

VOLUME II

1 X 660 MW PANKI TPS

TECHNICAL SPECIFICATION

FOR

NEUTRAL GROUNDING RESISTOR

SPECIFICATION NO: *PE-TS-426-506-E001*

REVISION: 01



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, UP (INDIA) – 201301



1X 660 MW PANKI TPS
TECHNICAL SPECIFICATION FOR
NEUTRAL GROUNDING RESISTOR

SPECIFICATION NO. PE-TS- 426-506-E001

VOLUME II

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REVISION 01

DATE: 17.03.2020

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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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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

3.1

<u>S.No.</u>	<u>Reference Clause No. of Section- II</u>	<u>Specific Requirement/ Change</u>
1.	3.2	In addition to existing cl. No 3.2 : The rated time for the earth fault current or specified thermal current shall be continuous.
2.	5.1.1	Shall be read as: " Each Neutral Grounding Resistor shall be formed of non-aging (grade ASTM-A240/AISI-304 or better) corrosion resistant punched stainless steel elements for 300A of earth fault current. Resistance material mentioned above shall have high electrical resistivity and low temperature co-efficient of resistance.
3.	5.1.2	Shall be read as : "Resistor bank shall be provided in series and parallel combination as mentioned in datasheet A to achieve the overall resistance value. Adjacent banks shall be insulated from each other and the metal frame."
4.	5.1.3	Shall be read as : "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. The resistors shall preferably be edge wound type. "
5.	5.1.10	Shall be read as follows: "All the 11 kV & 3.3 kV NGR shall be connected to respective transformer neutral by Cable (11 kV NGR by 11/11kV(UE) 1C-400 sq mm Al cond., XLPE insulated armoured cable and 3.3 kV NGR by 3.3/3.3 kV (UE) 1C-240 sq mm Al cond., XLPE insulated armoured cable).
6.	5.1.11	Cl. No. 5.1.11 shall be added as follows: "The resistor element shall be insulated from supporting bars by mica tubes. Supporting bar shall be insulated by porcelain insulators."
7.	5.1.12	Cl. 5.1.12 shall be added as "All Resistance Bank to Bank interconnections shall be done by solid stainless steel / copper."
8.	5.2.1	The clause will remain same except that enclosure minimum thickness shall be 2.5mm.
9.	5.2.5	Shall be read as "Each cubicle shall be mounted on insulators placed on cubicle mounting structure and shall be provided with suitable base channels for direct bolting to the foundation at site. The height of the cubicle mounting structure



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		shall be 2.5 meters."
10.	5.2.7	In addition to existing clause 5.2.7: "Cable box shall be provided and cable entry shall be through bottom."
11.	5.2.10	In addition to existing clause 5.2.10: Panel shall be provided with internal illumination lamp with door switch, space heater with thermostat one 5A, 3 pin receptacles with plug.
12.	5.2.11	In addition to existing cl. "The length of copper flat shall be suitably decided by bidder."
13.	5.2.12	Cl. No. shall be added as follows:" Two (2) Nos. porcelain bushing (incoming and outgoing) shall be housed at the side of the enclosure, one of which will be used for connection of transformer neutral and the other as ground side terminal. The bushing terminal boxes shall have detachable gland plates with cable glands."
14.	6.1	In addition to existing clause, following shall also be applicable: "Each equipment shall be completely assembled, wired, and routine tested as per relevant standards at manufacturer's works. The routine tests shall include: (i) Resistance measurement (ii) Voltage measurement (iii) Insulation resistance measurement (iv) Dielectric test"
15.	6.3	Clause 6.3 shall be read as follows: 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. The type test should have been conducted within 5 yrs from the date 02.11.2015 . In absence of such valid 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 (temperature rise and DOP test on enclosure and terminal box) without any commercial/delivery implication to BHEL according to the relevant standards and reports shall be submitted to the owner for approval.
16.	6.4	This clause stands deleted.
17.	7.2	Shall be replaced with following : "All surface shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease & rust."
18.	7.5	Shall be read as follows: "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 Siemens Grey RAL 7032 with two coats of synthetic enamel paint.
19.	7.9	Shall be added as follows: "Sufficient quantity of touch-up paint (approx. 1 litre) shall be furnished for each NGR for future application at site."

