | -- |
| 4 | Power frequency withstand for 1 min (rms) | 630 kV(rms) | 275 kV(rms) | 70 kV(rms) |
| 5 | Max. fault level (1 sec.) | 50 kA | 31.5kA | 25 kA |
| 6 | Minimum creepage distance | 10500 mm | 3625mm | 900 mm |

### 3.1.2 AUXILIARY POWER:

| Sl.No. | Nominal Connection Voltage | Variations in Voltage | Frequency | Phase | Neutral |
|---|---|---|---|---|---|
| 1 | 415V | ±10% | 50±5% | 3 | Solidly Earthed |
| 2 | 240V | ±10% | 50±5% | 4 | Solidly Earthed |

Combined variation of voltage and frequency shall be + 10%. Fault level of 415V system shall not be less than 20kA.

The minimum height of equipment supports shall be 2550mm. The various minimum heights of the switchyard shall be as given below from plinth level :

| Voltage | Equipment /1st Level | 2nd Level | 3rd Level |
|---|---|---|---|
| 132kV | 4600mm | 8500mm | 12500mm |
| 400kV (1½ breaker | 8000mm | 16000mm | -- |

## 3.2 INSTRUCTION TO BIDDERS:

The bidders shall submit the technical requirements, data and information as per the technical data sheets, provided in Section-4.

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

It is recognized that the bidders may have standardized on the use of certain components, materials, processes or procedures different than 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 the Purchaser. Unless brought out clearly, the Bidder shall be deemed to conform to this specification scrupulously. All deviations from the specification shall be clearly brought out in the respective schedule of deviations. Any discrepancy between the specification and the catalogues or the bid, if not clearly brought out in the schedule, will not be considered as valid deviation.

Except for lighting fixtures, 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. For lighting fixtures, makes shall be as defined in Section-Lighting System.

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 not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the switchyard 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 under supply shall be inter-changeable with one another.

The bidder shall supply type tested (including special tests as per tech. specification) equipment and materials. The test reports shall be furnished by the bidder along with equipment/ material drawings. In the event of any discrepancy in the test reports, (i.e., if any test report is not acceptable due to any design/ manufacturing changes or due to non-compliance with the Technical Specification and/ or applicable standard), the tests shall be carried out without any additional cost implication to the BHEL. BHEL reserves the right to get any or all type/tests conducted/repeated.

## 3.3 STANDARDS

3.3.1 The Contractor is required to follow local statutory regulations stipulated in the latest amended Electricity Supply Act 1948 and Indian Electricity Rules 1956, and other local rules and regulations.

3.3.2 The equipment to be furnished under this specification shall conform to latest issue with all amendments of standards and/or codes specified under respective section heads. The standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to compliment each other. The Contractor shall also note that list of standards presented in this specified is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC. When the specified requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.3.3 Other internationally accepted standards which ensure equivalent or better performance that that specified in the standards referred under section shall also be acceptable.

3.3.4 In case governing standards for the equipment is different from IS or IEC,the salient points of difference shall be clearly brought out in additional information schedule alongwith English language version of standard of relevant extract of the same. The

equipment conforming to standards other than IS/IEC shall be subject to Employer's approval.

3.3.5 The full names of the codes and standards mentioned in abbreviations under various equipment heads are as follows:

BS British Standards
IEC/CISPR International Electro-technical Commission
IS Bureau of Indian Standards
ISO International Organisation for Standards
NEMA National Electric Manufacturers Association

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

The 400 kV system is being designed to limit the power frequency over voltage of 1.5 p.u. and the switching surge over voltage to 2.5 p.u. In 400 kV system the initial value of temporary over voltage could be 2.0 p.u. for 1-2 cycles. All the equipment/materials covered in this specification shall perform all its function satisfactorily without undue strain, restrike etc. under such over voltage conditions.All equipment shall also perform satisfactorily under various other electrical, electromechanical and meteorological conditions of the site of installation. 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, (not applicable for this project) short circuit etc for the equipment.

The equipment shall also comply with the following:

a) All equipments shall be suitable for hot line washing.
b). To facilitate erection of equipment, all items to be assembled at site shall be "match marked"'.
c) Piping, if any, between equipment control cabinet or operating mechanism to marshalling box of the equipment, shall bear proper identification to facilitate the connection at site.
d) All equipment shall be supplied with necessary interpole cabling, and its cost shall be included in the cost of equipment.

## 3.5 ENGINEERING DATA

### 3.5.1 Drawings

All drawings submitted by the supplier including those submitted at the time of bid 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, the external connections, fixing arrangement required. The dimensions required for installation and interconnections with other equipment and materials, clearances and spaces required for installation and interconnections between various portions of equipment and any other information specifically requested in the specifications.

Each drawing submitted by the Contractor shall be clearly marked with the name of the Purchaser, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Purchaser, if so required.

The review of these data by the purchaser will cover only general conformance of the data to the specification and documents, interfaces with the equipment provided under specification, external connections and of the dimensions which might affect substation layout.. This review by the purchaser may not indicate a thorough review of the dimensions, quantities and details of the equipment, material, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the purchaser 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.

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

All engineering data submitted by the contractor after final process including review and approval by the purchaser shall form part of the contract document and the entire work performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the purchaser in writing.

