785947/2022/PS-PEM-EL

BHEL	2 X 660 MW KHURJA SUPER THERMAL POWER PROJECT PRE-QUALIFICATION REQUIRMENTS FOR NEUTRAL GROUNDING RESISTOR	PE-PQ-475-505-E001 REVISION NO. 00 DATE 11.04.2022 SHEET 1 OF 2

ITEMS : Neutral grounding resistor a/w supporting structure **SCOPE:** Supply : YES; Erection & Commissioning : NO;	
1	Availability of type test certificates conducted at independent Lab or witnessed by third party as per relevant IS/International standard.
2	Vendor should have in-house facility for design and manufacturing of neutral grounding resistor.
3	Vendor should have in-house capability to carry out all routine and type tests. In case facilities for type test are not available with the vendor, these tests can be conducted at Govt. Lab/Govt. approved independent Lab
4	Manufacturing capacity of at least 4 nos. neutral grounding resistor per month.
5	Supplied at least 8 nos. of neutral grounding resistor in one or more orders.
6	Minimum two (2) nos. purchase orders for neutral grounding resistor shall be submitted which should not be more than five (5) years old from the date of techno-commercial bid opening for establishing continuity in business.

Notes (General points of PQR):

1. Offers of the JV companies/ Joint Bidders/ bidders having collaboration/ licensing agreement/ MOU/ Indian subsidiaries shall be evaluated as follows:

   a. If bidder happens to be an Indian subsidiaries of foreign OEM, then the credentials of the foreign OEM can also be considered for meeting PQR.
   b. If bidder happens to be the Joint Venture Company, then the credentials of any of JV partners can be also considered for meeting PQR.
   c. If bidder happens to bid jointly with their partner, then credentials of both the partners will be considered for meeting PQR as per distribution of the work. In all such cases, lead bidder as specified in bid documents shall be responsible for overall execution of the contract and all guarantee/ warranty.
   d. If bidder happens to be the having valid collaboration agreement/ MOU/ licensing agreement with some other company, then the credentials of collaborator/ MOU partner/ licensing company can also be considered for meeting PQR.

Note: If bidder(s) qualifies on the basis of credentials of his principal/ JV partner/ Collaborator/ joint bidder etc., then the principal/ JV partner/ Collaborator/ MOU partner/ joint bidder shall be responsible for overall design vetting and warranty/ guarantee of the package. The scope matrix clearly defining their respective roles including design vetting, manufacturing of critical component, E&C etc. etc. and warranty/ guarantee shall be submitted along with the offer.

2. Bidder to note that the arrangement of bidding (joint bid partners/ collaborator/ MOU partner/ licensing company etc.) once offered to BHEL as a part of bidding documents cannot be changed till the execution of the project.

3. Consideration of offer shall be subject to customer's approval of bidders, if applicable

4. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self- attested English translated document should also be submitted.

PREPARED BY	REVIEWED BY	APPROVED BY
11/04/22	11/4/22	11/4/22
NAME: SOURABH TIWARI DESIGNATION: MANAGER	NAME: KAVITA GUPTA / OMKAR KUMAR DESIGNATION: MANAGER / DGM	NAME: DEBASISA RATH DESIGNATION: AGM & DH-ELECTRICAL

785947/2022/PS-PEM-EL

BHEL	2 x 660 MW KHURJA SUPER THERMAL POWER PROJECT PRE-QUALIFICATION REQUIRMENTS FOR NEUTRAL GROUNDING RESISTOR	PE-PQ-475-505-E001 REVISION NO. 00 DATE 11.04.2022 SHEET 2 OF 2

5. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.

6. After satisfactory fulfilment of the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of tender.

PREPARED BY	REVIEWED BY	APPROVED BY
11/04/22	11/4/22 11/4/2022	11/4/22
NAME: SOURABH TIWARI DESIGNATION: MANAGER	NAME: KAVITA GUPTA / OMKAR KUMAR DESIGNATION: MANAGER / DGM	NAME: DEBASISA RATH DESIGNATION: AGM & DH-ELECTRICAL

