

VOLUME II

5X800 MW YADADRI TPS #UNIT 1,2,3,4,5

**TELANGANA STATE POWER GENERATION
CORPORATION LTD**

TECHNICAL SPECIFICATION

FOR

NEUTRAL GROUNDING RESISTOR

SPECIFICATION NO: *PE-TS-417-506-E001*

REVISION: 0



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, UP (INDIA) – 201301



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR
NEUTRAL GROUNDING RESISTOR**

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CONTENT SHEET

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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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1.0 SCOPE OF ENQUIRY

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

2.0 BILL OF QUANTITIES:

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

3.0 SPECIFIC TECHNICAL REQUIREMENTS

S.No.	Reference Clause No. of Section- II	Specific Requirement/ Change
1.	5.2.5	Clause 5.2.5 shall be read as "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. Base of NGR enclosure should be at a height of 2.5m above ground level".
2.	5.2.11	Clause 5.2.11 shall be read as follows : "For connection of other end of NGR to ground, Tinned copper flat with Fork connector up to 300mm above ground, 2 nos. earthing terminal/pad, tapped holes and bolts suitable for Connection of 75X10 mm GS flats shall be provided by Bidder. GS flat for connection of fork connector of NGR to ground is excluded from bidder's scope."
3.	6.2	Clause 6.2 shall be read as "Bidder shall furnish Type Test certificates for DOP tests conducted on similar type of equipment for purchaser's review at contract stage. the report shall not be earlier than five (5) years prior to the zero date of the project i.e 17.10.2017 & conduct the Temperature rise test on one unit of each rating
4.	5.1.2	Clause 5.1.2 shall be read as "Resistor bank shall be provided in series and parallel combination of 6 x 6 to achieve the overall resistance value."
5.	9.0	-DELETED-



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3.1 CODES AND STANDARDS

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.2 DESIGN CRITERIA

The Neutral Grounding Resistor (NGR) shall be used for non-effective grounding of 11000 Volt and 3300 Volt System of the plant. NGR shall be connected between transformer 11000 and 3300 Volt side winding neutral points and earth.

Neutral Grounding Resistor shall be used to limit the magnitude of earth fault current so that damage of electrical equipment is reduced, safety of personnel is increased and sensitive, selective earth fault protection can be provided.

The NGR will be installed in dust prone, hot, humid and tropical atmosphere. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

The Resistor unit shall be air-cooled type suitable for installation at outdoor locations and shall meet arduous, heavy duty industrial application, shall be unbreakable, rigid, resilient & rustless. The thermal loading of the resistance box should be uniform.

The resistor enclosure shall be made of sheet steel and shall have minimum thickness of 2 mm.

3.3 SPECIFIC REQUIREMENTS**3.3.1 Resistor**

The resistor element shall be made of non-aging stainless steel having high electrical resistivity and low temperature co-efficient of resistance. Group of resistor elements shall be mounted together between end plates to form a bank. Banks are then to be connected in series-parallel combination to provide the current and ohmic value required. Adjacent banks shall be insulated from each other and the metal frame.

The resistor unit shall consist of a no. of elements. All the elements shall be mounted inside the cubicle so as to ensure ease of inspection and replacement of individual element.

Each Resistor element shall possess a balanced combination of both Mechanical and Electrical properties over the entire intended operating temperature range without any harmful effect on the elements and their accessories.

All the resistor elements constituting 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 through fault current to earth.



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All element connections shall be bolted type to ensure stable resistance value throughout the working life of the unit.

Wet process type brown glaze porcelain insulators shall be used for supporting resistor elements. Porcelain insulators shall have high creepage value suitable for heavily polluted atmosphere charged with dust particles.

The tie rod shall be insulated from the supporting structure by suitable insulators.

All Resistance Bank to Bank interconnections shall be done by solid stainless steel / copper.

3.3.2 Enclosure

Each neutral grounding resistor shall have structural steel work enclosed on all sides and also on top by 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 fire wire mesh to make it vermin proof. Protection class shall be IP33 or better.

Each enclosure shall be self supporting, weather proof type suitable for outdoor mounting. A sloped bottom sheet is welded to the angle iron structure and drain plug shall be provided at suitable place.

Each cubicle shall be complete with a front access door with handles, lock and also a removable bolted cover. All doors and removable covers shall be properly gasketed with neoprene rubber gaskets. All cubicle door hinges shall be concealed type.