### 3.5.2 Approval Procedure

The following procedure for submission and review/approval of the drawings, data,reports, information, etc. shall be followed by Contractor:

a. All data/information furnished by Vendor in the form of drawings, documents, catalogues or in any other form for NTPC's information/interface and/or review and approval are referred by the general term "drawings".

b. The 'Master drawings list' shall be submitted for review and approval of Employer before award of contract. The Contractor shall have to prepare and submit any other drawings and reference documents in addition to the drawings contained in the list, if so required during engineering stage as felt necessary by the Employer. Number of copies of the list for the distribution shall be as mutually agreed between Contractor and Employer.

c. All drawings (including those of subvendors') shall bear at the right hand bottom corner the 'title block' with all relevant information duly filled in. The format of title block shall approved by Engineer within thirty (30) days after the letter of award. The Contractor shall give this format to his subvendor along with his purchase order for subvendor's compliance. The size of title block basic format and its contents shall not be changed. All drawings shall be in English language. All dimensions shall be in metric units.

d. Contractor shall submit all the drawings in five (5) copies for review of Employer. Employer shall forward their comments within four (4) weeks of receipt of drawings.

e. Upon review of each drawings, depending on the correctness and completeness of the drawings, the same will be categorised and approval accorded in one of the following categories:

| | |
|---|---|
| CATEGORY I | Approved |
| CATEGORY II | Approved subject to incorporation of comments/modification as noted. Resubmit revised drawing incorporating the comments |
| CATEGORY III | Not approved. Resubmit revised drawings for Approval after incorporating comments/modifications as noted |
| CATEGORY IV | For information and records |

f. Contractor shall resubmit the drawings approved under Category II and III within three (3) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision number enclosed in a triangle (e.g 1.2.3. etc.)

g. In case Contractor does not agree with any specific comment, he shall furnish the explanation for the same to Employer consideration. In all such cases Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

h. It is the responsibility of the Contractor to get all the drawings approved in the Category I or IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

i. Contractor shall not make any changes in the portion of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawings identifying the changes (alongwith reasons for changes) for Employer's review and approval.

i. Approval of drawings will not in any way relieve the Contractor of his obligations of furnishing the equipment in accordance with the specification and shall not prevent subsequent rejection if such equipment is later found to be defective.

j. The drawing approval progress report shall be submitted in at least three (3) copies within one (1) week from the last date of the every month.

### 3.5.3 Erection Drawings.

a. Contractor shall furnish erection drawings for the guidance or commencement of erection or the first shipment, whichever is earlier. These shall generally comprise of fabrication/assembly drawings, various component/part details drawing, assembly, clearance data requirements, etc. The drawings shall contain details of components/ equipment with identification number, match marks, bill of materials, assembly procedures etc.

b. For all major equipment apart from above details, assembly sequence and instructions with check-lists shall be furnished in the form of erection manuals.

### 3.5.4 Instruction Manual

a. The Contractor shall submit to the Employer preliminary instruction manuals for all the equipments for review. The final instructions manuals incorporating Employer's comments and complete in all respect shall be submitted at least thirty (60) days before the first shipment of the equipment. The instruction manuals shall contain full details and drawings of all the equipments, the transportation, storage, installation, testing, operation and maintenance procedures, etc. separately for each component/equipment alongwith log record format. These instruction manuals shall be submitted in five (5) copies for approval.

b. If after commissioning and initial operation of the plant, the instruction manuals require any modifications/additions/changes, the same shall being corporated and the updated final instruction manuals shall be submitted .

c. The operating and maintenance instructions together with drawings (other than shop drawings) of the equipment, as completed, shall have sufficient details to enable the Employer to maintain, dismantle, reassemble and adjust all parts of the equipment. They shall give a step by step procedure for all operations likely to be carried out during the life of the plant/equipment, including erection, testing, commissioning, operation, maintenance dismantling and repair. Each manual shall also include a complete set of approved drawings together with performance/rating curves of the equipment and test certificates, wherever applicable. The contract shall not be considered completed for purpose of taking over until such instructions and drawings have been supplied to the Employer.

d. A separate section of the manual shall be for each size/type of equipment and shall contain a detailed description of construction and operation, together will all relevant pamphlets, drawings and list of parts with procedures for ordering spares. Maintenance instructions shall include charts showing lubrication, checking, testing and replacement procedure to be carried out daily, weekly, monthly and at longer intervals to ensure trouble free operation. Where applicable, fault location charts shall be included to facilitate finding the cause of mal-operation or breakdown. A collection of the manufacturer" standard leaflets will not accepted to be taken as a compliance of this clause. The manual shall be specifically compiled for the concerned project.

### 3.5.5 Final Submission of drawings and documents:

The Contractor shall furnish the following after approval of all drawings /documents and test reports:

a. List of drawings bearing the Employer's and Contractor's drawing number.
b. Ten (10) bound sets alongwith 4 CD-ROMs of all drawing.
c. All documents/designs in five (5) copies as noted above.
d. Contractor shall also furnish nine (9) bound sets of all as-built drawings including the list of all as-built drawings bearing drawing numbers. The Contractor shall also furnish four (4) sets of film reproducibles or CD-ROMs of all as-built drawings as decided by the Employer.
e. The Contractor shall also furnish eleven (11) copies of instruction manuals (after approval) for all the equipments.

### 3.5.6 TEST REPORTS

Five (5) copies of all test reports shall be supplied for approval before shipment of equipment. The report shall indicate clearly the standard value specified for each test to facilitate checking of the reports. After final approval seven bound copies of all type and routine test reports shall be submitted to Employer.

## 3.6 MATERIAL /WORKMANSHIP

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 and shall ensure satisfactory performance throughout the service life.

In case where the equipment, materials or components are indicated in the specification as "similar" to any special standard the purchaser shall decide upon the question of similarity. When required by the specification or when required by the purchaser 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 being understood that the cost as well as the time delay associated with the rejection shall be borne by the Contractor.

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

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.
The equipment offered in the bid only shall be accepted for supply, with the minimum modifications as agreed/accepted.