785947/2022/PS-PEM-EL

	DOCUMENT RECORD SHEET	SHEET 1 OF 1
	DOCUMENT NO. PE-TS-475-506-E001	NO. OF SHEETS OF DOCUMENT 29

DOCUMENT TITLE: TECHNICAL SPECIFICATION FOR NEUTRAL GROUNDING RESISTOR

PROJECT TITLE: 2X660 MW KHURJA TPS

ISSUE NO.	REVISION PARTICULARS	SIGNATURE AND DATE						
		PREP. BY	CHKD. BY	APPD. BY	COORDINATED WITH			
1	REVISION-00	ST 12/4/22	KG 12/4/22	OMK 12/4/2022				

VOLUME II

2 X 660 MW KHURJA SUPER THERMAL POWER PROJECT

TECHNICAL SPECIFICATION

FOR

NEUTRAL GROUNDING RESISTOR

SPECIFICATION NO: ***PE-TS-475-506-E001***

REVISION: **0**

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

	DOCUMENT TITLE **TECHNICAL SPECIFICATION FOR NEUTRAL GROUNDING RESISTOR**	SPECIFICATION NO. PE-TS- 475-506-E001
		VOLUME II
		CONTENT SHEET
		REVISION 0 / DATE: 03.02.2022
		SHEET

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	a) GENERAL TECHNICAL SPECIFICATION	05
	b) QUALITY PLAN	03
	c) ANNEXURE-1 to QP	01
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	(INCLUDING COVER/ SEPARATOR SHEETS)	

	DOCUMENT TITLE **TECHNICAL SPECIFICATION FOR NEUTRAL GROUNDING RESISTOR**	SPECIFICATION NO. PE-TS- 475-506-E001
		VOLUME II
		COMPLIANCE CERTIFICATE
		REVISION 0 / DATE: 03.02.2022
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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

SECTION –I

SPECIFIC TECHNICAL REQUIREMENTS

	DOCUMENT TITLE	SPECIFICATION NO. PE-TS- 475-506-E001	
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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

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***
1.	5.1.1	Clause 5.1.1 shall be read as follows: "Each Neutral Grounding Resistor shall be formed of non-aging (grade ASTM-A240/AISI-304 or better) corrosion resistant punched stainless steel elements for high values 600A of earth fault current. Resistance material mentioned above shall have high electrical resistivity and low temperature coefficient of resistance".
2.	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".
3.	5.1.11	Clause 5.1.11 shall be added as follows: "All resistance Bank to Bank interconnection shall be done by solid stainless steel/copper.".
4.	5.1.12	Clause 5.1.12 shall be added as follows: "The resistor element shall be insulated from supporting bars by mica tubes. Supporting bar shall be insulated by porcelain insulator".
5.	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.".

6.	5.2.7	Clause 5.2.7 shall be read as follows: "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. Cable gland shall be heavy duty Double compression type of Brass machine finished and nickel chrome plated. Thickness of plating shall not be less than 10 microns. All the washers and hardware shall also be made of brass with nickel chrome plating for cable glands. Testing requirement of cable glands shall conform to BS: 6121. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable lug for power cable shall be tinned copper solderless crimping type suitable for aluminium compacted conductor cables. Cable lugs for control cables shall be provided with insulating sleeve and shall suit the type of terminals provided on the equipment. Cable lugs & ferrule shall conform to relevant standard.
7.	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."
8.	6.0	In addition to clause 6.0: Following tests shall be conducted on NGR Cubicle 1. **Routine Tests:** DOP test on enclosure (routine test) as follows: It shall not be possible to insert a 2.5mm dia. steel wire into the enclosure from any direction without using force
9.	6.2	Clause 6.2 shall be read as follows: Bidder shall furnish Type test certificates (Short time current test along with temperature rise test & Degree of protection test i.e. IP33 for enclosure and IP55 for Terminal box). The type test should have been conducted within 10 yrs from the date of techno commercial bid opening i.e. 05.04.2019. Following valid type test report (within last ten years as on 05.04.2019) 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: 1. Short time current test along with temperature rise test. 2. Degree of protection test for IP33 on enclosure. 3. Degree of protection test for IP55 on Terminal Box.
10.	6.5	Clause 6.5 shall be read as follows: All materials & components and shall be procured, manufactured, inspected, and tested by vendor/sub-vendor as per applicable clauses of NTPC endorsed quality plan and Annexure-A to quality plan
11.	7.0	In addition to clause 7.0: 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. No. of coats shall be one coats each & total DFT shall not less than 100 microns. 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 & 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.