Each cubicle shall be provided with suitable base channels for direct bolting to the foundation at site. All necessary galvanised bolts, nuts, washers etc. shall be supplied by the Tenderer for installation of Cubicle at site.

3.3.3 Cubicle lamp and sockets

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.

3.3.4 Wiring

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.

All wiring shall be suitably ferruled with corresponding wiring identification marks used in the Schematic/wiring diagrams.

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.

The connection between Neutral terminal of transformer and NGR shall be through cable supplied by BHEL. A Cable box complete with required hardware (Double compression brass Cable glands and cable lugs) suitable for the cable size selected by BHEL shall be provided on NGR cubicle for terminating the cable. The cable box shall be dust tight, air insulated type with DOP of IP:55, as per IS 13947.



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3.3.5 Grounding

Each cubicle shall be completed with two (2) nos. ground pads, tapped holes and bolts suitable for connection of 75 x 10 mm galvanised steel flats.

3.3.6 Painting

All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease & rust.

After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

The cubicle shall be finished in Light grey shade (IS: 5, Shade # 631 for internal & external) with two coats of synthetic enamel paint after one coat of primer. The minimum thickness of paint shall be 100 microns.

Detail of painting shall be decided during detailed engineering.

3.4 TESTS

3.4.1 Routine Tests

Each equipment shall be completely assembled, wired, adjusted and routine tested as per relevant standards at manufacturer's works. The tests shall include :-

Resistance measurement

Voltage measurement

Insulation resistance measurement

Dielectric test

3.4.2 Type Test

Temperature test .

4.0 DOCUMENTATION

4.1 Documents required along with technical offer shall be as per attachment-I.

4.2 Documents required after award of LOI shall be as per attachment-II.

4.3 No. of prints to be submitted by vendor after award of contract shall be as under:-
as per attachment-III.

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ATTACHMENT – I

DOCUMENTS REQUIRED ALONG WITH TECHNICAL OFFER.

Sign & stamped copy of following documents:

- a] No technical deviation
- b] Schedule of BOQ cum price schedule. (Unpriced).
- c] Compliance Certificate.

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
1.	DATA SHEET FOR NGR	PE-V0-417-506-E005
2.	GA DRAWING FOR NGR	PE-V0-417-506-E279
3.	QUALITY PLAN OF NGR	PE-V0-417-506-E904
4.	TYPE TEST CERTIFICATES OF NGR	PE-V0-417-506-E014
5.	O & M MANUAL FOR NGR	PE-V0-417-506-E016



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ATTACHMENT – III

No. of prints to be submitted by vendor after award of contract shall be as under:-

S.NO.	DESCRIPTION	No. hard /soft copies	No. of CDROMs	REMARKS
1.	Docs. /drgs. for approval (First submission)	PDF File + 4 Hard copies	NIL	
2.	Drgs. / docs. for approval (Second & subsequent submission till approval)	PDF File + 4 Hard copies	NIL	
3.	Final approval drgs. / docs. for Distribution after CAT-1.	PDF File + 10 Hard Copies	4 CD-ROM	
4.	As Built drgs./doc.	PDF File + 10 Hard Copies	6 CD-ROMS	
5.	Operation, Erection & Maintenance manual for approval	PDF File + 2 Hard Copies	NIL	
6.	Approved Operation & Maintenance Manual for distribution	PDF File + 10 Hard Copies	6 CD-ROMS	
7.	Type Test Certificates/ Reports for approval	PDF+ 2 hard Copies	NIL	
8.	Type Test Certificates/ Reports for distribution	10 hard Copies	6 CD-ROMS	