## 3.7 LIMIT OF CONTRACT

All the equipment, materials and services furnished by the manufacturer shall be complete in every respect with all mountings, fitting, fixtures and standard accessories normally provided with such equipment, and needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in technical specification and unless included in the list of exclusions. The manufacturer shall supply at no extra cost to Employer any additional material/service not

covered specifically but which are found to be required for fulfillment of the scope of work under specification.

## 3.8 PROVISIONS FOR EXPOSURE TO HOT AND HUMID CLIMATE

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

### SPACE HEATERS

The heaters shall be suitable for continuous operation at 230 V as supply voltage. On –off switch and fuse shall be provided.

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.

The heaters shall be suitably designed to prevent any contact between the heater wire and the air and shall consist of coiled resistance wire centered in a metal sheath and completely encased in a highly compacted powder of magnesium oxide or other material having equal heat conducting and electrical insulation properties or they shall consist of resistance wire wound on a ceramic and completely covered with a ceramic material to prevent any contact between the wire and the air. Alternatively, they shall consist of a resistance wire mounted into a tubular ceramic body built into an envelope of stainless steel or the resistance wire is wound on a tubular ceramic body and embedded in vitreous glaze. The surface temperature of the heaters shall be restricted to a value which will not shorten the life of the heater sheaths or that of insulated wire or other component in the compartments.

### FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistance 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.

### Ventilation opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

### Degree of Protection

The enclosure of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide 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: 13947 (Part –I) / IEC-947 (Part-I) / IS 12063/IEC 529. Type test report for degree of protection test, on each type of the box shall be submitted for approval.

## 3.9 RATING PLATES, NAME PLATES AND LABELS

3.9.1 The equipment nameplate should preferably be of stainless steel. In case of aluminium, it should be at least 2mm thick.. The inscription on the nameplate shall be engraved and no punching shall be accepted except for equipment serial number and year of manufacture. These nameplates shall be black with white engraved lettering.

3.9.2 The rated current, extended current rating and rated thermal current shall be clearly indicated in the name plate in case of current transformer.

3.9.3 Rated voltage, voltage factor and intermediate voltage shall be clearly indicated on the nameplate in case of capacitor voltage transformer.

3.9.4 Name plates of cubicles and panels may be made of non-rusting metal or 3 ply lamicoid.

3.9.5 Each switch shall a clear inscription identifying its function. Switches shall also have a clear inscription of each position indication.

## 3.10 GALVANISING :

3.10.1 The galvanised surface shall consist of a continuous film adhering to the steel. The finished surface shall be clean and smooth, and shall be free from defects like dissolved patches, base, spot, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surfaces, flaking or peeling off, etc. The presence of any of these defects shall render the material liable to rejection.

3.10.2 All exposed ferrous parts shall be hot dip galvanised as per IS:2629 & IS:2633, Galvanising shall be uniform, smooth continuous and free from acidspots. Should the galvanising of the sample be found defective, the entire batch of steel shall have to be re-galvanised at Contractor's cost. The amount of zinc deposit shall be not less than 610 gms. per sq.m. of surface area and in addition, the thickness of zinc at any spot shall not be less than 85 microns. The Employer reserves the right to measure the thickness ofzinc deposit by Elkometer or any other instrument acceptable to Employer and reject any component which shows thickness of zinc at any location less than 85 microns. The testing on the galvanised materials shall be carried out as per IS:2633.

3.10.3 The amount of zinc deposit over threaded portion of the bolts, nuts and screws shall not be less than 300 gms. per sq. meter of surface area. The amount of zinc deposit on washers shall not be less than 340 gms. per sq. meter of surface area. The threads

having extra deposit of zinc shall be removed by die cutting after the completion of galvanising. The removal of extra zinc shall be carefully done so that threads shall have minimum deposits of zinc on them as specified.

## 3.11 PAINTING

The sheet steel to be painted shall be pretreated in tanks in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scales shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be "class-C" as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied. Electrostatic paining shall also be acceptable. Finishing paint on outside of the panels shall be as required otherwise by the Employer. The inside of the panels shall be glossy white. Each coat of finishing shall be properly stoved. The paint thickness shall not be less than 50 microns. Finished parts shall be coated by peelable compound by spraying method to protect the finished surfaces from scratches, grease, dirt and oil spots during testing, transportation, handling and erection.

## 3.12 QUALITY ASSURANCE PROGRAMME

3.12.1 The Contractor shall adopt suitable quality assurance programme to ensure that the equipment and services under the scope of contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Employer's site or at any other place of work are in accordance with the specifications. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS- 14001.

A quality assurance programme of the contractor shall generally cover the following:

i. His organisation structure for the management and implementation of the proposed quality assurance programme
ii. Quality System Manual
iii. Design Control System
iv. Documentation Data Control System
v. Qualification data for Bidder's key Personnel.
vi. The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
vii. System for shop manufacturing and site erection controls including process, fabrication and assembly.
viii. Control of non-conforming items and system for corrective actions and resolution of deviations.
ix. Inspection and test procedure both for manufacture and field activities.
x. Control of calibration and testing of measuring testing equipments.
xi. System for Quality Audits.
xii. System for identification and appraisal of inspection status.
xiii. System for authorising release of manufactured product to the Employer.

xiv. System for handling storage and delivery.
xv. System for maintenance of records, and
xvi. Furnishing quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component.

## 3.12.2 GENERAL REQUIREMENTS - QUALITY ASSURANCE

3.12.2.1 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the contractor for some of the major items is given in the respective technical specification.
This is, however, not intended to form a comprehensive programme as it is the contractor's responsibility to draw up and implement such programme duly approved by the Employer. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder and will be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award.

