

**VOLUME II**

**TECHNICAL SPECIFICATION  
FOR  
*NEUTRAL GROUNDING RESISTOR***

**SPECIFICATION NO: *PE-TS-999-506-E001***

***REVISION: 00***



**BHARAT HEAVY ELECTRICALS LIMITED  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NOIDA, UP (INDIA) – 201301**



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR  
NEUTRAL GROUNDING RESISTOR**

SPECIFICATION NO. PE-TS- 999-506-E001

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DATE: 14.01.2020

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COMPLIANCE CERTIFICATE

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**COMPLIANCE CERTIFICATE**

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

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

-----  
BIDDER'S STAMP & SIGNATURE



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**SECTION –I**

**SPECIFIC TECHNICAL REQUIREMENTS**



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# **TECHNICAL SPECIFICATION FOR NEUTRAL GROUNDING RESISTOR**

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## **1.0 PURPOSE**

This specification is intended for finalization of rate contract between BHEL PEM and Bidder. Standard technical detail as indicated in the specification shall be agreed upon between BHEL PEM and Bidder. Project specific technical detail shall be made available to the bidder along with project enquiry.

## **2.0 SCOPE OF ENQUIRY**

- 2.1 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of NEUTRAL GROUNDING RESISTOR conforming to this specification.
- 2.2 General technical requirements of the NEUTRAL GROUNDING RESISTOR are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Section-I.
- 2.3 **The requirements of Section-I shall prevail and govern in case of conflict between the corresponding requirements of Section-I and Section-II.**
- 2.4 The documents shall be in English Language and MKS system of units.

## **3.0 BILL OF QUANTITIES:**

- 3.1 Quantity requirements shall be as per 'BOQ-cum-price schedule' as part of NIT.

## **4.0 SPECIFIC TECHNICAL REQUIREMENTS**

### **4.1**

| <b><u>S.No.</u></b> | <b><u>Reference Clause No. of Section- II</u></b> | <b><u>Specific Requirement/ Change</u></b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------|---------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.                  | 5.1.10                                            | Clause 5.1.10 shall be read as follows: "The connection between neutral terminal of transformer and NGR is through a tinned copper strip of 50 X 8mm. The copper strip shall be supplied by bidder. The required hardware for the termination of copper flat at both ends shall be supplied by the bidder. This item is included in BOQ-cum-Price Schedule in NIT".                                                                                                                                                                                                                                  |
| 2                   | 5.2.1                                             | Clause 5.2.1 shall be read as follows: "Each neutral grounding resistor shall be housed in weather-proof enclosure having Degree of Protection as specified in Data Sheet-A. Enclosure shall be cold rolled sheet steel having a minimum thickness of 2.5 mm. Suitable ventilating louvers shall be provided on sides to ensure proper ventilation. The louvers shall be provided with fine wire mesh to make vermin proof."                                                                                                                                                                         |
| 3.                  | 5.2.11                                            | Clause 5.2.11 shall be read as follows: "For connection of other end of NGR to ground, Tinned copper flat (of size 50X8) mm with Fork connector up to 100mm above ground with 2 nos. earthing terminal/pad, tapped holes and bolts suitable for connection of GS Flat shall be supplied by bidder. The tinned copper flat shall be insulated from mounting structure through porcelain insulators. GS flat (size to be informed during detail engineering) for connection of fork connector of NGR to ground shall be in BHEL scope. The length of copper flat shall be suitably decided by bidder." |
| 4.                  | 6.0                                               | In addition to clause 6.0:<br>Following tests shall be conducted on NGR Cubicle<br><b>1. Routine Tests:</b> DOP test on enclosure (routine test) as follows:<br>It shall not be possible to insert a 2.5mm dia. steel wire into the enclosure from any direction without using force                                                                                                                                                                                                                                                                                                                 |



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|----|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5. | 6.2 | <p>Clause 6.2 shall be read as follows:<br/>Bidder shall furnish Type test certificates (Short time current test along with temperature rise test &amp; Degree of protection test i.e. IP33 for enclosure and IP55 for Terminal box).<br/>The type test should have been conducted within 10 yrs from the date of techno commercial bid opening i.e. 22.08.2019.<br/>Following valid type test report (within last ten years as on 22.08.2019) shall be furnished by the bidder and in absence of the same bidder has to conduct on each type (prototype) of NGR without any commercial/delivery implication to BHEL:</p> <ol style="list-style-type: none"><li>1. Short time current test along with temperature rise test.</li><li>2. Degree of protection test for IP33 on enclosure.</li><li>3. Degree of protection test for IP55 on Terminal Box.</li></ol> |
| 6. | 7.0 | <p>In addition to clause 7.0:<br/>1. External surface of NGR shall be Chemical resistant epoxy zinc phosphate primer, MIO (Micaceous iron oxide) as intermediate paint followed by polyurethane finish paint of blue colour corresponding to RAL 5012.<br/>No. of coats shall be one coats each &amp; total DFT shall not less than 100 microns.<br/>2. Internal surface of NGR shall be Chemical resistant epoxy zinc phosphate primer followed by chemical and heat resistant epoxy enamel white paint. No. of coats shall be one coats each &amp; total DFT shall not less than 100 microns. Colour code shall be subjected to customer approval at contract stage without any commercial implication to BHEL.</p>                                                                                                                                             |

- 4.2 All internal wiring between equipment and terminal block shall be carried out by fire resistance PVC insulated 1100V grade 2.5 Sq.mm Stranded copper conductor wires.
- 4.3 All devices and terminal blocks within the terminal box shall be clearly identified by symbol corresponding to those used on applicable schematic/wiring diagram. 20% spare terminals shall be provided in terminal block.
- 4.4 Each cubicle shall be provided with 5A, 5 pin plug socket and door-switch controlled cubicle illumination lamp. Two pole switch fuse unit shall be provided for receiving 240 V single phase AC supply for cubicle lamp and illumination circuit.

**5.0 DOCUMENTATION**

- 5.1 Documents required along with technical offer shall be as per attachment-I.
- 5.2 Documents required after award of LOI shall be as per attachment-II.

**ATTACHMENT – I****DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER.**

Sign & stamped copy of following documents:

- a] "Deviation Schedule" with "NO Deviations" and bidder's signature and company stamp.
- b] Unpriced Price Schedule as enclosed with NIT with 'Quoted' word against items with bidder's signature and company stamp.
- c] A copy of the sheet "Compliance Certificate" with bidder's signature and company stamp.



