



BHARAT HEAVY ELECTRICALS LIMITED

TRANSMISSION BUSINESS ENGINEERING MANAGEMENT

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TYPE OF DOC.	TECHNICAL SPECIFICATION	NAME	RD	VK	AG
TITLE 400 kV & 220 kV LINE TRAP		SIGN	[Signature] 22/01/18		
		DATE	09/11/18	9/11/18	9/11/18
		GROUP	TBEM	W.O. No	88005
CUSTOMER	UTTAR PRADESH TRANSMISSION CORPORATION LTD (UPPTCL)				
CONSULTANT	-----				
PROJECT	400/220/132 kV GIS SUBSTATION AT RASARA, BALLIA				

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SECTION 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and dispatch of 400kV & 220kV Line Traps (Wave Traps) complete with accessories as listed under this specification.

This section covers the specific technical requirements of Line Trap. This constitutes minimum technical parameters for the above item as specified by the customer (UPPTCL). The offered equipment shall also comply with the General Technical Requirements for the project as detailed under section-3 of this specification.

The specification comprise of following sections:

- Section-1: Scope, Specific Technical Requirements & Bill of Quantities
- Section-2: Equipment Specification
- Section-3: Project Details & General Technical Requirements
- Section-4: Guaranteed Technical Particulars
- Section-5: Checklist

- In case of any conflict between various sections, **order of precedence** shall be in the same order as listed above.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)

Name of consultant: -----

Name of Projects: 400/220/132 kV GIS Substation at Rasara, Ballia

Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 As per attached Annexure-I (UPPTCL specification, 3 pages).

1.2.2

Sl. No.	Technical Parameters	Unit	400kV System	220kV System
1	Max operating voltage of the system	kV rms	420	245
2	Rated short time current for 1-second	kA	50	40
3	Nominal discharge current of protective device	kA	As per Annexure-I, Section-1	
4	Type of tuning		Broad Band	Broad Band
5	Rated Blocking bandwidth		Typically in the range 50-500 kHz*	Typically in the range 50-500 kHz*
6	Capacitance of CVT	pF	8800	4400

Sl. No.	Technical Parameters	Unit	400kV System	220kV System
7	Max Radio Interference Voltage level	μ V	500 (for 280 kVrms)	500 (for 163 kVrms)
8	Rated power frequency	Hz	50	
9	Resistive component of impedance within Carrier frequency blocking range	ohms	Not less than 570 ohms	
10	Min Corona extinction voltage level	kV rms	320	156
11	Basic insulation level			
(i)	Lightning impulse withstand voltage	kVp	± 1550	± 1050
(ii)	Rated power frequency withstand voltage	kV rms	680	460
(iii)	Switching impulse withstand voltage	kVp	± 1050	-

* If required, two tuning pots to be offered to meet design requirements.

1.3 QUANTITIES

Sl. No.	Description	Quantity
1.	400 kV, 3150 A, 50 kA/1 sec, 1.0 mH Line Trap	4 Sets
2.	Terminal Connectors for line side of 400kV Line Trap (suitable for <u>Twin MOOSE conductor*</u>)	4 Sets
3.	Terminal Connectors for station side of 400kV Line Trap (suitable for <u>Twin MOOSE conductor*</u>)	4 Sets
4.	220 kV, 1600 A, 40 kA/1 sec, 0.5 mH Line Trap	8 Sets
5.	Terminal Connectors for line side of 220kV Line Trap (suitable for <u>Single ZEBRA conductor*</u>)	8 Sets
6.	Terminal Connectors for station side of 220kV Line Trap (suitable for <u>Single ZEBRA conductor*</u>)	8 Sets

Note:

1. Each Line Trap is required with following accessories

- (a) Hardware (Nuts, Bolts and Washers) – 1 set with Each Line Trap for mounting Line Trap
- (b) Grading ring, if necessary – 1 set with Each Line Trap

2. 400kV & 220kV Line Traps shall be suitable for pedestal mounting.

3. The above quantities are subject to change by $\pm 25\%$ at contract stage.

* The final requirements of terminal connectors will be furnished to the successful bidder during Contract stage.

1.4 TYPE TESTS

The offered equipment should have been successfully type tested as per relevant IS/ IEC and valid test reports shall be submitted. Bidder shall submit valid reports of type tests for Line Traps (type test reports shall not be older than **ten years from 17.04.18**). If these tests have been conducted more than **ten years** prior from **17.04.18** or bidder do not have valid test report/ test reports not acceptable to end customer, the type tests shall be repeated with no extra cost to BHEL/UPPTCL.

1.5 INSPECTION & TESTING

Before being fitted on the equipment, all components shall be subjected to routine tests at the Contractors factory, as per the relevant IEC/IS standards. A detailed test report proving the successful passing of such tests shall be provided.

Prior to dispatch, the routine & acceptance tests shall be carried out on each Line Trap in accordance with the applicable IEC /IS and the material shall be offered for final inspection to BHEL and UPPTCL in accordance with agreed quality plan with 3 weeks advance information.

Type test reports on identical rating shall be submitted for approval. In event of non-acceptability of submitted test reports on technical grounds at the contract stage, the type tests shall be conducted at no additional cost.

1.6 QUALITY PLAN

The contractor shall carry out contract works in accordance with sound quality management principles which shall include such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Contractor shall submit detailed Quality Plan for BHEL / customer's approval.

1.7 PACKING

1.7.1 All equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and outdoor storage (for a minimum period of 2 years) at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.

1.7.2 The Bidder shall include and provide for security, protection and packing the equipment so as to avoid loss or damage during transport by any mode.

1.7.3 All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as

Technical Specification: 400 kV & 220 kV Line Trap

considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the purchaser.

- 1.7.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- 1.7.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility.
- 1.7.6** Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 1.7.7** All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 1.7.8** Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 1.7.9** Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

ANNEXURE - I , SECTION - 1

5.10 ~~The Contractor shall have to check and prove through the results of his computer studies that attenuation due to transpositions in the EHV lines is within limits and the offered equipment will perform satisfactorily.~~

5.11 ~~The Bidder shall submit curves illustrating 'incorrect tripping' and "Failure to trip" probability plotted against corona noise level, in the presence of impulse noise due to switching of isolator and circuit breaker etc. Details of field tests and laboratory tests for successful operation of his equipment, under such adverse conditions shall be furnished by the Bidder. These are to be related to end-to-end signaling and shall take into account the type of communication link e.g. account shall be taken of transpositions in the phase to phase coupled H.T. line. Details of field tests and laboratory tests for successful operation of the equipment under the above circumstances shall be submitted by the Bidder illustrating the above parameters.~~

6.0 LINE TRAP

6.1 Line trap shall be broad band tuned for its entire carrier frequency range. Resistive component of impedance of the line trap within its carrier frequency blocking range shall not be less than 570 ohms for 400kV and 220 kV systems.