3.12.2.2 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor"s/ sub-supplier's Quality Control Organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing. The Quality Plan shall be submitted on electronic media e.g. floppy or E-mail in addition to hard copy, for review. Once the same is finalised, hard copies shall be submitted for approval. After approval the same shall be submitted in compiled form on CD ROM.

3.12.2.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control Organisation, during various stages of site activities starting from receipt of materials/equipment at site.

3.12.2.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans alongwith Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Employer's approval without which manufacturer shall not proceed.
These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer alongwith technical justification for approval and dispositioning.

3.12.2.5 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of MDCC.

3.12.2.6 All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties, chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details.

3.12.2.7 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorised representative for approval prior to carrying out the welding/brazing.

3.12.2.8 All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer.

3.12.2.9 Test results or qualification tests and specimen testing shall be furnished to the Employer for approval. However, where required by the Employer, tests shall be conducted in presence of Employer/authorised representative.

3.12.2.10 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. Similarly, any other statutory requirements for the equipments/systems shall also be complied with.

3.12.2.11 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

3.12.2.12 No welding shall be carried out on cast iron components for repair.

3.12.2.13 Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.

3.12.2.14 All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

3.12.2.15 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's

purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the subcontractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc..

Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within three weeks of the release of the purchase orders/contracts for such bought out items/components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor.

3.12.2.16 Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their subvendor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.

3.12.2.17 The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his sub-contractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipments conform to requirements of the specification and the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.

3.12.2.18 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

3.12.2.19 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

3.12.2.20 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.

**3.12.2.21 Burn in and Elevated Temperature Test Requirement for Electronics Solid State Equipment**

a. All solid state electronic systems/equipment shall be tested as a complete system/equipment with all devices connected for a minimum of 168 hours (7 Days) continuously under energized conditions prior to shipment from Manufacturing works, as per the following cycle.

b. Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

c. Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Contractor/ sub-contractor is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Contractor/ sub- contractor alongwith the statistical figures to validate the alternate procedure to be forwarded.

The Contractor/Sub-contractor shall carry out routine test on 100% item at contractor/sub-contractor's works. The quantum of check/test for routine & acceptance test by employer shall be generally as per criteria/sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check/test for routine / acceptance test shall be as agreed during detailed engineering stage.

## 3.12.3 QUALITY ASSURANCE DOCUMENTS

3.12.3.1 The Contractor shall be required to submit two hard copies and two sets on CDROM of the following Quality Assurance Documents as identifed in respective quality plan with tick ( _ ) mark within three weeks after despatch of the equipment. Typical contents of Quality Assurance Document is as below:-

i) Quality Plan,
ii) Material mill test reports on components as specified by the specification and approved Quality Plans.
iii) Factory test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.
iv) Type test report(wherever applicable).
v) Non-destructive examination results /reports including radiography interpretation reports.
Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
vi) Heat Treatment Certificate/Record (Time- temperature Chart)
vii) All the accepted Non-conformance Reports (Major/Minor) / deviation,

including complete technical details / repair procedure)Verification sketches, if used and methods used to verify that the inspection and testing points in the Quality Plan were performed satisfactorily

viii) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

ix) Certificate of Conformance (COC) whever applicable.

x) MDCC

3.12.3.2 Similarly, the contractor shall be required to submit two hard copies and two sets on CD ROM of Quality Assurance Documents ( in line with above) pertaining to field activities as per Approved Field Quality Plans and otheragreed manuals/ procedures, prior to commissioning of individual system.

3.12.3.3 Due to the large variety of equipment items, it is always possible to adapt the content of the quality document to better match the particularities of any equipment. This shall be done in agreement with the Supplier and the Inspector.
The Quality Document file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.Each quality document shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

3.12.3.4 Before shipping any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

i) If the result of the review carried out by the Inspector of the Quality document (or applicable section) is satisfactory.The Inspector shall stamp,the quality document ( or applicable section) for release.

ii) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document ( or applicable section) is stamped by the Inspector.

iii) If a decision is made to ship equipment, whereas all outstanding actions cannot be readily cleared for the release of the quality document by the time as per contract documents ( or finalization of the applicable section of the quality document within one month as per corresponding shipment date).The supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status ( signed by the Supplier Representative) to the Inspector and notify of the committed date for the completion of all outstanding actions & submission.The Inspector shall stamp the quality document for applicable section when it is effectively completed.
The final quality document will be compiled and issued at the final assembly place of equipment before shipment.

### 3.12.4 TRANSMISSION OF QUALITY DOCUMENTS

As a general rule, two hard copies of the quality document and Two CD ROMs shall be issued to the Employer not later than 1 month after the delivery date for the corresponding equipment . One set of quality document shall be forwarded to

Corporate Quality Assurance Department and other set to respective Site .
For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than 1 month after the date of the last delivery similarly as stated above

## 3.13 TYPE TESTING , INSPECTION, TESTING & INSPECTION CERTIFICATE

3.13.1 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

3.13.2 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Project Manager and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

3.13.3 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

3.13.4 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.

3.13.5 When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Project Manager /Inspector 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 certificates shall not bind the Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.

3.13.6 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.

3.13.7 The inspection by Project Manager / Inspector 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.

3.13.8 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 3.03.00, the Contractor shall furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

3.13.9 All inspection, measuring and test equipments used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, thecontractor shall re-calibrate the measuring/test equipments in the presence of Project Manager / Inspector.