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**ATTACHMENT – II****DOCUMENTS REQUIRED AFTER AWARD OF LOI.**

Following documents/drawings shall be submitted after placement of order for BHEL & customer's approval: -

| Sl. No. | Drawings/Document Description | Drawings / Document Number | Document Type |
|---------|-------------------------------|----------------------------|---------------|
| 1.      | DATA SHEET FOR NGR            | PE-V0-999-506-E005         | Primary       |
| 2.      | GA DRAWING FOR NGR            | PE-V0-999-506-E279         | Primary       |
| 3.      | QUALITY PLAN OF NGR           | PE-V0-999-506-E904         | Primary       |
| 4.      | TYPE TEST CERTIFICATES OF NGR | PE-V0-999-506-E014         | Primary*      |
| 5.      | O & M MANUAL FOR NGR          | PE-V0-999-506-E016         | Secondary     |

Note:

**1. Drawing Schedule for Vendors :**

- For Primary documents: R-0 within 14 days from PO & subsequent revisions within 10 days of comments received from BHEL. BHEL shall furnish comments / approval on each submission within 18 days from receipt.
- \*R-0 within 2 months of approval of other primary drawing/documents & subsequent revisions within 10 days of comments received from BHEL. BHEL shall furnish comments / approval on each submission within 18 days from receipt.
- For Secondary documents: Within 30days of issuance of MDCC.



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**DATA SHEET-A****1.0 SYSTEM DESIGN DATA**

- 1.1 Design Ambient : ☒ 50°C ☐ 40°C
- 1.3 Reference Standard : IEEE – 32
- 1.2 Rated Voltage : 12 / 7.2 / 3.6 kV
- 1.5 Location of NGR : Outdoor
- 1.6 Rated short time current and time : 600A for 10sec
- 1.7 Net resistance of resistor unit : As specified in BOQ-Cum-Price Schedule in NIT
- 1.8 Resistance per resistor element : As per Requirement
- 1.9 Material of resistor element
- i) For high value of current (Say 300/400/500/600A) : ☒ AISI-304 ☒ ASTM-A240 ☐ AISI-406
- 1.10 No. of parallel Path : 2 parallel paths
- 1.11 No. of resistance element par path : As per Requirement
- 1.12 Total no. resistor elements : As per Requirement
- 1.13 Current density of resistor element : As per Requirement
- 1.14 Max. allowable temp. rise (over ambient) of resistor element : ☐ 300° C ☒ 350° C  
☐ 500° C ☐ 790° C

**2.0 ENCLOSURE**

- 2.1 Material and thickness : Sheet Steel and ☐ 2.0 ☒ 2.5 ☐ 3.0 mm
- 2.2 Degree of Protection (As per IS/IEC-60529)
- i) Enclosure : ☒ IP-33 with canopy ☐ IP-55 with canopy



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ii) Terminal Box : IP-55 with canopy

**3.0 SUPPORT INSULATORS**

3.1 Material : Porcelain

3.2 Rated voltage

i) For 11/6.6/3.3kV NGR : 12 / 7.2 / 3.6 kV

3.3 One minute power frequency  
dry withstand voltage

i) For 11/6.6/3.3kV NGR : 28 / 20 / 10 kV  
(rms)

3.4 Creepage Distance : [ ] 25mm/KV [√] 31 mm/KV

**4.0 MOUNTING STRUCTURE (BOLTABLE TYPE)**

4.1 Material : Hot dip galvanised M.S

4.2 Thickness/deposit of galvanisation : 75 microns/610 g/m<sup>2</sup>

4.3 Equipment mounting : Base of NGR enclosure at 2.4m above ground

**5.0 TERMINAL CONNECTION**

5.1 Type : Bushing

5.2 Material : Porcelain

5.3 Rated voltage

i) For 11/6.6/3.3kV NGR : 12 / 7.2 / 3.6 kV

5.4 One minute power frequency  
dry withstand voltage

i) For 11/6.6/3.3kV NGR : 28 / 20 / 10 kV  
(rms)



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5.5 Creepage Distance : [ ] 25mm/KV [☒] 31 mm/KV

5.6 Connection between NGR & transformer : [ ] Cable [ ] GI Flat [☒] Copper Flat (50X 8mm)

|                                                                                   |                                                                                         |                                       |                  |
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**DATA SHEET-C**  
**(To be filled up by bidder)**

**1.0 General**

- 1.1 Make/Type :
- 1.2 Quantity Nos. :
- 1.3 Service :
- 1.4 Reference Standard :

**2.0 Resistor**

- 2.1 Rated Voltage (Volt) :
- 2.2 Net Resistance at 50 Deg. C (ohm) :
- 2.3 Resistance per resistor element at 50 Deg. C :
- 2.4 Tolerance limit on resistance at 50 Deg. C (%) :
- 2.5 Total no. of resistor elements per path :
- 2.6 No. of parallel path :
- 2.7 Material of resistor element :
- 2.8 Electrical Resistivity ( Ohm-cm) :
- 2.9 Temperature Co-efficient of resistance/ DegC :
- 2.10 Current rating
- a) Short time rating Amps., Secs :
- 2.11 Types of grid :
- 2.12 Temperature rise (over Ambient 50 Deg. C) :
- 2.13 Method of connecting elements :

**3.0 Insulation level**

- 3.1 One minute power frequency withstand volt. KVrms :

|                                                                                   |                |                                       |                  |
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#### 4.0 Support insulator

- 4.1 Make :
- 4.2 Material :
- 4.3 Creepage distance :
- 4.4 Voltage rating :
- 4.5 One minute power frequency withstand volt.(dry) KVrms :

#### 5.0 Terminal connection

- 5.1 Type :
- 5.2 Make :
- 5.3 Material :
- 5.4 Voltage rating :
- 5.5 Power frequency withstand volt. KVrms :

#### 6.0 Enclosure Cubicle

- 6.1 Enclosure material :
- 6.2 Thickness of enclosure materials :
- 6.3 Degree of protection :
- 6.4 Reference standard :
- 6.5 Painting shade :
- 6.6 Thickness of paint (mm) :
- 6.7 Dimension of NGR cubicle with resistor :
- 6.8 Weight of complete NGR cubicle with resistors ( W/O Mounting structure) :

#### 7.0 Test Voltage

- 7.1 One minute power frequency withstand volt.(dry) KVrms :

|                                                                                   |                                                                                         |                                       |                  |
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## 8.0 Mounting Structure

|      |                                           |   |
|------|-------------------------------------------|---|
| 8.1  | Materials                                 | : |
| 8.2  | Dimensions                                | : |
| 8.3  | Paints/Galvanisation                      | : |
| 8.4  | Wt. Of mounting structure                 | : |
| 9.0  | Whether space heater arrangement provided | : |
| 10.0 | Whether welded or bolted type             | : |



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**SECTION – II**

**GENERAL TECHNICAL SPECIFICATION**

|                                                                                   |                                                                   |                                       |                  |
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## 1.0 **SCOPE OF ENQUIRY**

- 1.1 This specification covers the design, manufacture, assembly, testing and inspection at vendor's/sub-vendor's works, packing and despatch to site of neutral grounding resistor as described in the various sections of this specification.
- 1.2 Although erection and commissioning is not included in vendor's scope, the vendor shall still not be absolved of his responsibility of establishing the correctness of equipment at site.