6.2 Line trap shall be provided with a protective device in the form of surge arrestors which shall be designed and arranged such that neither significant alteration in its protective function nor physical damage shall result from either temperature rise or the magnetic field of the main coil at continuous rated current or rated short time current. The protective device shall neither enter into operation nor remain in operation, following transient actuation by the power frequency voltage developed across the line trap by the rated short time current.

The lightning arrestor shall be station class current limiting active gap type. Its rated discharge current shall be 10 kA. Coordination, however, shall be done by taking 20 kA at 8/20 micro-sec. discharge current into account. Bidder has to furnish full justification in case the use of gap-less metal oxide arrestor is recommended by them.

6.3 The lightning arrestor provided with the line trap of each rating shall fully comply with the requirements of IS:3070 Part-I/IEC-60099-I Part-I. It shall conform to type tests as applicable and type test certificate for the same shall be submitted by the Bidder.

6.4 The lightning arrestor provided with the line trap shall be subject to routine and acceptance tests as per IEC-60099-1 (Part-I).

6.5 Radio interference voltage for 400/245 kV shall not exceed 500 micro volts at specified kV (rms) values.

6.6 Line trap shall be equipped with the bird barriers.

6.7 Line trap shall conform to IEC 60353 (latest) fulfilling all the technical requirements. The rated short time current for 1 Second shall be ~~31.5~~ 40/50/63 kA

as per requirement. The mH. rating shall be ~~0.25~~0.5/1.0 mH depending on frequency plan.

6.8 The Bidder shall indicate continuous current rating of the line trap at 65 deg. C ambient.

6.9 Reports for the following type tests on each type of line trap shall be submitted ~~as per clause 9.2 of GTR~~.

1. Measurement of Inductance of the main coil.
2. Measurement of temperature rise.
3. Insulation test.
4. Short time current test.
5. Corona Extinction Voltage test (procedure for this shall be mutually agreed).
6. Radio Interference Voltage measurement test (procedure for this shall be mutually agreed).

6.10 The Bidder must enclose with his bid the reports of type and routine tests conducted on similar equipment earlier as per IEC-60353.

6.11 Welding

All the welding included in the manufacture of line traps shall be performed by personnel and procedure qualified in accordance with ASME-IX and all the critical welds shall be subject to NDT as applicable.

6.12 Line Trap Mounting

6.12.1 The Line Trap shall be suitable for outdoor pedestal ~~or suspension~~ mounting and shall be mechanically strong enough to withstand the stresses due to maximum wind pressure of 260 kg/square meter.

6.12.2 For pedestal mounting, each line trap shall be mounted on a tripod structure formed by three insulator stacks arranged in a triangular form. All the accessories and hardware, mounting stool including bolts for fixing the line trap on insulators shall be of non-magnetic material and shall be supplied by the Contractor.

6.12.3 For suspension mounting, Contractor shall be required to coordinate the mounting arrangement with the existing arrangement. Non-magnetic suspension hook/link of adequate length and tensile strength to provide necessary magnetic clearance between the line trap and suspension hardware shall be supplied by the Contractor.

6.13 Terminal Connectors

6.13.1 The line traps shall be suitable for connecting to 4" IPS Aluminium tube or 3" IPS Al. tube or ACSR single/twin/Quad bundle conductor with horizontal or vertical take off. Necessary connector shall be supplied by the Contractor.

- 6.13.2 Terminal Connectors shall conform to IS:5561.
- 6.13.3 No part of clamp or connector (including hardware) shall be of magnetic material.
- 6.13.4 Clamps and connectors shall be designed corona controlled. All nuts and bolts shall be suitably shrouded.
- 6.13.5 Clamps/connectors shall be designed for the same current ratings as line trap and temperature rise shall not exceed 35 deg. C over 50 deg. C ambient. No current carrying part shall be less than 10 mm thick.
- 6.13.6 Clamps/connectors shall conform to type test as per IS:5561. Type Test reports shall also be submitted for following additional type tests :
- a) Visual Corona Extinction Test
 - b) Radio Interference Voltage Measurement
- 6.13.7 Bidders are required to submit alongwith their bid typical drawings clearly indicating the above mentioned features of the line traps, line trap mounting arrangement and terminal connectors. For suspension mounted line traps, Bidder shall submit drawings showing single point as well as multipoint (normally 3 point) suspension arrangements.

7.0 COUPLING DEVICE

- 7.1 The coupling devices shall be interposed between the capacitor voltage transformer and coaxial line to the PLC transmitter/receiver, and in conjunction with the capacitor voltage transformer shall ensure :
- a) Efficient transmission of carrier frequency signals between the carrier frequency connection and the power line.
 - b) Safety of personnel and protection of the low voltage parts and installation, against the effects of power frequency voltage and transient over voltages.
- 7.2 The coupling device, in conjunction with the CVT shall form an electric filter of band pass type :
- a) It shall match characteristic impedance of H.T. line to impedance of the carrier frequency connection.
 - b) Galvanic isolation between primary and secondary terminals of the coupling device shall be performed by the above mentioned transformer.
 - c) Power frequency currents derived by the CVT may be drained to the earth by a separate inductance termed drain coil of suitable rating.
 - d) Voltage surges coming from the power line at the terminals of the coupling device shall be limited by a non-linear surge arrestor of suitable rating in the primary side. Requirement of a gas type voltage arrestor in secondary side of the coupling device shall have to be fully justified, but in any case the input

SECTION-2

EQUIPMENT SPECIFICATION

2.0 SCOPE

This technical specification covers the requirements of design, manufacture, testing at works, packing and despatch of Line Traps. No deviation from the requirements specified in various clauses of this specification shall be allowed.

2.1 APPLICABLE STANDARDS

The Line Traps shall comply with applicable parts of the following standards, except as otherwise specified herein:

IEC: 60099(Part –1 and 4)	Surge arrester
IEC: 60353	Line Trap.
IS 8792	Line Traps.
IS 8793	Method of Tests for Line Trap.
IEC : 60	High Voltage Test Techniques.
IS 3070 (Part I)	Specification for Surge Arresters for AC System.
IS 5561	Specification of electric power Connectors.

The equipment shall also meet with following International publication on the subject:

CIGRE	319- 1962
CIGRE	35-01-1974
IEEE (USA)	Vol.83 No.7 PAS

The equipment shall conform to the latest applicable standards and their amendments.