## 3.14 PACKAGING & PROTECTION

3.14.1 Packing, Marking and shipping

The packing and shipping shall be carried out in accordance with the standard practice of Contractor and with the following additional requirements:

a. The equipment shall be prepared in such a manner as to protect the equipment from damage or deterioration during shipping or storage. The shipments can be exposed to heavy rains, hot sun, high humidity and sudden extreme changes of temperature. The equipment shall be packed and shipped so as to protect it from all such conditions and any other abnormal conditions, generally expected during shipping & storage.

b. The metallic containers, if any, shall be considered as the property of the Contractor and he will be allowed to remove them from site once the contents are unpacked, inspected, documented and placed in temporary storage or in final position.

c. The equipment shall be shipped in such a manner as to facilitate unloading, handling and storage enroute and at the site. The Contractor shall provide lifting lugs and special lifting devices for proper handling and erection.

d. The Contractor shall be liable for any damage or loss resulting due to careless, improper, poor or insufficient packing and handling.

e. Spare parts and spare equipment shall be packed separately in containers adequate for long term storage, plainly marked "Spare Parts Only". They shall be crated individually or in kits to be used in one single renewal or overhaul operation. Other spare part kits shall not be disturbed when using one set or kit.

f. The Contractor shall at all times protect and preserve from damage, loss, corrosion and all other forms of damage, all parts of the works.

### 3.14.2 Transportation

a. The Contractor shall make a careful examination of access rail/roadways to the site in order to confirm the practical maximum transport weight and dimensions as well as a careful examination of the ports of disembarkation particularly with respect to the capacity of the cranes installed and access roads.

b. All instruments and computer/microprocessor based equipment imported into India from overseas for the purpose of this contract shall be air freighted

to the nearest possible point and further by rail/road taking due precautions as per manufacturer's recommendations. Employer shall have the right to decide the items that should be air freighted and Employer's decision shall be binding on Contractor

**3.14.3 Insurance**

a. The Contractor shall insure all shipments and works at his own expense for not less than the full replacement cost plus any additional cost for accelerated manufacturing of the replacement parts.

b. Loss or the damage to equipment during shipping or transportation to the site(s) or otherwise shall not constitute groups for claims for extension in time or for extra payment.

**3.14.4 Storage of Equipment**

a. The Contractor shall provide and construct adequate storage sheds for proper storage of equipment. Sensitive equipments shall be stored indoors. All equipment during storage shall be protected against damage due to act of nature or accidents. The storage instructions of the equipment manufacturers shall be strictly adhered to.

b. The necessary transport packing shall be removed as soon as possible after receipt of equipment at the work site(s).

## 3.15 BUSHINGS, HOLLOW COLUMN INSULATORS, SUPPORT INSULATORS

3.15.1 Bushings shall be manufactured and tested in accordance with IS:2099 & IEC:137 while hollow column insulators shall be manufactured and tested in accordance with IEC 233/IS 5284. The support insulators shall be manufactured and tested as per IS:2544 / IEC 168/IEC 273. The insulators shall also conform to IEC 815 as applicable.
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.

3.15.2 Porcelain used shall be homogenous, 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. Hollow porcelain should be in one integral piece in green & fired stage.

3.15.3 Glazing of the porcelain shall be uniform brown in colour, free form blisters, burns and other similar defects.

3.15.4 When operating at normal rated voltage there shall be no electric discharge between conductor and insulators which would cause corrosion or injury to conductors or when operating at normal rated voltage.

3.15.5 The design of the insulator shall be such that stresses due to expansion and contraction in any part of the insulator shall be lead to deterioration. All ferrous parts shall be hot dip galvanised.

3.15.6 Contractor shall make available data on all the essential features of design including the method of assembly of shells and metal parts, number of shells per insulator, the manner in which mechanical stresses are transmitted through shells to adjacent parts, provision for meeting expansion stresses, results of corona and thermal shock tests, recommended working strength and any special design or arrangement employed to increase life under service conditions.

3.15.7 Post type insulators shall consist of a porcelain part permanently secured in metal base to be mounted on supporting structures. They shall be capable of being mounted upright. They shall be designed to withstand all shocks to which they may be subjected to during operation of the associated equipment.

3.15.8 Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps, 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.

3.15.9 All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued; 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.

3.15.10 Bushings, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests and acceptance test/ sample test in accordance with relevant standards.

3.15.11 Insulator shall also meet requirement of IEC - 815 as applicable, having alternate long & short sheds.

## 3.16 CORONA AND RIV TESTS AND SEISMIC WITHSTAND TEST:

The corona (for 400kV only) and RIV tests shall confirm to the requirements as per **Annexure A** to this chapter. The seismic withstand test for 400kV shall conform to requirements as per **Annexure B** to this chapter.

## 3.17 Enclosures:

1. Annexure- A - CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST
2. Annexure- B - SEISMIC WITHSTAND TEST
3. Appendix -Q3 - Manufacturing Quality Plan
4. Appendix -Q4 - Endorsement sheet for QP
5. Appendix -Q5 - Field Quality plan
6. Annexure-J- Quality Assurance & Inspection (switchyard) -Module No. SQE 19

SECTION-3

| Clause No. | TECHNICAL REQUIREMENTS | |
|---|---|---|
| | | **Annexure – A** |
| | **CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST** | |
| 1.0 | **General** | |
| | Unless otherwise stipulated, all equipment together with its associated connectors where applicable shall be tested for external corona both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and measurement of radio interference voltage ( RIV). | |
| 2.0 | **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. | |
| 3.0 | **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 – I. 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 result shall be in microvolts. | |
| 3.2 | Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107 – 1964 except otherwise noted herein. | |
| 3.3 | In measurement of RIV temporary additional external corona shielding may be provided. In measurement 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%, 115% and 130% for the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 420 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 recommendations or equivalent device so long as it has been used by other testing authorities. | |