- 3.2 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. All wiring shall be suitably ferruled with corresponding wiring identification marks used in the Schematic/wiring diagrams.
- 3.3 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.
- 3.4 BHEL Customer specification Quality plan is attached with this Section as Attachment- III. Customer standard quality plan is also attached with this specification as "STANDARD QP NO. : 0000-999-QOE-S-045". In case of contradiction between two quality plans, more stringent of the two shall be followed. In case bidder has reference



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QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial or delivery implication to BHEL on account of changes in QP during QP approval by customer.

3.5 Packing- Packing shall be as per Attachment IV to Section I.

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 BHEL Customer quality plan is attached as attachment-III.

4.4 Packing details as per attachment IV.



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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.

In addition to documents specified in NIT, following documents/drawings shall be submitted after placement of order for BHEL's approval: -

Sl. No.	Drawings/Document Description	Drawings / Document Number	Document Type	First Submission	Resubmission
6	BILL OF MATERIAL (BOM) FOR NGR	PE-V0-426-506-E017	Secondary	One week after approval of all primary drawings	Within one week of BHEL comments

NOTE-

- Vendor shall submit the dates for drawing/document submission/BHEL comments/ resubmission after approval of documents.
- In BOM each of the item to be uniquely identified with item code no. or item Sl. no. Supplier to ensure that all the items which will find separate mention in the packing list are covered in detailed BOM. Supplier to give following undertaking in BOM: " The BOM provided here completes the scope (in content and intent) of material supply under PO no. ---- dtd ---- Any additional material which may become necessary for the intended application of supplied item/package will be supplied free of cost in most reasonable time."

E8: NEUTRAL GROUNDING RESISTOR

ATTRIBUTES / CHARACTERISTICS													
	→ ←												
ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY	Visual & Dimensional check	Mechanical properties	Electrical strength	Chemical Composition	Make / Type / Rating / Model / TC / General Physical Inspection.	Insulation Resistance Measurement before and after HV Test	HV Test	Degree of Protection Test	Routine Test as per relevant standard	Functional / Operator Check	Painting / silver Plating Quality & Adhesion Test	Galvanising Test	Routine Test
Resistor	Y	Y	Y	Y		Y							
Cubilce	Y		Y					Y			Y		
Galvanised Steel Structures (IS:2633/2629/ 6745) (IS:2062)	Y											Y	
Bushing / Post & Support Insulator (IS:2544 / 5621)	Y	Y	Y		Y				Y				
NGR, Elastomer Spring Head, Panel Mounted Items & NG Cubicle.	Y				Y	Y			Y	Y			
Complete NGR (IEEE-32)	Y					Y	Y	Y	Y				Y
Complete Cubicle	Y										Y		
Notes :													
1) This is an indicative list of tests / checks. The manufacturer is to furnish a detailed quality plan indicating the Practice and procedure along with relevant supporting documents during QP finalisation for all the items.													
2) All major Bought Out Items will be subject to Owner/ Owner Engineer approval.													



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ATTACHMENT – IV to SECTION I

Packing:

A. Support Structure of NGR shall be despatched in open in such a manner there shall be no damage during transit.

B. NGR shall be despatched in “Crate Packing” using wood

1.0 PREPARATION OF PACKING CASES:

1.1 DIMENSIONS:

- 1.1.1 Minimum number of planks shall be used for a shook.
- 1.1.2 Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm
- 1.1.3 Horizontal, vertical, diagonal planks shall be given for binding
- 1.1.4 Width of binding planks shall be minimum 100mm
- 1.1.5 Distance between any 2 binding planks shall be less than 750mm
- 1.1.6 Diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm
- 1.1.7 Distance of the outer edges of these planks from the edge of case shall be less than 250mm.
- 1.1.8 Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

1.2 JOINTING OF PLANKS:

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag

manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

1.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12 ± 1 mm, thickness of tongue shall be 8 ± 1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

1.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

1.5 OTHER MATERIALS

1.5.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

1.5.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

1.5.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust. If sufficient nailing is done for bigger boxes, strapping need not be done.

1.5.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

1.5.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

1.5.6 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

100GSM (Colourless) Multi Layered Cross Laminated Polyethylene Film are used to make covers to the jobs individually.

The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

1.5.6 RUBBERISED COIR:

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

1.5.7 FASTENERS

Bolts, double nuts, spring washers will have to be used to hold the job to the bottom plank of the box so that there shall be no jerk on the NGR during transit.