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DATA SHEET-A

1.0 SYSTEM DESIGN DATA

- | | | | | |
|------|--|---|---|-------------------------------|
| 1.1 | Design Ambient | : | ☒ 50°C | ☐ 40°C |
| 1.2 | Reference Standard | : | IEEE – 32 | |
| 1.3 | Rated Voltage | : | As specified in BOQ-Cum-Price Schedule in NIT | |
| 1.4 | voltage & frequency variation | : | voltage: +-10%, frequency: +3to -5% | |
| 1.5 | Location of NGR | : | Outdoor | |
| 1.6 | Rated short time current and time | : | As specified in BOQ-Cum-Price Schedule in NIT | |
| 1.7 | a)Net resistance of resistor unit | : | As specified in BOQ-Cum-Price Schedule in NIT | |
| | b) Tolerance in resistance | : | +-10% | |
| 1.8 | Resistance per resistor element | : | As per Requirement | |
| 1.9 | Material of resistor element | | | |
| | Non-aging Punched stainless steel | | | |
| | i) For high value of current (300/400/500A) | : | ☐ AISI-304 ☒ ASTM-A240 ☐ AISI-A406 (Say | |
| | ii) For low value of current (say 1A) | : | ☐ AISI-406 | |
| 1.10 | No. of parallel Path | : | ☐ Two, ☒ Six (6X6), (Series-parallel) | |
| 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 | |
| 1.15 | Max. allowable temp. rise (over ambient) of enclosure | : | ☐ 20° C ☒ 30° C | |

2.0 ENCLOSURE



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2.1 Material and thickness : Sheet Steel and [√] 2.0 [] 2.5 [] 3.0 mm

2.2 Degree of Protection (As per IS13947)

i) Enclosure : [√] IP-33 + additional canopy [] IP-55 with canopy

ii) Terminal Box : IP-55

3.0 SUPPORT INSULATORS

3.1 Material : Porcelain

3.2 Insulation class of insulating material Over 220°C : Class C :

3.3 Rated voltage

i) For 11kV NGR : 12 kV

ii) For 3.3kV NGR : 3.6 kV

iii) For LV NGR : 1.1kV

3.4 One minute power frequency dry withstand voltage

i) For 11kV NGR : 75/28kV (peak/rms)

ii) For 3.3kV NGR : 40/10kV (peak/rms)

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

4.0 PAINT/FINISH

4.1 Enclosure : As Specified in Sec-I

4.2 Paint Finish

a) Interior : As Specified in Sec-I

b) Exterior : As Specified in Sec-I

4.3 Paint thickness

(i) Spray Painting : As Specified in Sec-I

(ii) Powder coating : As Specified in Sec-I

5.0 MOUNTING STRUCTURE (BOLTABLE TYPE)



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5.1 Material : Hot dip galvanised standard steel section

5.2 Thickness/deposit of galvanisation : 75 microns/610 g/m²

6.0 TERMINAL CONNECTION

6.1 Type : Bushing

6.2 Material : Porcelain

6.3 Rated voltage

i) For 11kV NGR : 12kV

ii) For 3.3kV NGR : 3.6kV

6.4 One minute power frequency dry withstand voltage

iii) For 11kV NGR : 75/28kV (peak/rms)

iv) For 3.3kV NGR : 40/10kV (peak/rms)

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

6.6 Connection between NGR & transformer Neutral : [√] Cable [] GI Flat [] Tinned Copper Flat

Cable size: 1CX240 sqmm XLPE insulated Armoured cable for 11kV NGR & 3.3kV NGR



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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 :
- 7.2 Impulse withstand voltage (peak) KV :

8.0 Mounting Structure

- 8.1 Materials :



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- | | | |
|------|---|---|
| 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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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:

- a) Neutral grounding resistor along with suitable cable glands and lugs for incoming cables from transformer neutral.
- b) Supporting structure along with insulators and necessary foundation hardware.
- c) 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.
- d) All Civil works, Erection & commissioning of equipment are excluded from bidder's scope.
- e) Termination and Jointing kits are excluded from bidder's scope.

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 for supporting resistor elements and used to insulate the resistor element from enclosure. Porcelain insulators shall have high creepage value (as specified in Data sheet-A) suitable for heavily polluted atmosphere charged with dust particles.
- 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.
- 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.
- 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.



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- 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, 2 nos. earthing terminal/pad tapped holes and bolts for connection of 50X6 or 65X8 mm copper strip shall be provided. Copper strip/ copper ground wire for ground connection is in bidder's 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. PED-505-00-Q-002/01 (subject to approval of customer) enclosed.
- 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.



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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

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

9.0 SPARES

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



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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.