## 2.0 **CODES & STANDARDS**

- 2.1 The material, constructional features and various processes involved in manufacture shall comply with latest revision of Indian Standards.
- 2.2 The design, material, construction, manufacture, inspection, testing and performance of Neutral Grounding Resistor shall conform to the latest revision of relevant standards and codes of practices mentioned in Datasheet – A.
- 2.3 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

## 3.0 **DESIGN REQUIREMENTS AND CONSTRUCTIONAL FEATURES**

- 3.1 The NGR is used for medium resistance grounding of MV (11 / 6.6 / 3.3KV) or LV (415 V) system. NGR shall be connected between earth pit and neutral point of applicable transformer.
- 3.2 The NGR shall be suitable for limiting the desired value of earth fault current and duty as specified in BOQ-Cum-Price Schedule in NIT.
- 3.3 The resistor unit shall be natural air-cooled type suitable for installation at outdoor/ indoor locations.
- 3.4 The NGR will be installed in hot humid and tropical atmosphere. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

## 4.0 **TERMINAL POINTS OF SUPPLY:**

- Neutral grounding resistor along with suitable cable glands and lugs for incoming cables from transformer neutral.
- Supporting structure along with insulators and necessary foundation hardware.
- Bushing along with tinned copper strip of suitable cross-section (as specified in Datasheet-A / BOQ-cum-Price Schedule in NIT) and connecting hardware for neutral connection of transformer. Copper strip will be applicable only when cable connection is not applicable and vice-versa.
- All Civil works, Erection & commissioning of equipment are excluded from bidder's scope.
- Termination and Jointing kits are excluded from bidder's cope.

## 5.0 **SPECIFIC TECHNICAL REQUIREMENTS**

### 5.1 **NEUTRAL GROUNDING RESISTOR**



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- 5.1.1 Each Neutral Grounding Resistor shall be formed of non-aging (grade ASTM-A240/AISI-304 or better) corrosion resistant punched stainless steel elements or FECRAL (AISI-406) as specified in data sheet-A for high value (say 300A/400/500A) of earth fault current and of FECRAL (AISI-406) material for low value (say 1A) of earth fault current. Resistance material mentioned above shall have high electrical resistivity and low temperature co-efficient of resistance.
- 5.1.2 Resistor bank shall be provided in series and parallel combination to achieve the overall resistance value. Minimum two banks in parallel shall be provided in the system, unless specified otherwise.
- 5.1.3 The resistor unit shall consist of suitable no. of elements. All the elements shall be mounted inside the cubicle so as to ensure ease of inspection and replacement of individual element. For Low value of earth fault current edge wound configuration of resistance material is also acceptable.
- 5.1.4 Each resistor element shall possess a balanced combination of both Mechanical and Electrical properties over entire intended operating temperature range without any harmful effect on the elements and their accessories.
- 5.1.5 All the resistor elements consisting the NGR shall be assembled and supported inside the cubicle in such a way that no distortion or breakage will occur during the passage of specified fault current to earth.
- 5.1.6 All elements connection shall be bolted type to ensure stable resistance value throughout the working life of the unit.
- 5.1.7 Wet process type brown glass porcelain insulators shall be used between Tie-rod and end support structure and shall also be used to insulate the resistor bank from enclosure. Porcelain insulators shall have high creepage value (as specified in Data sheet-A) suitable for heavily polluted atmosphere charged with dust particles. Interposing insulator (except Mica) shall be provided to insulate resistor tier.
- 5.1.8 The resistor elements shall be provided with necessary installations and shall have maximum temperature rise as specified in Data Sheet-A.
- 5.1.9 The NGR shall be provided with suitable taps for cable/strip connection as specified in Section-I.
- 5.1.10 In case the connection between neutral terminal of transformer and NGR is through a copper strip, then copper strip shall be supplied by bidder. The required hardware for the termination of copper flat at both ends shall be supplied by the bidder.
- 5.2 ENCLOSURE:**
- 5.2.1 Each neutral grounding resistor shall be housed in weather-proof enclosure having Degree of Protection as specified in Data Sheet-A. Enclosure shall be cold rolled sheet steel having a minimum thickness of 2 mm. Suitable ventilating louvers shall be provided on sides to ensure proper ventilation. The louvers shall be provided with fine wire mesh to make vermin proof.
- 5.2.2 The terminals for neutral and earthing connections shall be housed in separate vermin-proof, weather-proof terminal box with min. IP-55 degree of ingress protection.
- 5.2.3 A separate canopy shall be provided above enclosure roof with a suitable air gap between them. It shall also cover the terminal compartment. Suitable lifting arrangement shall be provided to lift the canopy.
- 5.2.4 The bottom of the enclosure shall be provided with a drain plug to remove water that may get collected in the enclosure.



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- 5.2.5 The enclosure shall be supported on insulators placed on mounting structure in such a fashion that it is not easily accessible for man standing on ground level. Any part of insulator shall be at a height 2500 mm above ground/plinth.
- 5.2.6 Each cubicle shall be complete with front access door with handles, lock and also a removable bolted cover. All doors and removable covers shall be properly gasketed with good quality neoprene /synthetic rubber gaskets.
- 5.2.7 All cubicle door hinges shall be concealed type. Each cubicle shall be complete with suitably mounted cable box fitted with removable gland plate of Aluminium of suitable thickness for fixing cable gland. Double compression brass Cable glands and cable lugs of tinned copper shall be in the scope of bidder.
- 5.2.8 All necessary galvanised bolts, nuts washers etc. shall be included by the BIDDER for installation of Cubicle at site.
- 5.2.9 The enclosure shall not be earthed to prevent bypassing of resistor in case of any inadvertent shorting of resistor from inside.
- 5.2.10 Panel space heater arrangement along with thermostat, suitable for connection to 240V AC single supply, shall be provided at the bottom of the panel. The illumination arrangement and switch socket shall also be provided in the panel. The required cable glands, lug etc. required shall be supplied by the bidder.
- 5.2.11 For connection of other end of NGR to ground, Tinned copper flat (of size 50mm x 6mm) with Fork connector up to 300mm above ground with 2 nos. earthing terminal/pad, tapped holes and bolts suitable for Connection of GS Flat shall be provided by Bidder. The tinned copper flat shall be insulated from mounting structure through porcelain insulators. GS flat (size to be informed during detail engineering) for connection of fork connector of NGR to ground shall be in BHEL scope.