2.2 FEATURES

1. Line trap shall be inserted into high voltage transmission line to prevent undue loss of carrier signal for all power system conditions. Its impedance shall be negligible at power frequency (50 Hz) so as not to disturb power transmission but shall be relatively high over the frequency band appropriate to carrier transmission.
2. The Line Traps shall be broadband type tuned for its entire carrier frequency range. Resistive component of impedance within carrier frequency blocking range shall not be less than 570 ohms or else specified.
3. Line trap shall consist of a main coil designed to carry continuously the rated current without exceeding the limit of temperature rise. It shall be provided with a protective device and a tuning device. Also suitable corona rings shall be provided to meet corona and radio interference performance.
4. Line Trap shall be provided with a protective device in the form of surge arrester which shall be designed and arranged such that neither significant alteration in its protective function nor physical damage shall result from either temperature rise or the magnetic field of the main coil at continuous

rated current or rated short time current. The protective device shall neither enter into operation nor remain in operation, following transient actuation by the power frequency voltage developed across the line trap by the rated short time current. The protective device shall be shunt connected to the drain coil and tuning device.

5. The surge arrester shall be station class current limiting active gap /gap-less type. Its rated discharge current shall be 10 /20 kA. Coordination, however, shall be done by taking 20kA at 8/20 micro sec discharge current into account. Bidder has to furnish full justification in case the gap-less metal oxide arrester is recommended at contract stage. The SA provided with line trap of each rating shall fully comply with the requirements of IS 3070 Part-I/ IEC-60099-1Part-1/IEC-60099-4. The SA provided with the line trap shall be subjected to routine and acceptance tests as per IEC-60099-1 (Part-1) /IEC-60099-4.

6. The Line traps shall be equipped with suitable bird barriers and shall be painted.

7. WELDING

All the welding included in the manufacture of line traps shall be performed by personnel and procedure qualified in accordance with ASME-IX and all the critical welds shall be subjected to NDT as applicable.

8. MOUNTING

The Line traps shall be suitable for outdoor pedestal ~~or suspension~~ mounting and shall be mechanically strong to withstand the stresses due to wind pressure of 260 kg/sq m. All the accessories, mounting stools and hardware including bolts for fixing the line trap on insulators shall be of non-magnetic material and shall be supplied by bidder. For pedestal mounting, it shall be mounted on a tripod structure formed by three solid core bus post insulators.

9. TERMINAL CONNECTORS

The Line Traps shall be suitable for connecting to 4" / 4.5" IPS Aluminium tube or ACSR bundle conductor with horizontal or vertical take off, as mentioned in Section-1. Necessary connector shall be supplied by the bidder.

Terminal Connectors shall conform to IS: 5561.

No part of clamp or connector (including hardware) shall be magnetic material.

All castings shall be free from blowholes, surface blisters, cracks and cavities. All sharp edges shall be blurred and rounded off.

Clamps and connectors shall be designed corona controlled. All nuts and bolts shall be suitably shrouded.

Clamps/connectors shall be designed for the same current ratings as line trap and temperature rise shall not exceed 35.deg. C over 50.deg. C ambient. No current carrying part shall be less than 10mm thick.

Project: 400/220/132 kV GIS Substation at Rasara, Ballia

Bharat Heavy Electricals Limited

Customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)

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Consultant: -----

Technical Specification: 400 kV & 220 kV Line Trap

Clamps / connectors shall conform to type test as per IS: 5561. Type Test reports shall also be submitted for following additional tests at contract stage:

- a) Visual Corona Extinction Test (shall not be less than 320 kV rms for 400kV System & 156 kV rms for 220kV System)
- b) Radio Interference Voltage Measurement (shall not exceed 500 microvolts at 280 kV rms for 400kV System & 500 microvolts at 163 kV rms for 220kV System)

2.3 RATING PLATE

Each Line Traps shall be provided with anodized aluminium rating plate of thickness not less than 2 mm, secured permanently on the main coil, tuning device and protective device as per clause 15 of IEC: 353.

In addition to above requirements, the name of ultimate customer & BHEL shall be given on the rating plate.

2.4 TESTS

The Line Traps, Connectors & Surge Arresters shall be accompanied by Type, routine and acceptance testing as per latest IS/ IEC standards.

Bidders shall submit valid reports of type tests carried out within ten ~~five~~ years of bid opening date mentioned in Section-1. These reports should have been conducted on identical / similar equipment to those offered, in case less than ten ~~five~~ years old type test reports OR valid type tests are not furnished, the tests shall be conducted free of charge. No separate type test charges shall be paid.

All valid type test reports as per latest IS/ IEC for Line Traps shall be submitted for approval at contract stage, which shall include but not limited to the the following:

- a) Short time current & peak withstand test.
- b) Temperature rise test.
- c) Corona extinction voltage test
- d) Radio Interference Voltage test
- e) Measurement of Inductance of main coil
- f) Insulation Test

The SA provided with the WT of each rating shall fully comply with the requirement of IS: 3070 Part-1 & IEC-60099-1/IEC-60099-4. It shall conform to type tests as applicable & type test certificate for the same shall be submitted by the Bidder for approval. The SA provided with Line Trap shall be subject to routine & acceptance tests as per IEC-60099-1/IEC-60099-4.

Bidder shall also submit type test charges for conducting type tests on Line Traps, Connectors & Surge Arresters.

SECTION-3

PROJECT DETAILS & GENERAL SPECIFICATION

SITE INFORMATION

	Particular	Details
a)	Owner	UPPTCL
b)	Customer	UPPTCL
c)	Project Title	400/220/132 kV GIS at Rasara, Ballia
d)	Location	Uttar Pradesh
e)	Transport Facilities	Nearest rail head - Ballia
SITE CONDITIONS		
a)	Max. Ambient air temp.	50°C
b)	Min. Ambient air temp.	0°C
c)	Max. design ambient emp.	50°C
d)	Design reference temp.	50°C
e)	Average Humidity	Max. 100%
f)	Special corrosion conditions	No
g)	Solar Radiation	
h)	Atmospheric UV radiation	High
i)	Altitude above sea level	Less than 1000meter
j)	Pollution Severity	High Pollution level
k)	Seismic Zone	As per the seismic zone defined in the relevant BIS / IEC-62271-300 but not less than 0.3g horizontal
WIND DATA		
	Wind load	195kg/ sq m
	Average No. of thunderstorm days per annum	As per IS

1. GENERAL

This Chapter covers Technical Requirements and requirements of auxiliary items.

- 1.1 Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures and standard accessories specified &/or normally provided with such equipment and/ or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specifications.