12.0 DELIVERY

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

		QUALITY PLAN SHEET 1 OF 4		CUSTOMER : TELANGANA STATE POWER GENERATION CORPORATION LIMITED		PROJECT TITLE : 5X800 MW YADADRI		SPECIFICATION NO. : PE-TS-417-506-E001				
				BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-505-E001, REV. 0		SPECIFICATION TITLE: TS FOR NEUTRAL GROUNDING RESISTOR				
SYSTEM		GROUNDING		ITEM : NEUTRAL GROUNDING RESISTOR				DOC. NO. : PE-TS-417-506-E001				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P W V			REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.0	MATERIALS											
1.1	SHEET STEEL AND STRUCTURES	1. DIMENSIONS (THICKNESS) 2. SURFACE FINISH & WAVINESS / FLATNESS 3. DUCTILITY OF SHEET	MA MI CR	MEASUREMENT VISUAL BEND TEST	10% 100% SAMPLES	APPD. DRG./DATA SHEET IS-1079 , IS-2062 IS-513 -DO- -DO-	APPD. DRG./DATA SHEET IS-1079 , IS-2062 IS-513 NO VISUAL DIFECTS IS-1079 IS-2062 IS-513	QC RECORD -DO- TEST CERT.	3/2 3/2 3/2	1* - 1	1 1	1* - TO BE WITNESSED DURING FINAL INSPECTION TEST CERT. FOR PLATING QUALITY TO BE PROVIDED
1.2	COPPER FLATS	1. DIMENSIONS (THICKNESS) 2. SURFACE FINISH 3. CHEMICAL COMPOSITION	MA MI MA	MEASUREMENT VISUAL CHEMICAL ANALYSIS	10% 100% 1/ MELT	APPD. DRG./DATA SHEET IS-1897 -DO- -DO-	APPD. DRG./DATA SHEET IS-1897 -DO- -DO-	QC RECORD -DO- TEST CERT.	3/2 3/2 3/2	1* - 1	1 1	1* - TO BE WITNESSED DURING FINAL INSPECTION
1.3	RESISTOR GRIDS	1. SURFACE FINISH 2. DIMENSIONS (THICKNESS & AREA) 3. RESISTANCE VALUE	CR MA MA	VISUAL MEASUREMENT ELECTRICAL	100% 100% 10%	MFRS. STD. -DO- -DO-	MFRS. STD. -DO- -DO-	INSPN. REPORT -DO- -DO-	3/2 3/2 3/2	- 1* -	1 1	1* - ONE SAMPLE RESISTOR GRID ELEMENT SHOULD BE PROVIDED TO VERIFY THE DIMENSION AT THE TIME OF FINAL INSPECTION.
BHEL												
PARTICULARS												
NAME												
SIGNATURE												
DATE												
LEGEND :				1 - BHEL/ CUSTOMER	2 - VENDOR	3 - SUB-VENDOR	P - PERFORM	W - WITNESS	V - VERIFICATION			
BIDDER'S/VENDORS COMPANY SEAL												

QUALITY PLAN			CUSTOMER : TAMIL NADU GENERATION & DISTRIBUTION CO. L.TD.		PROJECT TITLE : 1X800 MW NORTH CHENNAI, STAGE-III		SPECIFICATION NO. :PE-TS-423-506-E001				
SHEET 3 OF 4			BIDDER/ VENDOR :		STANDARD QP NO. : PE-QP-999-505-E001, REV. 0		SPECIFICATION TITLE: TS FOR NEUTRAL GROUNDING RESISTOR				
SYSTEM			GROUNDING		ITEM : NEUTRAL GROUNDING RESISTOR		DOC. NO. : PE-TS-423-506-E001				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
1	2	3	4	5	6	7	8	9	10		11
3	SUB-ASSEMBLY RESISTOR UNIT FRAME ASSEMBLED	1. HV TEST	CR	ELECTRICAL	100%	APPD. DRG./ DATA SHEET BS-587	APPD. DRG./ DATA SHEET BS-587	TEST REPORT	2	- 1	
		2.RESISTANCE VALUE	CR	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	- 1	
		3. DIMENSIONS	MA	MEASUREMENT	100%	MFG. STAND.	MFG. STAND.	-DO-	2	- 1	
3.2	FITTING OF RESISTOR UNIT FRAME, PORCELAIN BUSHING & POST INSULATOR	1. FITMENT	MA	VISUAL	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	INSPECTION REPORT	2	- 1	
		2.DIMENSION	MA	MEASUREMENT	100%	-DO-	-DO-	-DO-	2	- 1	
		3. CONNECTION	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	- 1	
		4. TERMINATION	MA	MEASUREMENT	100%	-DO-	-DO-	-DO-	2	- 1	
		5. RESISTANCE VALUE	MA	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	- 1	
3.3	ENCLOSURE & ITS PARTS	1. FINISH	MA	VISUAL	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	INSPECTION REPORT	2	- 1	
		2.DIMENSION	MA	MEASUREMENT	100%	-DO-	-DO-	-DO-	2	- 1	
		3. PAINT SHADE	MA	VISUAL	100%	-DO-	-DO-	-DO-	2	- 1	
4	FINAL ASSEMBLY COMPLETE NGR	1. HV TEST	CR	ELECTRICAL	100%	APPD. DRG./ DATA SHEET BS-587 / STD. IEEE 32	APPD. DRG./ DATA SHEET BS-587 / STD. IEEE 32	TEST REPORT	2	1 -	
		2. MEASUREMENT OF IR VALUE BEFORE & AFTER HV TEST	CR	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	1 -	
4.1		3. RESISTANCE VALUE	CR	ELECTRICAL	100%	-DO-	-DO-	-DO-	2	1 -	
		4. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	-DO-	-DO-	2	1 -	
BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME								
			SIGNATURE								
			DATE								
					BIDDER'S/VENDORS COMPANY SEAL						