## 6.0 INSPECTION & TESTS

- 6.1 All tests shall be conducted as per relevant IS/IEC/ IEEE standards and shall be performed in the presence of purchaser's representative, if so desired by the purchaser. The bidder shall give at least 21 days advance notice of the date when the tests are to be carried out.
- 6.2 Bidder shall furnish Type Test certificates (temperature rise and DOP tests) conducted on similar type of equipment for purchaser's review at contract stage.
- 6.3 For all components / materials, for which type test reports have been asked for in the specification, such Type tests should have been carried out on identical components / materials. In absence of such type tests reports or in case such reports are not found to be meeting the specification/standards requirements, vendor shall conduct all such type tests without any commercial/delivery implication to BHEL according to the relevant standards and reports shall be submitted to the owner for approval. (Type test charges as per clause 6.4 shall not be applicable in such cases).
- 6.4 The bidder shall indicate cost of carrying out all the Type tests as specified in the specification. The charges for each of the Type tests shall be given separately as BOQ-cum-price schedule as part of NIT. These prices will be applicable in case a type test is required to be conducted by purchaser despite availability of satisfactory type test report as per clause 6.3 above.
- 6.5 All materials & components and shall be procured, manufactured, inspected, and tested by vendor/sub-vendor as per applicable clauses of BHEL Quality Plan no. PE-QP-999-505-E001, (subject to approval of customer) enclosed.



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- 6.6 All acceptance and routine tests as per relevant standards shall be carried out by the manufacturer. Charges for all these routine and acceptance tests for all the materials shall be deemed to be included in the bid price.
- 6.7 Test reports of the various tests conducted at the time of inspection shall be furnished by the vendor.
- 6.8 Bidder shall furnish unit prices of all items in the prescribed schedule of BOQ-cum-price schedule as part of NIT. Purchaser reserves the right to add/delete the quantity during detailed engineering as finally required for the project. Unit rate quoted shall be applicable for price adjustment in such cases.
- 6.9 All bought out items shall be procured from reputed manufacturers and shall be subject to approval of purchaser.

### 7.0 PAINTING

- 7.1 All bidders must have 7-tank or 8-tank painting procedure.
- 7.2 All metal parts, surfaces shall be degreased by dipping in hot alkaline solution and rubbed with wire brush to remove oil and scale and then rinsed in water. Alternatively, they may be shot blasted.
- 7.3 Parts shall be pickled by dipping in hydrochloric acid to remove the rust from the surfaces formed during storage of sheets and then rinsed to remove traces of the acid. The cleaning and pre-treatment of all metal parts shall be as per applicable standard.
- 7.4 The surfaces to be painted shall then be prepared by phosphatizing to protect them from further rusting and to create a good bond with the paint.
- 7.5 All parts shall then be subjected to a coat of primer paint. All inside surfaces of enclosure shall be spray painted with black matt finish and outside surfaces of enclosure shall be spray painted with hard semi glossy synthetic enamel or power coated (as specified in Sec-I) of shade as per Sec-I.
- 7.6 Paint thickness shall be minimum 50 microns unless specified otherwise in Sec-I.
- 7.7 Electrostatic or powder painting shall be acceptable subject to purchaser's approval.
- 7.8 Finished parts shall be coated with peelable compound by spraying method to protect the finished product from scratches, grease, dirty and oily spots during handling and transportation.

### 8.0 PACKING

- 8.1 Specification for the sea worthy packing, if enclosed, for the export jobs shall form part of the specification.

### 9.0 SPARES



## TECHNICAL SPECIFICATION FOR NEUTRAL GROUNDING RESISTOR

SPECIFICATION NO. PE-SS- 999-506-E001

VOLUME II

SECTION - II

REVISION 01

DATE: 19.02.2019

SHEET 5 OF 5

- 9.1 A list of Erection & commissioning spares (if required by BHEL) along with quantities considered is indicated in **BOQ-cum-price schedule as part of NIT**.
- 9.2 A list of Mandatory spares (if required by BHEL) along with quantities considered is indicated in **BOQ-cum-price schedule as part of NIT**.

### 10.0 GUARANTEED PERFORMANCE REQUIREMENTS

- 10.1 The vendor shall guarantee satisfactory performance of the equipment supplied under all conditions and requirement as laid down by this specification.
- 10.2 The vendor shall comply with the general requirements of performance guarantee specified elsewhere.

### 11.0 O & M MANUAL

O & M manual for installation, operation and maintenance of NGR shall be furnished before despatch of the equipment.

Draft O & M manual shall be submitted for purchaser's approval. Manual shall contain minimum following details:

- i) Description of the equipment.
- ii) Salient construction features.
- iii) Packing details.
- iv) Instructions to be followed on receipt at site for storage.
- v) Erection procedure & checks.
- vi) Test to be conducted at site.
- vii) Commissioning procedure.
- viii) Maintenance instructions.

### 13.0 DELIVERY

The delivery shall be as per NIT (Notice Inviting Tender).

| ENDORSEMENT SHEET FOR Q.P.<br>STANDARD QUALITY PLAN ( SQP)                                                                                                                                    |                                             |                                  |                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|----------------------------------|------------------------------------------------------------------------------------------------------------------|
| TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION                                                                                                                                             |                                             |                                  | <b><i>NTPC</i></b>                                                                                               |
|                                                                                                                                                                                               |                                             |                                  | To be filled in by NTPC                                                                                          |
| PROJECT NAME                                                                                                                                                                                  |                                             |                                  | REVIEW & ENDORSEMENT BY NTPC                                                                                     |
| CONTRACT No.                                                                                                                                                                                  |                                             |                                  | PROJECT SPECIFIC Q.P. NUMBER ALLOTTED                                                                            |
| MAIN SUPPLIER                                                                                                                                                                                 | BHEL                                        |                                  | Q.P. No.:                                                                                                        |
| MANUFACTURER WORKS & ADDRESS                                                                                                                                                                  |                                             |                                  |                                                                                                                  |
| ITEM/ EQUIPMENT/ SYSTEM/<br>SUB-SYSTEM DETAILS i.e. MODEL<br>TYPE/ SIZE/ RATING etc.                                                                                                          |                                             |                                  | REV. No.:                      DATE:                                                                             |
| APPROVED Q.P. No.:                                                                                                                                                                            | SQP NO 0000-999-QOE-S-045 DATED: 15/12/2011 |                                  |                                                                                                                  |
| Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)                                                                                                                                     |                                             |                                  | (TICK APPLICABLE)                                                                                                |
| I. That the item/ component is identical to that considered for Q.P. approval. OR                                                                                                             |                                             |                                  | The Q.P. is enclosed for this project without any                                                                |
| II. That there are minor changes in the item/ component with respect to that considered for Q.P. approval, however the same do not affect the contents of Q.P. OR                             |                                             |                                  | change.                                                                                                          |
| III. That there are minor changes in the item/ component with respect to that considered for Q.P. approval, however the same affect the Q.P. slightly, as indicated below/ in attached sheet. |                                             |                                  | √ The Q.P. is enclosed for this project with changes as indicated.                                               |
| A] <b>Annexure -1 (Annexure to Quality Plan) also to be referred along with QP.</b>                                                                                                           |                                             |                                  | <u>DISTRIBUTION OF ENDORSEMENT OF</u><br>A)<br>1. MAIN SUPPLIER<br>2. MANUFACTURER<br>3. RIO/ CQA- as applicable |
| SIGN.: (Main Supplier)                      DATE:                                                                                                                                             |                                             | SIGN.: (Manufacturer)      DATE: | BIFPCL (Reviewed / Approved by / Date & Seal)                                                                    |