Materials and components not specifically stated in the specification but which are necessary for commissioning and satisfactory operation of the substation unless specifically excluded shall be deemed to be included in the scope of the specification and shall be supplied without any extra cost All similar standard components/ parts of similar standard equipment provided, shall be inter-changeable with one another.

- 1.2 The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same shall be carried out without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 05(five) years prior to the date of bid opening. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

2. SYSTEM PARTICULARS

	Rated System voltage	420 kV, 245kV, 145kV, 36kV
	System frequency	50 Hz, This may vary by $\pm 5\%$
	Number of phases	Three
	Neutral	Effectively Earthed
	Auxiliary power supply:-	
	Auxiliary electrical equipment shall be suitable for operation on the following supply system:	
(a)	Power device (Like drive motors)	400V, 3Phase, 4Wire 50Hz Effectively earthed AC system.
(b)	Lighting fixtures, space heaters, fractional Horse Power motors and control devices.	250V, 2wire, 50Hz, AC supply with one point grounded.
(c)	DC alarm, Control and Protective Devices from sub station batteries as under	2 wire ungrounded DC supplies (i) 400 kV S/S : 220V DC (ii) 220/132kV S/S : 110V DC (iii) Communication : 48 V DC The above supply voltage is subject to variation as follows: All devices must be suitable for a continuous operation over the entire range of voltage variations : (i) AC Voltage may vary by $\pm 10\%$. Frequency by $\pm 5\%$ Combined Voltage & frequency by $\pm 10\%$ (ii) DC a) 220 V may vary between 187 & 242 V b) 110 V may vary between 93 & 121 V c) 48 V may vary between 41 & 53 V

3. System parameters

Sl. No.	Description of Parameters	400 kV System	220 kV System	132 kV System	33 kV System
1	Nominal system voltage	400kV	220kV	132kV	33kV
2	Maximum operating voltage of the system (rms)	420kV	245kV	145kV	36kV
3	Rated frequency	50Hz	50Hz	50Hz	50Hz
4	No. of phase	3	3	3	3
5	Rated short time current	50 kA for 3 Sec.	40 kA for 3 SEC	40 kA for 3 SEC	25 kA for 3 SEC
6	Dry and wet one minute power frequency withstand voltage	680 kV	460 kV	275 kV	95 kV
7	Dry and wet impulse withstand voltage positive and negative	1550 kVp	1050 kVp	650 kVp	250 kVp
8	Corona extinction voltage	320 kV	156 kV	105 kV	-
9	Max. Radio interference voltage for frequency between 0.5 MHz and 2 MHz at 508 kV rms for 765kV, 320kV rms for 400kV system and 156kV rms for 220kV system & 92kV rms for 132kV system	1000 microvolt	1000 microvolt	500 microvolt	-
10	Minimum total creepage	25mm/kV (10500 mm)	25mm/kV (6125 mm)	25mm/kV (3625 mm)	25mm/kV (1300 mm)
11	Min. clearances				
	i. Phase to phase	4000mm (for Conductor-conductor)	2100 mm	1300 mm	320 mm
		4200mm (for rod - Conductor)			
	ii. Phase to earth	3500 mm	2100 mm	1300 mm	320 mm
	iii) Sectional clearances	6500 mm	5000 mm	4000 mm	3000 mm
12.	System neutral earthing	Effectively Earthed			

4. SERVICES TO BE PERFORMED BY THE EQUIPMENT BEING FURNISHED

- 4.1 All equipments shall perform satisfactorily under various electrical, electromechanical and meteorological conditions of the installation site.

- 4.2 All equipment shall be able to withstand all external and internal mechanical thermal and electromechanical forces due to various factors like wind load temperature variation, ice & snow (wherever applicable) short circuit etc for the equipment.
- 4.3 The Bidder shall design the various forces which the terminal connectors of the equipment are required to withstand.
- 4.4 All outdoor EHV equipments except marshalling kiosks shall be suitable for hot line washing.
- 4.5 To facilitate erection of equipment, all items to be assembled at site shall be "match marked".

5. SUPPORT STRUCTURES (If in the scope of Bidder)

The base design of all the equipments, to be installed on auxiliary structures, shall conform to the standard auxiliary structure designs presently being used in UPPTCL at 400/220/132/33kV Substations.

All equipment support structures shall be supplied along with brackets, angles, stools etc. for attaching the operating mechanism, control cabinets and marshalling box (wherever applicable) etc. The support structures should be hot dip galvanised with minimum 610 gram/sq.m net of zinc.

6. STANDARDS

- 6.1 Except as modified by this Bid specification, all material and equipment shall conform to the requirement of the latest editions of relevant ISS/ IEC and other applicable standards. The equipments/ works shall be designed, engineered, manufactured, built, tested and commissioned shall be carried out in accordance with the Acts, Rules, Laws and Regulations in force in India.
- 6.2 In addition to meeting the specific requirements called for in the respective sections of the Technical Specification, the equipment shall also conform to the general requirement of the relevant standards which shall form an integral part of the specification. When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.
- 6.3 In the event of the Bidder offering equipment conforming to standards other than ISS/IES standards, which ensure equivalent or better performance than that specified in the standards, the salient point of comparison between the standards adopted and relevant ISS/ IEC standards shall be indicated clearly in the proposal, along with English language version of such standard or relevant extract of the same. The equipment conforming to standards other than IS/IEC shall be subject to Purchaser's approval.
- 6.4 The standards mentioned in the respective equipment specifications are not mutually exclusive or complete in themselves. The equipment &/or work shall also conform to any other applicable standard, even if not specifically mentioned in these specifications.
- 6.5 Should the Bidder wish to depart from the provisions of the specifications, either on

accounts of manufacturing practices or for any other reason, he shall clearly mention the departure and submit complete justification supported by information, drawings etc. as will enable to assess the suitability of equipment(s) offered. In the event of the Bidder's specifications, drawings, forms and tables etc. being found to disagree with the requirement of the Bid specifications at any stage, Bid specifications shall be binding, unless the departures have been duly approved in writing by the purchaser.

6.6 REFERENCE OF STANDARDS

Reference	Abbreviation	Name and Address
BS	British Standards,	British Standards Institution, 101, Penton villa Road, N-19-ND UK
ISO	International Organization	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	For Standardization, National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A
BS	British Standards,	British Standards Institution, 101, Pentonnvilla Road, N-19-ND UK
ISO	International Organization	Danish Board of Standardization Danish Standardising Sraat, Aurehoegvej-12, DK-2900, Heelstrup, DENMARK
NEMA	For Standardization, National Electric Manufacture Associate	115, East 44th Street, New York NY 10017 U.S.A

7. ENGINEERING DATA AND DRAWINGS

7.1 SUBMISSION AND APPROVAL OF DRAWINGS/ DOCUMENTS

- 7.1.1 The Bidder shall follow a well-defined coding system for proper and quick identification of all systems/ sub-systems/ equipments/ assemblies/ sub-assemblies/ accessories/ other plant material/ spare parts/ special tools and plants and drawings for the execution of the plant and later for its operation and maintenance.