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|---|---|
| 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 the voltage read by the noise meter. |
| 4.0 | **Test Methods for visible Corona**<br><br>The purpose of this test is to determine the corona extinction voltage of the 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 130 % of RIV test voltage and maintained there for five minutes. In case corona inception does not take place at 130 %, the voltage level shall be raised till inception of corona or rated voltage whichever is lower. The voltage will then be decreased slowly until all visible corona disappears. The test procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which the visible corona ( negative or positive polarity ) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions at all voltage steps i.e. 85%,100%,115% and 130%.Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f / 5.6 or equivalent. The photographic procedure shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connectors so as to show corona on bushing, insulators and all parts of energized connectors. The photographs shall be framed such that test object essentially fills the frame with no cut off. |
| 4.1 | For recording purposes, modern devices using UV recording methods such as image intensifier may also be used. |
| 4.2 | The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence. |
| 4.3 | In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of the test equipment and test object. Thes e four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by |

| | |
|---|---|
| | purchaser's inspector after determining the best camera locations by trial energisation of test object at a voltage which results in corona. |
| 4.4 | The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels. |
| 4.5 | However both tests shall be carried out with the same test set up and as little time duration between tests as possible. No modification or treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of the owner's engineer, if in his opinion it will not prejudice other test. |
| 5.0 | **Test Records:** |
| | In addition to the information previously mentioned and requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in the test report- |
| a) | Background noise before and after the test |
| b) | Detailed procedure of application of test voltage |
| c) | Measurement of RIV levels expressed in microvolts 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 micro volt in each direction. |
| f) | Onset and extinction of visible corona for each of the four tests required shall be recorded. |

SECTION-3



**Annexure – B**

**SEISMIC WITHSTAND TEST**
**(For 400kV Only)**

The seismic withstand test on the complete equipment (except BPI) shall be carried out along with supporting structure.

The bidder shall arrange to transport the structure from his contractor's premises / owner's sites for 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 at any other point as agreed by the owner. 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 purchaser.

SECTION 3

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APPENDIX-03

| MFGR.'s LOGO | MANUFACTURER'S NAME AND ADDRESS | MANUFACTURING QUALITY PLAN<br>ITEM :<br>SUB-SYSTEM: | QP NO.:<br>REV.NO.:<br>DATE:<br>PAGE: ..... OF.... | PROJECT :<br>PACKAGE :<br>CONTRACT NO. :<br>MAIN-SUPPLIER: |
|---|---|---|---|---|

| SL. NO | COMPONENT & OPERATIONS | CHARACTERISTIC | CLASS | TYPE OF CHECK | QUANTUM OF CHECK | | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | | AGENCY | | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | M | C/N | | | 9. | D* | M | C | N | |
| 1. | 2. | 3. | 4. | 5. | 6. | | 7. | 8. | | | ** | 10. | | 11. |
| | | | | | | | | | | | | | | |

| MANUFACTURER/ SUB-SUPPLIER | MAIN SUPPLIER |
|---|---|
| SIGNATURE | |

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" ( √ ) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** M: MANUFACTURER/SUB-SUPPLIER, C: MAIN SUPPLIER, N: NTPC
P: PERFORM, W: WITNESS AND V: VERIFICATION AS APPROPRIATE.
CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS "W"

1/1

FOR NTPC USE

DOC. NO.: REV..... CAT.....

| REVIEWED BY | APPROVED BY | APPROVAL SEAL |
|---|---|---|
| | | |

ENGG. DIV./QA&I

FORMAT NO.: QS-01-QA1-P-09/F1-R1

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APPENDIX-Q4

# ENDORSEMENT SHEET FOR QP

## REFERENCE / *STANDARD* / FIELD QUALITY PLAN (RQP / SQP/*RFQP/SFQP*)

| *TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION* | | To be filled in by NTPC |
|---|---|---|
| PROJECT NAME | | *REVIEW & ENDORSEMENT BY NTPC* PROJECT SPECIFIC QP NUMBER ALLOTTED QP NO.: |
| CONTRACT NO | | |
| CONTRACT NAME | | |
| MAIN SUPPLIER | | |
| MANUFACTURER WORKS & ADDRESS | M/S | REV. NO.: DATE: ** The RQP/SQP/RFQP/SFQP once endorsed for a particular contract shall remain valid even though the original QP may have expired or revised, unless otherwise mutually agreed with the supplier. ① |
| ITEM /EQUIPMENT / SYSTEM/ SUB-SYSTEM DETAILS i.e. MODEL TYPE / SIZE /RATING etc. | | |
| APPROVED QP NO.: RQP/SQP/RFQP/SFQP | 0000-999-QV - - REV. NO.: DATED**: | |
| *Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)* | | *(TICK APPLICABLE)* |
| *I. That the item/ component is identical to that considered for QP approval.* OR. | | The QP is endorsed for this project without any change |
| *II. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same do not affect the contents of QP.* OR | | |
| *III. That there are minor changes in the item/ component with respect to that considered for QP approval, however the same affect the QP slightly, as indicated below / in attached sheet* | | The QP is endorsed for this project with changes as indicated. |
| | | *DISTRIBUTION OF ENDORSEMENT OF*<br>A) RQP/SQP:<br>*1. MAIN SUPPLIER (WITH A COPY OF QP)*<br>*2. MANUFACTURER*<br>*3. RIO*<br>*4. CQA-SPL*<br>*5. CQA-O/C*<br><br>B) RFQP/SFQP:<br>*1. MAIN SUPPLIER (with a copy of QP)*<br>*2. MANUFACTURER*<br>*3. NTPC FQA (with a copy of QP)*<br>*4. NTPC Erection (with a copy of QP)*<br>*5. CQA-SPL*<br>*6. CQA-O/C* |
| *SIGN.: (Main Supplier) DATE* | *SIGN.: (Manufacturer) DATE:* | NTPC (Reviewed /Approved by/ Date & Seal) |