| 2 X 500 MW NTPC MAUDA STAGE-I FGD         |                                                                                                                                                                                                                                                                    |                                                  |
|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|
| NTPC DRAWING NO. : 9561-109-PEM-QVE-Q-010 |                                                                                                                                                                                                                                                                    |                                                  |
| Document Name : QP FOR NGR Rev-0          |                                                                                                                                                                                                                                                                    |                                                  |
| SL NO.                                    | NTPC comments Dated 14.08.19                                                                                                                                                                                                                                       | BHEL reply Dtd. 22.08.19                         |
| 1                                         | Please endorse either SQP No. 0000-999-QOE-S-023 for NEUTRAL GROUNDING RESISTOR (UP TO 46 KV & 2000 AMPS) OR SQP No. 0000-999-QOE-S-045 for NEUTRAL GROUNDING RESISTOR UPTO 66 KV. In case of any doubt/query, please contact Ms. Aman Pandey (Mob No. 9650992159) | Noted & Incorporated.                            |
| 2                                         | Please mention the rating of the NGR                                                                                                                                                                                                                               | Mentioned in endorsement sheet attached with QP. |

|                                                                                                                                                                           |                                                                                                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
|  <b>BHARAT HEAVY ELECTRICALS LTD</b><br>PROJECTS ENGINEERING MANAGEMENT<br>(ELECTRICAL) |                                                                                                |
| This approval status shall be interpreted as laid down in the contract and it shall not relieve the contractor from his contractual obligations.                          |                                                                                                |
| <b>APPROVAL CATEGORY AWARDED</b>                                                                                                                                          |                                                                                                |
| CAT I                                                                                                                                                                     | = Approved                                                                                     |
| CAT II                                                                                                                                                                    | = Approved with comments as noted                                                              |
| CAT III                                                                                                                                                                   | = Not Approved                                                                                 |
| CAT IV                                                                                                                                                                    | = Reference Drawing                                                                            |
| Name: NIDHI RAWAT                                                                                                                                                         | Signature:  |
| Date: 27.08.19                                                                                                                                                            |                                                                                                |

Certification signature by **Digitaly Signed**  
 <sksamanta@ntpceoc.com> Validity Unknown  
**SAMANTA**  
 Date: 2019.08.23  
 17:56:56 IST  
 Reason: CAT I  
 Location:  
 NTPCEOC

# QUALITY PLAN FOR NGR

NTPC DRAWING NO. : 9561-109-PEM-QVE-Q-010

CUSTOMER

NTPC Limited



(A GOVERNMENT OF INDIA ENTERPRISE)

PROJECT

2 X 500 MW MAUDA STAGE - 1 (FGD)



BHARAT HEAVY ELECTRICALS LTD.  
POWER SECTOR  
PROJECT ENGINEERING MANAGEMENT  
NOIDA

| DEPT<br>CODE | NAME | SIGN | DATE |
|--------------|------|------|------|
| E            | DSGN |      |      |
|              | CHD  |      |      |
|              | APPD |      |      |

VENDOR



AMPCONTROL EQUIPMENTS  
PVT. LTD., CHAKAN, PUNE

AEPL DRG. NO. : AEPL / S-5371- QAP

TITLE

QUALITY PLAN FOR NGR

DRAWING NO. PE-V0-444-506-E904

SHEET 1 OF 1 REV. 1

|              |          |
|--------------|----------|
| JOB NO.      | 444      |
| STATUS       | CONTRACT |
| DISTRIBUTION |          |
| TO           |          |
| NO.          |          |

| ENDORSEMENT SHEET FOR Q.P.<br>STANDARD QUALITY PLAN ( SQP)                                                                                                                                                           |                                                                                                               |                                                                                                                                                                                                                         |                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION                                                                                                                                                                    |                                                                                                               | <b>BIFPCL</b>                                                                                                                                                                                                           | To be filled in by BIFPCL                                                                                        |
| PROJECT NAME                                                                                                                                                                                                         | 2X500 MW NTPC MAUDA FGD                                                                                       |                                                                                                                                                                                                                         | <u>REVIEW &amp; ENDORSEMENT BY BIFPCL</u>                                                                        |
| CONTRACT No.                                                                                                                                                                                                         |                                                                                                               |                                                                                                                                                                                                                         | PROJECT SPECIFIC Q.P. NUMBER ALLOTTED                                                                            |
| MAIN SUPPLIER                                                                                                                                                                                                        | M/S BHARAT HEAVY ELECTRICALS LIMITED, PEM, NOIDA                                                              |                                                                                                                                                                                                                         | Q.P. No.: <b>9561-109-PEM-QVE-Q-010</b>                                                                          |
| MANUFACTURER WORKS & ADDRESS                                                                                                                                                                                         | AMPCONTROL EQUIPMENTS PVT. LTD.<br>153/5/1/2,MHALUNGE, CHAKAN-TELEGAON ROAD, TAL. KHED,<br>DIST. PUNE, 410501 |                                                                                                                                                                                                                         |                                                                                                                  |
| ITEM/ EQUIPMENT/ SYSTEM/<br>SUB-SYSTEM DETAILS i.e. MODEL<br>TYPE/ SIZE/ RATING etc.                                                                                                                                 | QAP FOR NGR 3.3kV, 600A FOR 10SEC.                                                                            |                                                                                                                                                                                                                         | REV. No.: 00      DATE: 19.08.2019                                                                               |
| APPROVED Q.P. No.:                                                                                                                                                                                                   | SQP NO 0000-999-QOE-S-045 DATED: 15/12/2011                                                                   |                                                                                                                                                                                                                         |                                                                                                                  |
| Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)                                                                                                                                                            |                                                                                                               |                                                                                                                                                                                                                         | (TICK APPLICABLE)                                                                                                |
| I. That the item/ component is identical to that considered for Q.P. approval. OR                                                                                                                                    |                                                                                                               |                                                                                                                                                                                                                         | The Q.P. is enclosed for this project without any change.                                                        |
| II. That there are minor changes in the item/ component with respect to that considered for Q.P. approval, however the same do not affect the contents of Q.P. OR                                                    |                                                                                                               |                                                                                                                                                                                                                         |                                                                                                                  |
| III. That there are minor changes in the item/ component with respect to that considered for Q.P. approval, however the same affect the Q.P. slightly, as indicated below/ in attached sheet.                        |                                                                                                               |                                                                                                                                                                                                                         | √ The Q.P. is enclosed for this project with changes as indicated.                                               |
| Note : 1. DOP Test IP-33 & IP-55 : Test Report no. KPIL-BTG-16-12-53R1 dtd. 30.05.18 enclosed<br>2. Temperature Rise Test will be conducted on limited resistance element in presence of BHEL / NTPC representative. |                                                                                                               |                                                                                                                                                                                                                         | <u>DISTRIBUTION OF ENDORSEMENT OF</u><br>A)<br>1. MAIN SUPPLIER<br>2. MANUFACTURER<br>3. RIO/ CQA- as applicable |
| SIGN.: (Main Supplier)                                                                                                                                                                                               | DATE:                                                                                                         |  <br>SIGN.: (Manufacturer)      DATE: 19.08.2019 | BIFPCL (Reviewed / Approved by / Date & Seal)                                                                    |