Copies of coding documents defining the above shall be supplied along with drawings to understand the system.

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- 7.1.2 All drawings submitted by the Bidder shall be in sufficient details to indicate the type, size arrangement, weight of each component, details for packing and shipment, the external connections, fixing arrangements, dimensions required for installation arrangement, dimensions required for installation and interconnections with other equipment and other information specifically, as called for in the drawing schedules. All the equipments tapping points etc. shall be numbered according to pre-determined scheme/ system which shall be subject to approval of Purchaser.
- 7.1.3 Each drawing shall be clearly marked with the name of the Purchaser, unit designation, UPPTCL's Contract No. and the name of the project. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawings shall be in English. All the dimensions should be in metric units.
- 7.1.4 If any dimension figures on a drawing or a plan differs from those obtained by scaling the drawing or plan, the dimensions as mentioned in figures on the drawing or plan shall be taken as correct.

7.2 Submission and distribution of drawings/ documents

All the drawings which do not require approval shall be submitted along with reproducible in required number and those requiring approval shall be initially submitted for comments/ approval before submitting along with reproducible as per "Document Distribution Schedule".

7.3 APPROVAL OF DRAWINGS

- 7.3.1 The Purchaser shall return to the Bidder one set of drawings, plans and technical data requiring approval after marking them with their comments/ corrections, if any, either (a) marked 'Approved' or (b) marked 'Approved subject to incorporation of comments' or (c) marked 'Not Approved' with comments requiring resubmission of drawings etc. in 14 days or (d) marked 'Approval not required', where drawing is for information only. In case of (a) no further revision of drawings will be required. In case of (b) Bidder can proceed with the work but will resubmit the drawings incorporating the corrections as per comments only within fourteen (14) days. In case of (c) Bidder can proceed with the work only after resubmitting the drawings within fourteen (14) days and getting approval under (a) or (b) categories above. In case of (d) the Bidder drawing is deemed to have been received only for information purpose.
- 7.3.2 The Purchaser shall have the right to ask the Bidder to make any change in the design/ drawing which may be necessary to make equipment conform to the provisions and intent of the contract, without any extra cost to the Purchaser.

The drawings submitted shall be re-viewed by the Purchaser and shall be modified by the Bidder as required. The Bidder shall incorporate such modifications and/or corrections and submit the final drawings for approval/ reference.

- 7.3.3 No deviation from the approved drawings shall be permitted without the written approval of the Engineer.

- 7.3.4 The review of drawings/ data by the Purchaser will cover only general conformance of the data of the specifications and document, interfaces with the equipment provided under the specifications, external connections and the dimensions which might effect substation layout.

This review by the Purchaser may not indicate thorough review of all dimensions, quantities and details of the equipment, wiring, materials, any devices or items indicated or the accuracy of the information submitted. This review and/ or approval by the purchaser shall not be considered by the Bidder, as limiting any of his responsibilities specified under these specifications and documents.

Approval/ comments conveyed as above shall neither relieve the Bidder of his contractual obligations and his responsibilities for correctness of dimensions, material of construction, quantities, design details, assembly fits, performance particulars, guarantees and conformity of the supplies with the specifications, schemes, systems and statutory laws, nor does it limit the Purchasers right under the contract.

- 7.3.5 Should any minor revision be made after 'approval', at the time of erection/ commissioning the Bidder shall redistribute prints and reproducible, clearly certifying the changes incorporated in the drawing and marking it in a block. Every revision shall be marked by a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.
- 7.3.6 The Bidder shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors and omissions in the drawings or other particulars supplied by him, whether such drawings or particulars have been approved by Engineer or not.

No extension of delivery periods shall be granted on this account.

7.3.7 As- built drawings

Drawings of all equipments as detailed in technical specifications of respective equipments necessarily including schematic drawings and terminal block drawings wherever applicable whether mentioned in respective technical specifications or not.

8. NAME PLATE, MARKING OF PARTS, LABELS

- 8.1 All equipment shall have metal name plates fixed in suitable position with full particulars engraved legibly thereon and not painted.
- 8.2 Each main and auxiliary item of plant is to have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which is to be engraved identifying manufacturer's name, equipment type or serial number, rating together with details of the loading/ operating conditions under which the item or plant in question has been designed to operate and such diagram plates as may be required by the Engineer.
- 8.3 Each item of plant is to be provided with a name plate or label designating the service of the particular equipment. These inscriptions are to be approved by the Engineer or as detailed in the appropriate sections of the technical specifications.
- 8.4 Such name plates or labels are to be white non hygroscopic material with engraved block

lettering or, alternatively, in the case of indoor equipments of transparent plastic material with suitably colored lettering engraved on the back

- 8.5 Each bay module in GIS room will have a clear marking showing the name of bay, identification, name and rating plate marking for each individual equipment like circuit breaker, disconnectors grounding switches, current transformer, voltage transformers and bushings etc. as per relevant IEC to facilitate identification during routine operation/ maintenance.
- 8.6 All such name plates, instruction plates, lubrication charts etc. shall be bilingual with Hindi inscription first followed by English. Provisions shall be made to fit in name plates, lubrication/ connection diagram plates etc.
- 8.7 In order to facilitate identification, the parts of the equipment shall be suitably marked.

9. INSTRUCTION MANUALS

- 9.1 The Bidder shall submit to the Engineer 'Descriptive Manuals', i.e. system design concept, detailed catalogues of equipment and typical equipment instructions for this project, for all major systems and equipment, covered under this contract along with dispatch of equipment.
These initial copies of descriptive manuals shall be in sufficient details, bringing out detailed internal construction, characteristics, performance parameters, principles of operation, maintenance requirements, replacement and renewals needed, erection and overhauling procedure, testing and operation procedure etc. for various equipment.
- 9.2 The integrated instruction manuals, fully defining the interfaces between various systems and complete in all respects shall be submitted by the Bidder one month before scheduled date of commissioning. The instruction manuals shall contain full details of designation and drawings of all the equipment furnished, the erection procedure, testing procedure, operation and maintenance procedure of the equipment, single line diagrams, and schematics. After the commissioning and initial operation of the plant, modifications/ additions/ changes, wherever required shall be incorporated in the instruction manuals and drawings shall be submitted by the Bidder to the Purchaser.
- 9.3 The manuals shall be specific to the equipment supplied and not of general nature.