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APPENDIX-Q5

| SUPPLIER'S LOGO | SUPPLIER'S NAME AND ADDRESS | FIELD QUALITY PLAN | | PROJECT :<br>PACKAGE :<br>CONTRACT NO. :<br>MAIN-SUPPLIER: |
|---|---|---|---|---|
| | | ITEM :<br>SUB-SYSTEM: | QP NO.:<br>REV. NO.:<br>DATE:<br>PAGE: .... OF.... | |

| SL. NO. | ACTIVITY AND OPERATION | CHARACTERISTICS / INSTRUMENTS | CLASS OF CHECK # | TYPE OF CHECK | QUANTUM OF CHECK | REFERENCE DOCUMENT | ACCEPTANCE NORMS | FORMAT OF RECORD | D* | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | | 10. |
| | | | | | | | | | | |

| MANUFACTURER/ SUB-SUPPLIER | MAIN-SUPPLIER |
|---|---|
| SIGNATURE | |

LEGEND: * RECORDS INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
LEGEND TO BE USED: CLASS # : A = CRITICAL, B=MAJOR, C=MINOR;
'A' SHALL BE WITNESSED BY NTPC FQA, 'B' SHALL BE WITNESSED BY NTPC ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY MAIN SUPPLIER (A & B CHECK SHALL BE NTPC CHP STAGE)

FOR NTPC USE

| DOC. NO.: | | REV..... |
|---|---|---|
| REVIEWED BY | APPROVED BY | APPROVAL SEAL |

FORMAT NO.: QS-01-QAI-P-09/F2-R1

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ANNEXURE-J

| QUALITY ASSURANCE | एनटीपीसी NTPC |
|---|---|
| QUALITY ASSURANCE & INSPECTION | MODULE NO. SQE19 |
| SWITCHYARD | |

| Attributes / Characteristics<br><br>Items/Components Sub Systems | Make, model, Type & Rating, Test Certificate | Routine & Acceptance Test as per IS / IEC | Functional requirements as per NTPC Specification |
|---|---|---|---|
| Circuit Breaker (IEC:56) | Y | Y | Y |
| Interrupter & hollow insulator (IEC:233/ IS:5284) | Y | Y | Y |
| Isolator (IEC:129 / IEC:694) | Y | Y | Y |
| Current Transformer (IEC:185) | Y | Y | Y |
| Capacitor Voltage Transformer (IEC:186 / 358) | Y | Y | Y |
| Bus Post Insualtor (IEC:168 / 273 / IS:2544) | Y | Y | Y |
| Disc,Pin & String Insualtor (IEC:383 / IS:731) | Y | Y | Y |
| Long Rod Insualtor (IEC:433) | Y | Y | Y |
| Surge Arrestor (IEC:99-4) | Y | Y | Y |
| Hardware fittings for Insulator (IS:2486 / BS:3288) | Y | Y | Y |
| Spacer Clamps & Connector (IS:10162 / 5561) | Y | Y | Y |
| Aluminium Tube (IS:5082 / 2673 / 2678) | Y | Y | Y |
| Wave Trap (IEC:353 / IS:8792 / 8793) | Y | Y | Y |
| Conductor (IS:398-P-II)(V) | Y | Y | Y |
| Galvanised Steel Structures (IS:2062/2629/4759/6745) | Y | Y | Y |
| Vibration Damper (IS:9708) | Y | Y | Y |
| Sag Compensating Spring DIN:2089/2096 IS:3195 / 7906 | Y | Y | Y |
| Control & Relay Panel | Y | Y | Y |
| SF6 Gas filling & evacuating plant | Y | Y | Y |
| SF6 Gas Leak Detector | Y | Y | Y |
| Leakage Current Analyser | Y | Y | Y |
| Nitrogen Gas Filling Device | Y | Y | Y |
| Protection Relays | Y | Y | Y |
| Event Logger | Y | Y | Y |
| Operation Analyser | Y | Y | Y |
| Disturbance Recorder | Y | Y | Y |
| Tariff Metering System | Y | Y | Y |
| Synchronising Trolly | Y | Y | Y |

| Attributes / Characteristics<br><br>Items/Components Sub Systems | Make, Type Rating,and Model, Test Certificates | Routine & Acceptance Test as per relevant IS/IEC | Functional requirements as per NTPC Specification |
|---|---|---|---|
| Relay Test Kit | Y | Y | Y |
| LT Switchgear /LT Panels (IEC:947 / IS:13947) | Y | Y | Y |
| Battery IS:1652 | Y | Y | Y |
| Lighting Panels | Y | Y | Y |
| Surge Monitor | Y | Y | Y |

Notes : 1) This is an indicative list of test/checks. The manufacture is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents during QP finalisation for all items.

2) All major Bought Out Items will be subject to NTPC approval.

# Contents

## SECTION 4:
## ANNEXURES

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## ANNEXURE-A: COMPLIANCE CERTIFICATE OF TECHNICAL SPECIFICATION

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation(s) with respect to specification other than those furnished in the schedule of deviations.