**NOTE : MAKE SHALL BE AS PER NTPC PREFERRED MAKE LIST / AS PER APPROVED DRAWINGS / DOCUMENTS**

# QUALITY PLAN FOR NEUTRAL GROUNDING RESISTOR

|                                      |         |     |          |             |                                                                                                                                                                                               |  |                              |                              |     |      |      |
|--------------------------------------|---------|-----|----------|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------------------------------|------------------------------|-----|------|------|
|                                      |         |     |          | CUSTOMER    |  NTPC—SAIL POWER COMPANY PVT.LTD.                                                                          |  |                              |                              |     |      |      |
| REV.                                 | ALTD    | CHD | APPD     | CONSULTANT  |  MECON LIMITED                                                                                             |  |                              |                              |     |      |      |
|                                      |         |     |          | PROJECT     | ROURKELA PP—II EXPANSION (1x250 MW)                                                                                                                                                           |  |                              |                              |     |      |      |
|                                      |         |     |          | JOB NO. 427 | BHARAT HEAVY ELECTRICALS LIMITED<br>POWER SECTOR<br>PROJECT ENGINEERING MANAGEMENT<br>NOIDA(U.P) INDIA<br> |  |                              | DPT CODE—E                   | DRN | NAME | SIGN |
| DSN                                  | Vimal   |     | 23.10.17 |             |                                                                                                                                                                                               |  |                              |                              |     |      |      |
| CHD                                  | Sandeep |     | 23.10.17 |             |                                                                                                                                                                                               |  |                              |                              |     |      |      |
| APP                                  | Amit    |     | 23.10.17 |             |                                                                                                                                                                                               |  |                              |                              |     |      |      |
| RSI DOC. NO. RSI/QAP/2017/76; REV.01 |         |     |          |             |                                                                                                                                                                                               |  |                              | DWG. NO. PE—V0— 427—506—E904 |     |      |      |
|                                      |         |     |          |             |                                                                                                                                                                                               |  | TITLE : QUALITY PLAN FOR NGR |                              |     |      |      |
|                                      |         |     |          |             |                                                                                                                                                                                               |  | SHT. 1 OF 4 REV. 01          |                              |     |      |      |

| ENDORSEMENT SHEET FOR SQP<br>QUALITY PLAN(QP)                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                             |                                                                                                                                                                                                                   |                                                                                                                                                               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                             |                                                                                                                                | To be filled in by NTPC                                                                                                                                       |
| PROJECT NAME                                                                                                                                                                                                                                                                                                                                                                                                                           | 1X250MW NSPCL ROURKELA TPP STAGE-III                                                                                                        |                                                                                                                                                                                                                   | <b><u>REVIEW &amp; ENDORSEMENT BY NTPC PROJECT</u></b><br>SPECIFIC QP NUMBER ALLOTTED<br>QP NO.: 9572-215-PVE-Q-003<br><br>REV. NO.: 00      DATE: 13.11.2017 |
| CONTRACT NO.:                                                                                                                                                                                                                                                                                                                                                                                                                          | CS-9572-215-2-FC-NOA-6048                                                                                                                   |                                                                                                                                                                                                                   |                                                                                                                                                               |
| MAIN SUPPLIER                                                                                                                                                                                                                                                                                                                                                                                                                          | M/S BHARAT HEAVY ELECTRICALS LIMITED, PEM, NOIDA                                                                                            |                                                                                                                                                                                                                   |                                                                                                                                                               |
| MANUFACTURER WORKS & ADDRESS                                                                                                                                                                                                                                                                                                                                                                                                           | RSI SWITCHGEAR PRIVATE LTD.<br>F-252 & 253, RIICO INDUSTRIAL AREA,<br>(BHIWADI EXTN.), KEHRANI – 301019,<br>DISTT. ALWAR, RAJASTHAN (INDIA) |                                                                                                                                                                                                                   |                                                                                                                                                               |
| ITEM /EQUIPMENT / SYSTEM/<br>SUB-SYSTEM DETAILS i.e. MODEL TYPE /<br>SIZE /RATING etc.                                                                                                                                                                                                                                                                                                                                                 | QAP FOR NGR 6.6KV, 9.9% OHMS, 400A FOR 30SEC.                                                                                               |                                                                                                                                                                                                                   |                                                                                                                                                               |
| APPROVED NTPC DRG. NO.:                                                                                                                                                                                                                                                                                                                                                                                                                | SQP NO 0000-999-QOE-S-045 DATED 15/12/2011                                                                                                  |                                                                                                                                                                                                                   |                                                                                                                                                               |
| Confirmation by Main Supplier (TICK WHICHEVER APPLICABLE)                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                             |                                                                                                                                                                                                                   | (TICK APPLICABLE)                                                                                                                                             |
| √I. That the item/ component is identical to that considered for QP approval                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                             |                                                                                                                                                                                                                   | 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.                                                                                               |
| Note:-<br>1. DOP IP-33 test Report No. RP-1516-000397; Dt. 04.04.2015 for Enclosure issued by ERDA, Enclosed.<br>2. DOP IP-55 test Report No. RP-1516-000398; Dt. 04.04.2015 for Cable / LT box issued by ERDA, Enclosed.<br>3. Temp. Rise Teat Report No. RSI/TRT/2017/76; Dt. 07.11.2017 Enclosed.<br>If desire, Temp. Rise Test on limited resistance element will be carried out in presence of BHEL/ NTPC before bulk inspection. |                                                                                                                                             |                                                                                                                                                                                                                   | <b><u>DISTRIBUTION OF ENDORSEMENT OF</u></b><br><b>A)</b><br>1. MAIN SUPPLIER<br>2. MANUFACTURER<br>3. RIO/ CQA- as applicable                                |
| SIGN.: (Main Supplier)                                                                                                                                                                                                                                                                                                                                                                                                                 | DATE:                                                                                                                                       | SIGN(Sub Supplier):  <br>DATE: 13.11.2017 | NTPC (Reviewed /Approved by/ Date & Seal)                                                                                                                     |

NOTE: MAKE SHALL BE AS PER PREFERRED MAKE LIST / AS PER APPROVED DRAWINGS / DOCUMENTS.