		QUALITY PLAN		CUSTOMER : TAMIL NADU GENERATION & DISTRIBUTION CO. LTD.		PROJECT TITLE : 1X800 MW NORTH CHENNAI, STAGE-III		SPECIFICATION NO. :PE-TS-423-506-E001		
		SHEET 4 OF 4		BIDDER/ : VENDOR		STANDARD QP NO. : PE-QP-999-505-E001, REV. 0		SPECIFICATION TITLE: TS FOR NEUTRAL GROUNDING RESISTOR		
		SYSTEM GROUNDING		ITEM : NEUTRAL GROUNDING RESISTOR		DOC. NO. : PE-TS-423-506-E001				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	REMARKS
1	2	3	4	5	6	7	8	9	10	11
		5. SHORT TIME RATING / TEMPERATURE RISE TEST	MA	HEAT RUN	1/TYPE	APPD. DRG./ DATA SHEET BS:587	APPD. DRG./ DATA SHEET BS:587	TEST REPORT	2 1* 1**	1** TYPE TEST CERTIFICATE OF SIMILAR RATING TO BE FURNISHED FOR VERIFICATION BY ENGINEERING
		6. DEGREE OF PROTECTION	MA	AS PER IS:12063 IEC:60529	1/TYPE	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	TEST REPORT	2 1* 1**	1* CONDUCTION OF TYPE TEST TO BE DONE IF CALLED FOR IN TECHNICAL SPECIFICATION & TEST REPORT OF THE SAME TO BE FURNISHED FOR VERIFICATION BY ENGINEERING.
		7. PAINT FINISH	MA	VISUAL	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	INSPECTION REPORT	2 1 -	
		8. PAINT THICKNESS	MA	MEASUREMENT	ALL	-DO-	-DO-	-DO-	2 1 -	
		9. PAINT SHADE	MI	VISUAL-SHADE CARD	ALL	-DO-	-DO-	-DO-	2 1 -	
		10. PAINT ADHESION TEST	MI	MECHANICAL	FEW PLACES OF ALL NGR	-DO-	-DO-	-DO-	2 1 -	
		11. THICKNESS OF GALVANISINGS OF STRUCTURE	MI	VISUAL / MEASUREMENT	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	TEST REPORT	2 1 -	
		12. CHECKING OF EARTH CONNECTION	MA	ELECTRICAL	100%	-DO-	-DO-	-DO-	2 1	
		13. CHECKING OF EARTHING MATERIAL (TINNED COPPER STRIP)	MA	VISUAL	100%	-DO-	-DO-	-DO-	2 1	
		14. VERIFICATION OF BOM INCLUDING CABLE GLAND & LUGS (AS APPLICABLE)	MA	VISUAL	100%	-DO-	-DO-	-DO-	2 1	
BHEL			PARTICULARS			BIDDER/VENDOR				
			NAME							
			SIGNATURE							
			DATE							
LEGEND :			1 - BHEL/ CUSTOMER		2 - VENDOR		3 - SUB- VENDOR		P - PERFORM W - WITNESS V - VERIFICATION	
									BIDDER'S/VENDORS COMPANY SEAL	