3. Only those technical submittals which are specifically asked for in Notice Inviting Tender (NIT) to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of technical offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

Date: Bidder's Stamp & Signature

## ANNEXURE-B: DEVIATION/ CHANGE REQUEST OF TECHNICAL SPECIFICATION

Bidder shall list out all technical potential deviation/ change request (s) along with clause with respect to technical specifications.

| Sl. No. | Page No. | Clause No. | Deviation | Reason/ Justification(s) |
|---|---|---|---|---|

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

Date: Bidder's Stamp & Signature

## ANNEXURE-C: GUARANTEED TECHNICAL PARTICULARS

| Sl. No. | Description | Particulars to be filled by Bidder |
|---|---|---|
| **1** | **General** | |
| 1.1 | Name of the project | |
| 1.2 | Name of manufacturer (OEM) | |
| 1.3 | Country of origin | |
| 1.4 | Manufacturer works | |
| **2** | **Type & Designation** | |
| 2.1 | Type tested at (Name of laboratory) | |
| 2.2 | Address of laboratory | |
| 2.3 | Application | |
| 2.4 | Standards applicable | |
| 3 | For connection to | |
| 3.1 | Conductor size and arrangement | |
| 3.2 | Equipment Terminal and arrangement | |
| 4 | Material (state percentage -composition of constituents and impurities present) | |
| 4.1 | Clamp body | |
| 4.2 | Bolts and Nuts | |
| 4.3 | Spring Washers | |
| 4.4 | Bimetallic Liners, if any and its thickness | |
| 5 | Rated current (A) | |
| 6 | Maximum contact resistance (ohms) Continuous current rating of the clamps/fittings | |
| 7 | Maximum temp. rise of the clamps/fittings over ambient temp (50°C) when carrying full load current (°C) | |
| 8 | Maximum temp. rise of the clamps/fittings over ambient temp. (50°C) when carrying an estimated fault current of 50KA for 1 sec. (°C)<br>i) Rated terminal load<br>ii) ii) Minimum failing load | |
| 9 | Factor of safety | |
| 10 | Minimum thickness of any part. | |
| 11 | Weight of each type of clamp complete with hardware fittings (KG) | |
| 12 | Machining accuracy of matching surface. | |
| 13 | Service Indoor/outdoor. | |
| 14 | Major dimensions of the clamps/fittings | |

| | | |
|---|---|---|
| | (with accompanied drawings). | |
| 15 | Mechanical test.<br>i) Heat run test<br>ii) Material Composition tests.<br>iii) Tests for checking blow, holes cracks etc. | |
| 16 | List of routine test to be carried out. | |
| 17 | Whether the type tests are already carried out if Yes, enclose the type test certificates. | |
| 18 | Details of the type tests to be carried out if not carried out earlier. | |
| 19 | List of testing facilities available at your works for carrying out above type tests & routine tests & mechanical tests. If facilities not available at your works, please indicate the name and address of the firm/institute where these shall be carried out | |

Date: Bidder's Stamp & Signature

## ANNEXURE-D: TECHNICAL CHECKLIST

| Sl. No. | Parameters/ Particulars | Requirement | Bidder's confirmation |
|---|---|---|---|
| **1** | **Technical Qualifying Requirement** | | |
| 1.1 | The bidder to furnish relevant documents for meeting the qualifying requirement. | Confirmed | Yes |
| 1.2 | The technical bid shall be submitted by the Manufacturer. | Confirmed | Yes |
| 1.3 | All the documents shall be submitted in English. | Confirmed | Yes |
| **2** | **Un-priced BOQ** | | |
| 2.1 | Confirm that all items have been quoted separately. Non-quoting of any item shall lead to non-evaluation of technical bid. | Confirmed | Yes |
| 2.2 | Any other accessories for the completeness of supply is deemed to be included in the offer, whether specifically mentioned in the specification or not. | Confirmed | Yes |
| **3** | **Technical requirement** | | |
| 3.1 | Material of Clamps/ fittings | As per Section -2 of TS | Yes |
| 3.1.1 | Clamp Body | Designation A6 of IS 617 | Yes |
| 3.1.2 | Bolts, nuts and plain washers | Electrogalvanized for sizes below M12, for others hot dip galvanized | Yes |
| 3.1.3 | Spring washers | Spring steel- E.G | Yes |
| 3.2 | Type of Connectors | Bolted | Yes |
| 3.3 | Continuous current rating of the clamps/fittings | Is it compatible with the conductor rating/ equipment rating? | Yes |
| 3.4 | Short circuit current rating of the clamps/fittings | As per Section -1 of TS | Yes |
| 3.5 | Minimum thickness of any part of clamps and connector | 10 mm | Yes |
| 3.6 | Bimetallic Sleeves /liner thickness | 2 mm | Yes |
| 3.7 | Hardware for connecting clamp to | Included in scope of bidder supply | Yes |

| | | | |
|---|---|---|---|
| | equipment/ conductor/ tube | | |
| 3.8 | Maximum temperature rise (35oC) of the clamps/fittings over ambient temperature ( 50oC) when carrying rated current | | Yes |
| 3.9 | Nominal Breaking load of conductor is minimum 1100 kg and tensile load is 110 kg | | Yes |
| **4** | **Type Tests** | | |
| 4.1 | Please confirm that there are no deviations from the technical specifications. | Deviations/ No Deviations are attached | Yes |
| 4.2 | Whether similar items offered have been supplied? | Similar clamps have been supplied earlier | Yes |
| 4.3 | Valid Type Test Reports (of identical Clamps & Connectors) for all offered Clamps & connectors as per spec are available. | List as mentioned below,<br>1. Clamp Slip Test<br>2. Fault current resistance test<br>3. Resilience test<br>4. Movement test<br>5. Compression test<br>6. Galvanization test<br>7. Clamp bolt torque test<br>8. Assembly torque test<br>9. Tensile load test<br>10. Compression and pull off test<br>11. Vibration test<br>12. Log decrement test (for spacer damper)<br>13. Magnetic Power loss test<br>14. Measurement of RIV (dry) and corona extinction voltage test (dry) | Yes |
| 4.4 | The onus is on vendor to check the applicability of Type test reports vis-à-vis the clamps offered. | | Yes |
| 4.5 | In case the type test reports are not found valid at detailed engineering stage, the same will have to be conducted without any commercial implication to BHEL | | Yes |

Date: Bidder's Stamp & Signature