CAT-I





ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.): NEUTRAL GROUNDING RESISTOR (UPTO 66KV)

## STANDARD QUALITY PLAN

CONFORMING TO CODE :  
NTPC TECHNICAL SPECIFICATION

TO BE FILLED IN BY NTPC

QP No:

0000-999-QOE-S-045

Rev. : 0 Date: 15.12.2011

Page: 01 of 02

VALID UPTO: 14.12.2014

REVIEWED BY

Banish K. Jha

R Garg

H Shekhar

APPROVED BY

Approved

Dt. ....

NTPC, Noida

A K Garg

| VALID UPTO: 14.12.2014           |                                             |                 |                                       |               |                  |           |                    |                            |                             |            |        |    |    | H Shekhar |                                                                                          | A K Garg |  |
|----------------------------------|---------------------------------------------|-----------------|---------------------------------------|---------------|------------------|-----------|--------------------|----------------------------|-----------------------------|------------|--------|----|----|-----------|------------------------------------------------------------------------------------------|----------|--|
| Sl No                            | COMPONENT & OPERATIONS                      | CHARACTERISTICS | CLASS                                 | TYPE OF CHECK | QUANTUM OF CHECK |           | REFERENCE DOCUMENT | ACCEPTANCE NORMS           | FORMAT OF RECORD            |            | AGENCY |    |    | REMARKS   |                                                                                          |          |  |
|                                  |                                             |                 |                                       |               | M                | C/N       |                    |                            |                             | D*         | M      | C  | N  |           |                                                                                          |          |  |
| 1                                | 2                                           | 3               | 4                                     | 5             | 6                |           | 7                  | 8                          | 9                           |            | D*     | ** | 10 |           | 11                                                                                       |          |  |
| 1.0 RAW MATERIAL BOUGHT OUT ITEM |                                             |                 |                                       |               |                  |           |                    |                            |                             |            |        |    |    |           |                                                                                          |          |  |
| 1.01                             | MS Sheet                                    | a)              | Thickness                             | Major         | Visual           | 100%      | 100%               | Appvd. Drg./Spec.          | Appvd. Drg./Spec.           | QC Records |        | P  | V  | -         |                                                                                          |          |  |
|                                  | (For NGR Enclosure)                         | b)              | Surface finish                        | "             | Visual           | 100%      | 100%               | IS:2062                    | No damage/corrosion/Pitting | "          |        | P  | V  | -         |                                                                                          |          |  |
|                                  |                                             | c)              | Chemical & Mechanical Properties      | "             | Chem/Mech        | 1/Heat    | 1/Heat             | IS:2062                    | IS:2062                     | MTC        |        | V  | V  | V         |                                                                                          |          |  |
| 1.02                             | MS Angle/Flat/Channel                       | a)              | Dimensional check                     | Major         | Measure          | 100%      | 100%               | IS:2062                    | IS:2062                     | QC Records |        | P  | V  | -         |                                                                                          |          |  |
|                                  | (As applicable)                             | b)              | Surface finish                        | "             | Visual           | 100%      | -                  | "                          | "                           | QC Records |        | P  | -  | -         |                                                                                          |          |  |
|                                  |                                             | c)              | Chemical &                            | "             | Chem/            | 1/Heat    | -                  | "                          | "                           | MTC        |        | V  | -  | -         |                                                                                          |          |  |
|                                  |                                             |                 | Mechanical Properties                 |               | Mech             |           |                    |                            |                             |            |        |    |    |           |                                                                                          |          |  |
|                                  |                                             | d)              | Galvanising Check                     | "             | "                | 100%      | -                  | Relevant Material Standard |                             | "          |        | V  | -  | -         | Proper galvanising of MS Structural members as required shall be ensured by Manufacturer |          |  |
| 1.03                             | Copper Connector                            | a)              | Surface finish                        | Major         | Visual           | 100%      | 100%               | Relevant Material Standard | No damage/corrosion/Pitting | MTC        |        | P  | V  | -         |                                                                                          |          |  |
|                                  |                                             | b)              | Chemical composition                  | "             | Chem             | 1samp/lot | 1samp/lot          | Relevant Material Standard |                             |            |        | V  | V  | V         |                                                                                          |          |  |
|                                  |                                             | c)              | Dimensional check                     | "             | Elect.           | 100%      | 100%               | NTPC Spec./Appvd.drg/DS    | NTPC Spec./Appvd.drg/DS     | "          |        | P  | V  | -         |                                                                                          |          |  |
| 1.04                             | Resistor Grid                               | a)              | Surface finish                        | Major         | Visual           | 100%      | 100%               | Appvd. Drg/DS              | Appvd. Drg/DS               | MTC        |        | P  | V  | -         |                                                                                          |          |  |
|                                  | (Punched stainless steel grid element type) | b)              | Chemical composition                  | "             | Chem             | 1samp/lot | -                  | Relevant Material Standard |                             |            |        | V  | V  | V         |                                                                                          |          |  |
|                                  |                                             | c)              | Resistivity                           | "             | Elect.           | 100%      | 100%               | Appvd. Drg/DS              | Appvd. Drg/DS               | "          |        | P  | V  | -         |                                                                                          |          |  |
| 1.05                             | Porcelaine Bushing/ Mica                    | a)              | Visual Examination                    | Major         | Visual           | 100%      | 100%               | IS:5621                    | IS:5621                     | QC Records |        | P  | V  | -         |                                                                                          |          |  |
|                                  | Insulator                                   | b)              | Dimensional check                     | "             | Measure          | 10%       | -                  | IS:3347                    | IS:3347                     | MTC        |        | P  | -  | -         |                                                                                          |          |  |
|                                  |                                             | c)              | Acceptance Test                       | "             | Review           | 100%      | 100%               | IS:5621                    | IS:5621                     | MTC        |        | V  | V  | V         |                                                                                          |          |  |
| 2.00 IN-PROCESS CHECKS           |                                             |                 |                                       |               |                  |           |                    |                            |                             |            |        |    |    |           |                                                                                          |          |  |
| 2.01                             | Treatment of Sheet                          | a)              | Surface condition & Galvanising Check | Major         | Visual           | 100%      | -                  | IS:277                     | IS:277                      | QC Record  |        | P  | -  | -         |                                                                                          |          |  |
| 2.02                             | Structural Fabrication & Enclosure          | a)              | Dimensional check                     | Major         | Measure          | 100%      | -                  | NTPC Spec./Appvd.drg/DS    | NTPC Spec./Appvd.drg/DS     | QC Record  |        | P  | -  | -         |                                                                                          |          |  |

LEGEND: \* RECORDS, IDENTIFIED 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 COLUMN "N" AS "W".