1.5.8 PACKING SLIP:

Packing slip kept in the polyethylene bag shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder shall be nailed to front / rear of case.

1.5.9 MARKING PLATE:

Marking on the packing case shall be done as per the manufacturer standard.



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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 & frequency of system : 11KV±6% & 3.3 KV±6%, 50 Hz±3%
- 1.5 Location of NGR : Outdoor , free standing
- 1.6 Rated short time current and time : 300A for 10sec
- 1.7 Net resistance of resistor unit : 22.13 Ω for 11 KV and 6.64 Ω for 3.3 KV
- 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 : ☒ AISI-304 ☒ ASTM-A240 ☐ AISI-406
(Say 300/400/500A)
- ii) For low value of current (say 1A) : ☐ AISI-406
- 1.10 No. of parallel Path : ☐ Two (2X2) ☒ Six (6X6)
- 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
- 1.14 Max. allowable temp. rise (over ambient) of enclosure : ☐ 20° C ☒ 30° 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

2.3 Finish paint of Interior & Exterior : RAL 7032

2.4 Base : Black

3.0 SUPPORT INSULATORS

3.1 Material : Porcelain

3.2 Rated voltage

- i) For 3.3 kV NGR : 3.6 kV
- ii) For 11 kV NGR : 12 kV

3.3 One minute power frequency
dry withstand voltage

- i) For 3.3kV NGR : 40/10kV (peak/ r.m.s)
- ii) For 11kV NGR : 75/28kV (peak/ r.m.s)

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

4.0 MOUNTING STRUCTURE (BOLTABLE TYPE)

4.1 Material : Hot dip galvanised standard steel section

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

4.3 Equipment mounting : Height of cubicle mounting structure shall be 2.5 m.

5.0 TERMINAL CONNECTION

5.1 Type : Bushing

5.2 Material : Porcelain

5.3 Rated voltage

- i) For 3.3kV NGR : 3.6kV
- ii) For 11kV NGR : 12 kV

5.4 One minute power frequency
dry withstand voltage

- i) For 3.3kV NGR : 40/10kV (peak/rms)
- ii) For 11 kV NGR : 75/28 kV(peak/rms)

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



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

***Refer cl. No. 3.1 (5) of Section I for details**

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

7.0 Allowable tolerance in resistance Value :±10%

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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 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



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- 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).

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

Format No.: QS-01-QA1-P-10/F3-RL

Engg. Div./Q.A.

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CONFORMING TO CODE : NTPC TECHNICAL SPECIFICATION		QP No: 0000-999-QOE-S-045 Rev.: 0 Date: 15.12.2011 Page: 02 of 02 VALID UPTO: 14.12.2014				REVIEWED BY: Banish K. Thakur R Gang H Shetkar Approved Approved Approved			
COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
				M C/N				M C N	
1	2	3	4	5	6	7	8	9	10
2.03	Resistance Tier	Major	Elect	100%	100%	Appvd.drg/DS	Appvd.drg/DS	QC Record	P
	b) Insulation Resistance	"	"	100%	100%	"	"	"	P
	b) High Voltage w/s Test	"	"	100%	100%	"	"	"	P
3.00	TYPE TEST	Critical	Review	100%	100%	NTPC Tech. spec./ Apvd Drg/DS	NTPC Tech. spec./ Apvd Drg/DS	TC	Valid type test report to be submit and type test carried out Not required.
4.00	FINAL INSPECTION								
4.01	Routine Test on assembled NGR	Critical	Visual	100%	100%				
	a) Visual appearance, Rating & GA layout	"	Measure	"	"				
	b) Dimensional check	"	Elect	"	"				
	c) No. of grid & arrangement of resistance tier	"	Elect	"	"				
	d) Ohmic value measurement at all taps (if applicable)	Critical	Elect	100%	100%				
	e) Insulation Resistance	"	"	"	"				
	f) HV withstand test	"	"	"	"				
	g) Degree of Protection test on enclosure	"	Physical/ Measure	"	"				
	h) Paint Shade & Thickness	"	"	"	"				
	i) Functional test of all auxiliary items/Wirings	"	Elect	"	"				
5.00	DESPATCH	Major	Physical	"	"				
	a) Packing and Delivery	"	"	"	"				

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-QA1-P-10/F3-RL

Engg. Div/JQA&I