10. DOCUMENTS AND ERECTION DRAWINGS

The Bidder shall submit within a reasonable time but at least four (4) weeks before dispatch of equipment (as per distribution schedule) the following drawings/ documents and instruction manuals etc. to the consignee and the Engineer.

- I. List of item-wise equipment as proposed to be dispatched by the Bidder.
- II. Erection drawings along with reproducible prints of each drawings.
- III. Instruction books for proper handling/ checking of material on receipt at site/storage,
- IV. erection and assembly of all equipment and necessary instruction for checking and
- V. recording proper assembly of the plant.
- VI. Instruction sheets for proper balancing, alignment, adjustment, checking and calibrations
- VII as may be necessary.

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- VIII. Descriptive literature and drawings to illustrate the working principals, methods of
 - IX. assembly and dismantling of plants and equipment.
 - X. Testing/commissioning format for recording data during erection/testing/
 - XI. commissioning and trial run. These formats/data sheets shall clearly indicate the results
 - XII. obtained during shop tests and permissible deviations.

11. QUALITY CONTROL PROGRAMME

To ensure that the equipment construction work and the services covered under this job are in accordance with the specifications and conform to the high standard of workmanship. It is obligatory on the part of the Bidder to adopt a suitable quality control program. Such a program shall include suitable hold point for check for major equipments during manufacture at supplier's work, during erection at site and during the construction stage such that material checks for attaining proper strength and dimensional checks for attaining close tolerances required for equipment installation can be obtained.

In order to attain the above objectives, the Bidder shall draw out a plan listing all quality control checks in detail, including all hold points at which the quality checks shall be applied, also specifically mentioning those hold points where the Purchaser shall also participate in the quality check to assure him of the quality of the products supplied. Such a program shall be outlined by the Bidder for the acceptance by the Purchaser. The Bidder shall furnish detailed information regarding his quality control program and its strict implementation. Following information shall be included in the proposal along with others regarding quality control program:

- I. The quality control organizations and the proposal of its implementation.
- II. The system for controlling drawings and documents for correctness.
- III. The system of quality control for raw materials, process control and maintaining
- IV. tolerances during manufacturing, assembly and fabrication.
- V. Quality control during purchase of components, sub-systems and assemblies.
- VI. Methods for ensuring selection of proper vendors/ sub-vendors.
- VII. Inspection of testing at shop after assembly.
- VIII. Control of accuracy during calibration of measuring and testing equipments.
- IX. Preservation and quality control during the transit.
- X. Procedure for inspection before erection and quality control during erection.
- XI. System for storage and delivery.

Bidder shall be wholly responsible for the quality control and quality assurance for the manufacture, supply, erection, testing and commissioning etc.

During inspection, destructive testing and non destructive test evaluation shall be done wherever applicable, in presence of Purchaser's representative in accordance with established norms. Directions of Purchaser shall be rigorously followed.

12. INSPECTION & TESTING

12.1 The Purchaser reserves the right to inspect any machinery and material to ensure that

approved Q.A.P. is being strictly implemented by the Bidder or his Sub Bidder/ Supplier under this contract and to reject any item found defective in workmanship or design or otherwise unsuitable for the use and purpose intended or which is not in accordance with the intent of this contract. The Bidder should on demand by the Purchaser, rectify or replace such defective or unsuitable equipment, or the Purchaser may at the Bidder's expense, rectify or replace such defective or unsuitable equipment whether before or after supply.

- 12.2** That Bidder shall, for purpose of clause 15 of the annexed conditions of contract Form-A inform to the Purchaser places of manufacture, testing and inspection of various equipment offered by him. Unless specifically provided otherwise, all tests shall be carried out at the Bidder's work or for bought out items at sub-vendors works before dispatch.
- 12.3** The Bidder shall advise the Purchaser at least 4 weeks in advance as to when the equipment will be ready for stage/ final inspection at the Bidder's works or at his Sub-Bidder's works.

PENAL CHARGES

In case the equipment is not available for inspection at the time of arrival of inspection officers,
the Bidder shall pay to UPPTCL towards futile journey a sum decided by Chief Engineer (765 KV DU), UPPTCL and demanded by "Engineer of Contract". This amount shall be paid within 10 days from the date of demand. Further action for inspection of the material shall be taken only after the said amount is deposited.

- 12.4** During inspection, the Purchaser's Inspecting Engineers at all times have access to all part of shops where the equipment is being manufactured and also shall be provided with all reasonable inspection facilities by the Bidder and/ or sub-Bidders.
Even without scheduled inspection, the Engineer and/or his duly authorized representative shall have at all reasonable times access to the Bidder's premises, works or site and shall have the power to inspect and examine the materials and workmanship of the works during it's manufacture or erection.
- 12.5** All plants equipment/ parts, sub-assemblies/ assemblies shall comply with the requirement of type tests and shall be subjected to the routine/ acceptance tests specified in the set of standards adopted and to such other tests as are stipulated in the respective technical specifications.

The Purchaser reserves to himself the right of having at his own expense any inspection or special test of a reasonable nature at Bidder's premises or at site, in addition to those Prescribed in applicable standards and the enclosed technical specifications.

- 12.6** The Engineer shall either depute his representative to witness the tests as applicable and inspect the material or shall waive the inspection. In case of waiver the Bidder or his sub-Bidder shall carryout the all applicable tests in absence of Purchaser's representative. In both the cases i.e. either inspection or waiver the test certificates shall

be submitted to Engineer of Contract for approval and issue of dispatch authorization. In case of inspection the test certificates must bear signatures of the Purchaser's inspecting officer.

The Engineer of Contract, within 10 days of receipt of test certificates, shall issue approval/ dispatch authorization, if test certificates are found satisfactory.

In case test certificates are not found satisfactory the Engineer of Contract, within 10 days of receipt of test certificates, shall communicate his objections and actions required to be taken in writing to the Bidder. The Bidder shall take remedial action and shall re-submit the test certificates or re-offer the material for inspection as asked for by the Engineer. Subsequent actions shall follow as in case of fresh offer for inspection. No extension of delivery/ completion period shall be granted on this account.

12.7 REJECTON

Purchaser reserves the right to reject any equipment if during the tests at works or site, the test value achieved do not comply with the respective standard/ specifications and exceeds that tolerable limits. Rejection of any equipment will not be held as a valid reason for delay in timely completion of the work.