Format No.: QS-01-QAI-P-10/F3-RL

Engg. Div./QA&I

|  |                               | ITEM (MATERIAL, CLASS, GRADE, RATING, RANGE, SIZE ETC.) : NEUTRAL GROUNDING RESISTOR (UPTO 66KV) |          | STANDARD QUALITY PLAN                             |                  |      |                                                             | TO BE FILLED IN BY NTPC                                                                             |                  |                                                     |        |                                                                                                                                       |   |              |                                                                                                  |
|-----------------------------------------------------------------------------------|-------------------------------|--------------------------------------------------------------------------------------------------|----------|---------------------------------------------------|------------------|------|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|------------------|-----------------------------------------------------|--------|---------------------------------------------------------------------------------------------------------------------------------------|---|--------------|--------------------------------------------------------------------------------------------------|
|                                                                                   |                               |                                                                                                  |          | CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION |                  |      |                                                             | QP No: 0000-999-QOE-S-045<br>Rev. : 0 Date: 15.12..2011<br>Page: 02 of 02<br>VALID UPTO: 14.12.2014 |                  | REVIEWED BY<br>Banish K. Jha<br>R Garg<br>H Shekhar |        | APPROVED BY<br><br>Approved<br>Dt.....<br>A K Garg |   |              |                                                                                                  |
| Sl No                                                                             | COMPONENT & OPERATIONS        | CHARACTERISTICS                                                                                  | CLASS    | TYPE OF CHECK                                     | QUANTUM OF CHECK |      | REFERENCE DOCUMENT                                          | ACCEPTANCE NORMS                                                                                    | FORMAT OF RECORD |                                                     | AGENCY |                                                                                                                                       |   | REMARKS      |                                                                                                  |
|                                                                                   |                               |                                                                                                  |          |                                                   | M                | C/N  |                                                             |                                                                                                     |                  | D*                                                  | M      | C                                                                                                                                     | N |              |                                                                                                  |
| 1                                                                                 | 2                             | 3                                                                                                | 4        | 5                                                 | 6                |      | 7                                                           | 8                                                                                                   | 9                |                                                     |        |                                                                                                                                       |   | 11           |                                                                                                  |
| 2.03                                                                              | Resistance Tier               | a) Resistance                                                                                    | Major    | Elect                                             | 100%             | 100% | Appvd.drg/DS                                                | Appvd.drg/DS                                                                                        | QC Record        |                                                     | P      | V                                                                                                                                     | - | At amb. Temp |                                                                                                  |
|                                                                                   |                               | b) Insulation Resistance                                                                         | "        | "                                                 | 100%             | 100% | "                                                           | "                                                                                                   | "                |                                                     | P      | V                                                                                                                                     | - |              |                                                                                                  |
|                                                                                   |                               | b) High Voltage w/s Test                                                                         | "        | "                                                 | 100%             | 100% | "                                                           | "                                                                                                   | "                |                                                     | P      | V                                                                                                                                     | V |              |                                                                                                  |
| 3.00                                                                              | <b>TYPE TEST</b>              | a) Review of Type Test clearance from NTPC Engineering                                           | Critical | Review                                            | 100%             | 100% | NTPC Tech. spec./ Apvd Drg/DS                               | NTPC Tech. spec./ Apvd Drg/DS                                                                       | TC               | ✓                                                   | P      | W                                                                                                                                     | W | <b>CHP</b>   |                                                                                                  |
| 4.00                                                                              | <b>FINAL INSPECTION</b>       |                                                                                                  |          |                                                   |                  |      |                                                             |                                                                                                     |                  |                                                     |        |                                                                                                                                       |   |              |                                                                                                  |
| 4.01                                                                              | Routine Test on assembled NGR | a) Visula appearance, Rating & GA layout                                                         | Critical | Visual                                            | 100%             | 100% | NTPC Technical Specification./ Approved Drawingg/Data Sheet |                                                                                                     |                  | Test Report                                         | ✓      | P                                                                                                                                     | W | W            |                                                                                                  |
|                                                                                   |                               | b) Dimensional check                                                                             | "        | Measure                                           | "                | "    |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            |                                                                                                  |
|                                                                                   |                               | c) No. of grid & arrangement of resistance tier                                                  | "        | Elect                                             | "                | "    |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            |                                                                                                  |
|                                                                                   |                               | d) Ohmic value measurement at all taps (if applicable)                                           | Critical | Elect                                             | 100%             | 100% |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            | Resustance & Reactance shall be measured seperately                                              |
|                                                                                   |                               | e) Insulation Resistance                                                                         | "        | "                                                 | "                | "    |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            | Shall be done before and after HV Test                                                           |
|                                                                                   |                               | f) HV withstand test                                                                             | "        | "                                                 | "                | "    |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            | 1min. at a Voltage corresponding to the Insulation level of the Resistor                         |
|                                                                                   |                               | g) Degree of Protection test on enclosure                                                        | "        | Physical/ Measure                                 | "                | "    |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            | 2.5mm dia Steel Wire should not enter into the enclosure from any direction without using Force. |
|                                                                                   |                               | h) Paint Shade & Thickness                                                                       | "        | "                                                 | "                | "    |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            |                                                                                                  |
|                                                                                   |                               | i) Functional test of all auxilaary Items/Wirings                                                | "        | Elect                                             | "                | "    |                                                             |                                                                                                     |                  | "                                                   | ✓      | P                                                                                                                                     | W | W            | As applicable                                                                                    |
| 5.00                                                                              | <b>DESPATCH</b>               | a) Packing and Delivery                                                                          | Major    | Physical                                          | "                | "    | Mfr's Packing Instruction                                   |                                                                                                     | "                | ✓                                                   | P      | V                                                                                                                                     | - |              |                                                                                                  |

LEGEND: \* RECORDS, IDENTIFIED 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'.

## ANNEXURE TO QUALITY PLAN

| SL. NO. | COMPONENT/OPERATION | CHARACTERISTIC CHECK                                      | EXTENT OF CHECK | REFERENCE DOCUMENT                              | ACCEPTANCE NORM                                 | FORMAT OF RECORD | AGENCY |   |   |
|---------|---------------------|-----------------------------------------------------------|-----------------|-------------------------------------------------|-------------------------------------------------|------------------|--------|---|---|
|         |                     |                                                           |                 |                                                 |                                                 |                  | P      | W | V |
| 1       | COMPLETE NGR        | 1. HV TEST<br><br>( a ) BETWEEN NEUTRAL BUS AND ENCLOSURE | 100%            | APPD. DRG./ DATA SHEET<br>BS-587 / STD. IEEE 32 | APPD. DRG./ DATA SHEET<br>BS-587 / STD. IEEE 32 | TEST REPORT      | 2      | 1 | - |
|         |                     | ( b ) BETWEEN RESISTOR ELEMENT AND END SUPPORT STRUCTURE. | 100%            | STD. IEEE 32 clause 10.3.2                      | STD. IEEE 32 clause 10.3.2                      | TEST REPORT      | 2      | 1 | - |

**LEGEND :**    1   -   BHEL/ CUSTOMER            2   -   VENDOR            3   -   SUB-VENDOR            P - PERFORM            W - WITNESS            V - VERIFICATION