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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.

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 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.

3.5 Packing shall be as per Attachment-III of 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 Packing details as per attachment-III.

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.

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-V0-475-506-E005
2.	GA DRAWING FOR NGR	PE-V0-475-506-E279
3.	QUALITY PLAN OF NGR	PE-V0-475-506-E904
4.	TYPE TEST CERTIFICATES OF NGR	PE-V0-475-506-E014
5.	O & M MANUAL FOR NGR	PE-V0-475-506-E016
6.	BILL OF MATERIAL (BOM) OF NGR	PE-V0-475-506-E017

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."

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ATTACHMENT –III 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 Specification No: AA51420 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	:	12 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	:	11.066 Ω
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
	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

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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

ii) Terminal Box : IP-55 with canopy

3.0 SUPPORT INSULATORS

3.1 Material : Porcelain

3.2 Rated voltage

i) For 11 kV NGR : 12 kV

3.3 One minute power frequency dry withstand voltage

i) For 11kV NGR : 28kV (rms)

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 : 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

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i) For 11kV NGR : 12kV

5.4 One minute power frequency dry withstand voltage

i) For 11kV NGR : 28kV (rms)

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 :

4.0 Support insulator

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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 Cubcle**	
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	:
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	:

SECTION – II

GENERAL TECHNICAL SPECIFICATION

	TECHNICAL SPECIFICATION FOR NEUTRAL GROUNDING RESISTOR	SPECIFICATION NO. PE-SS- 999-506-E001	
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		SECTION - II	
		REVISION 01	DATE: 19.02.2019
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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

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.

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.

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

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.

STANDARD QUALITY PLAN (SQP)

TO BE FILLED IN BY SUPPLIER AT TIME OF SUBMISSION		**NTPC**	**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/ SUB-SYSTEM DETAILS i.e. MODEL 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 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.	
A] Annexure -1 (Annexure to Quality Plan) also to be referred along with QP.		*DISTRIBUTION OF ENDORSEMENT OF* A) *1. MAIN SUPPLIER* *2. MANUFACTURER* *3. RIO/ CQA- as applicable*	
SIGN.: (Main Supplier) *DATE:*	*SIGN.: (Manufacturer)* *DATE:*	BIFPCL (Reviewed / Approved by / Date & Seal)	

एनटीपीसी NTPC	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..... 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					M	C	N	
1	2		3	4	5	6		7	8	9	D*	**	10		11
1.0	**RAW MATERIAL BOUHGT 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/ corrossion/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%	-	Relevent 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%	Relevent Material Standard	No damage/ corrossion/Pitting	MTC		P	V	-	
		b)	Chemical composition	"	Chem	1samp/lot	1samp/lot	Relevent 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	b)	Chemical composition	"	Chem	1samp/lot	-	Relevent Material Standard				V	V	V	
	grid element type)	c)	Resistivity	"	Elect.	100%	100%	Appvd. Drg/DS	Appvd. Drg/DS	"		P	V	-	
1.05	Porceline 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, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** **M: MANUFACTURER / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE,**
CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

2

	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: 02 of 02 VALID UPTO: 14.12.2014	REVIEWED BY Banish K. Jha R Garg H Shekhar	APPROVED BY Approved Dt..... N.T.P.C., Noida 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					M	C	N	
1	2		3	4	5	6		7	8	9	D*	**	10		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	**TYPE TEST**	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	***CHP***
4.00	**FINAL INSPECTION**														
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 auxilairy Items/Wirings	"	Elect	"	"			"	√	P	W	W	As applicable
5.00	**DESPATCH**	a)	Packing and Delivery	Major	Physical	"	"	BHEL Specification		"	√	P	W	-	

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.

** M: MANUFACTURER / SUB-SUPPLIER C: MAIN SUPPLIER, N: NTPC P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUM "N" AS 'W'.

ANNEXURE – 1

ANNEXURE TO QUALITY PLAN

Following tests shall also be conducted in addition to those mentioned in Quality plan (SQP No. 0000-999-QOE-S-045, Rev.0):

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							
		(a) BETWEEN NEUTRAL BUS AND ENCLOSURE	100%	APPD. DRG./ DATA SHEET BS-587 / STD. IEEE 32	APPD. DRG./ DATA SHEET 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