- 12.8** No equipment to be furnished or used in connection with this contract shall be dispatched, until factory inspection and acceptance test have been carried out satisfactorily and dispatch authorization issued by Engineer of Contract. Such factory inspection of the equipment or approval of acceptance tests shall not however, relieve the Bidder from full responsibility for supplying equipment conforming to the requirements of this contract, nor prejudice any claim, right or privilege which the Purchaser may have because of the use of defective or unsatisfactory equipment. Should Purchaser waive the right to inspect any equipment, such waiver shall not relieve the Bidder in any way from his obligations under this contract. The inspection/waiver by Engineer and/ or approval of test certificates shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed quality assurance program, and the desired performance of the equipment.

- 12.9** In all cases where the contract provides for tests whether at the premises or works of the Bidder or of any Sub-Bidder, the Bidder shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably required to carry out effectively, such tests on the equipment in accordance with the contract and shall give facilities to the Engineer or to his authorized representative to accomplish inspection.
All the expenses incurred for testing including material consumed in testing shall be to the Bidder's account.

- 12.10** Purchaser will not entertain any request for waiver of inspection on the ground that sub vendors are not agreeing for the Purchaser's inspection. It is the responsibility of the Bidder to ensure that all the requirements of the Purchaser as envisaged in the technical specifications are incorporated.

- 12.11** The Bidder is required to record the following certificates on the invoices and challans of

each and every consignment:

"Certified that material being dispatched against the above invoices and challan has been inspected and tested by the representative of Engineer of the contract on (date) and all the test results were satisfactory, as per approved test certificate enclosed."

Or

Certified that inspection of material being dispatched against the above invoice and challan has been waived off by Engineer of Contract vide letter No.....Dt..... (Copy enclosed) and all the acceptance and routine tests as per relevant standards and those provided in Contract, have been conducted and all the test results were found satisfactory as per test certificates enclosed."

- 12.12** In case the inspection or testing of the material is to be carried out outside India, all the expenditure including boarding and lodging etc. of the inspecting officer/ officers shall be borne by the contractor and information regarding inspection has to given at least 8 weeks in advance.

13. PACKING

- 13.1** All equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection.
While packing all the materials, the limitations from the point of view of availability of transportation facilities in India should be taken into account. The Bidder shall be responsible for any loss or damage during transportation, handling and storage.
- 13.2** The Bidder shall include and provide for security protection and packing the plant so as to avoid loss or damage during transport by any mode.
- 13.3** All packing shall allow for easy removal and checking at site. Wherever necessary, proper arrangement for attaching slings for lifting shall be provided. All packages shall be clearly marked for with signs showing 'UP' and 'DOWN' side of boxes, and handling and unpacking instructions as considered necessary. Special precautions shall be taken to prevent rusting of steel and iron parts during transit and storage. Gas seals or other methods proposed to be adopted for protection against moisture during transit shall be to the satisfaction of the engineer.
- 13.4** The cases containing easily damageable material shall be very carefully packed and marked with appropriate caution symbols i.e. FRAGILE, HANDLE WITH CARE, USE NO HOOKS etc.
- 13.5** Each package delivered under the contract shall be marked by the Bidder at his expense and such marking must be distinct (all previous irrelevant marking being carefully obliterated). Such marking shall show the description and quantity of contents, the name of consignee and address, the gross and net weights of the package, the name of Bidder with a distinctive number of mark sufficient for purpose of identification. All markings shall be carried out with such materials as to ensure quickness of drying, fastness and legibility

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- 13.6** Each Package shall contain a note quoting specifically the name of the Bidder, the number and date of contract or order and the name of office placing the contract, nomenclature of the stores and include a schedule of parts for each complete equipment giving the parts number with reference to the General Arrangement/ Assembly drawing and the quantity of each part, drawing number and tag numbers.
- 13.7** All equipment/ material shall be suitably packed for transport, carriage at site and outdoor storage during transit. The Bidder shall be responsible for any damage to the equipment during transit. The contents of each package shall bear marking that can be readily identified from the package list and packing shall provide complete protection from moisture, termites and mechanical shocks etc.
- 13.8** Any material found short inside the packing cases shall be supplied by the Bidder without any extra cost.
- 13.9** Notwithstanding anything stated in this clause the Bidder shall be entirely responsible for any loss, damage or depreciation to the stores.

14. DESPATCH OF EQUIPMENT

- 14.1** Detailed dispatch instructions will be intimated to the Bidder. All materials shall be dispatched by road.
- 14.2** The Bidder shall intimate, at least thirty (30) days in advance to the consignee as well as the concerned Superintending Engineer at site, the probable date when the equipment will be ready for dispatch from the works. Notification of delivery or dispatch in regard to each and every consignment shall be made to the Purchaser immediately after dispatch or delivery. The supplier shall further supply to the consignee a priced invoice and packing account of all stores delivered or dispatched by him. All packages, containers, bundles and loose materials forming parts of each and every consignment shall be described fully in the packing account, and full details of the contents of packages and quantity of material shall be given to enable the consignee to check the stores on arrival at destination.
- 14.3** A list in duplicate containing details of equipment for verification at site shall also be placed inside each package and shall correspond with the advice note. One additional copy of each of the package lists shall also be sent to the consignee.

15. TYPE TESTING, INSPECTION, TESTING & INSPECTION CERTIFICATE

The Bidder shall supply type tested (including special test as per technical specification) equipments and materials. The test reports/details shall be furnished by the Bidder in the bid.

In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes or due to non-compliance with the requirement stipulated in the Technical Specification and/or IEC/ IS, same, shall be carried out

without any additional cost implication to the Purchaser. The Purchaser reserves the right to get any or all type tests conducted/ repeated.

The reports for all type tests and additional type tests as per technical specification furnished by the Bidder shall be of the tests conducted within last 10 (ten) years prior to the date of bid opening. The type tests conducted should have either been conducted in accredited laboratory (accredited based on ISO/ IEC Guide 25/ 17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by UPPTCL or representative authorized by UPPTCL or Utility or representative of accredited test lab or reputed consultant.

15.1 Pre-commissioning Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Purchaser and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests to be performed are given in respective chapters and shall be included in the Contractor's quality assurance programme.

15.2 Commissioning Tests

- 15.2.1 The available instrumentation and control equipment will to be used during such tests and the Purchaser will calibrate, all such measuring equipment and devices as far as practicable.
- 15.2.2 Any special equipment, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- 15.2.3 The specific tests requirement on equipment have been brought out in the respective chapters of the technical specification.
- 15.2.4 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning the equipment and the switchyard. However necessary fee shall be reimbursed by POWERGRID on production of requisite documents.

16. MATERIAL WORKMANSHIP

16.1 General Requirement

Where the specification does not contain references to workmanship, equipment, materials and components of the covered equipment, it is understood that the same must be new, of highest grade of the best quality of their kind, conforming to best engineering practice and suitable for the purpose for which they are intended.

The design of the works shall be such that installation, future expansions, replacements and general maintenance may be undertaken with a minimum of time and expenses. Each component shall be designed to be consistent with its duty and suitable factors of safety, subject to mutual agreements. All joints and fastenings shall be devised, constructed and documented so that the component parts shall be accurately positioned

and restrained to fulfil their required function. In general screw threads shall be standard metric threads. The use of other thread forms will only be permitted when prior approval has been obtained from the Purchaser.

Whenever possible, all similar part of the Works shall be made to gauge and shall also be made interchangeable with similar parts. All spare parts shall also be interchangeable and shall be made of the same materials and workmanship as the corresponding parts of the Equipment supplied under the Specification. Where feasible, common component units shall be employed in different pieces of equipment in order to minimize spare parts stocking requirements. All equipment of the same type and rating shall be physically and electrically interchangeable.

All materials and equipment shall be installed in strict accordance with the manufacturer's recommendation(s). Only first-class work in accordance with the best modern practices will be accepted. Installation shall be considered as being the erection of equipment at its permanent location. This, unless otherwise specified, shall include unpacking, cleaning and lifting into position, grouting, leveling, aligning, coupling of or bolting down to previously installed equipment bases/foundations, performing the alignment check and final adjustment prior to initial operation, testing and commissioning in accordance with the manufacturer's tolerances, instructions and the Specification. All factory assembled rotating machinery shall be checked for alignment and adjustments made as necessary to re-establish the manufacturer's limits.

Suitable guards shall be provided for the protection of personnel on all exposed rotating and/ or moving machine parts and shall be designed for easy installation and removal for maintenance purposes. The spare equipment(s) shall be installed at designated locations and tested for healthiness.

The Bidder shall apply oil and grease of the proper specification to suit the machinery, as is necessary for the installation of the equipment. Lubricants used for installation purposes shall be drained out and the system flushed through where necessary for applying the lubricant required for operation. The Bidder shall apply all operational lubricants to the equipment installed by him.

All oil, grease and other consumables used in the Works/ Equipment shall be purchased in India unless the Bidder has any special requirement for the specific application of a type of oil or grease not available in India. In such is the case he shall declare in the proposal, where such oil or grease is available. He shall help Purchaser in establishing equivalent Indian make and Indian Contractor. The same shall be applicable to other consumables too.

A cast iron or welded steel base plate shall be provided for all rotating equipment which are to be installed on a concrete base unless otherwise agreed to by the Purchaser. Each base plate shall support the unit and its drive assembly, shall be of design with pads for anchoring the units and shall have a raised up all around and shall have threaded in air connections, of so required.

16.2 Provisions For Exposure to Hot and Humid climate

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

16.3 Space Heaters

The heaters shall be suitable for continuous operation at 240V AC supply. On-off switch and fuse shall be provided for the heater.

One or more adequately rated thermostatically connected heaters shall be supplied to prevent condensation in any compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made sufficiently away from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation.

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

16.4 FUNGI STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

16.5 Ventilation opening

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

shutter type blinds and suitable provision shall be made so as to avoid any communication of air/ dust with any part in the enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc.

16.6 Degree of Protection

The enclosures of the Control Cabinets, Junction boxes and Marshalling Boxes, panels etc. to be installed shall provide degree of protection as detailed here under:

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- a) Installed out door: IP- 55
 - b) Installed indoor in air conditioned area: IP-31
 - c) Installed in covered area: IP-52
 - d) Installed indoor in non air conditioned area where possibility of entry of water is limited: IP-41.
 - e) For LT Switchgear (AC & DC distribution Boards) : IP-52

The degree of protection shall be in accordance with IS: 13947 (Part-I) / IEC-60947(Part-I) / IS 12063 / IEC-60529. Type test report for degree of protection test, shall be submitted for approval.

16.7 RATING PLATES, NAME PLATES AND LABELS

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the Purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instructions plates, rating plates CB, CT, VT, SA, Isolators and Relay & Protection panels/ equipments shall be bilingual with Hindi inscription first followed by English.

Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.8 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment, covered under the scope of the specifications, into successful operation, shall be furnished by the Bidder unless specifically excluded under the exclusions in these specifications and documents.

17. Surface finish

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to

withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

All external painting shall be as per shade No. 631 of IS: 5.

18. HOT DIP GALVANISING

All ferrous parts including all sizes of nuts, bolts, plain and spring washers, support channels, structures, shall be hot dip galvanized conforming to latest version of IS: 2629 or any other equivalent authoritative standard. However, hardware less than M12 size shall be electrogalvanized.

Minimum weight of zinc coating shall be 610 gm/ sq.mm and minimum thickness of Coating shall be 85 microns for all items thicker than 6 mm. For items lower than 6mm Thickness, requirement of coating shall be as per relevant ASTM. For surface which shall be embedded in concrete, the zinc coating shall be 610 gm/sq. m minimum.

The galvanized surfaces shall have a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off, etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing, no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

Galvanised material must be transported properly to ensure that galvanised surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

19. PAINTING

- 19.1** All sheet steel work shall be degreased, pickled, phosphated in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces, which will not be easily accessible after shop assembly, shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.
- 19.2** After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, stoving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be stoved.

- 19.3** After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. The second finishing coat shall be applied after inspection of first coat of painting.
- 19.4** The exterior and interior colour of the paint in case of new substations shall preferably be RAL 7032 for all equipment, marshalling boxes, junction boxes, control cabinets, panels etc. unless specifically mentioned under respective sections of the equipments. Glossy white colour inside the equipments /boards/panels/junction boxes is also acceptable. The exterior colour for panels shall bematching with the existing panels in case of extension of a substation. Each coatof primer and finishing paint shall be of slightly different shade to enable inspection of the painting. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments.
- 19.5** In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures, like electrostatic painting etc., the procedure shall be submitted alongwith the Bids for Purchaser's review & approval.

The colour scheme as given below shall be followed for Fire Protection and Air Conditioning systems

S. No.	PIPE LINE	Base colour	Band colour
Fire Protection System			
1	Hydrant and Emulsifier system pipeline	FIRE RED	-
2	Emulsifier system detection line – water	FIRE RED	Sea Green
3	Emulsifier system detection line – Air	FIRE RED	Sky Blue
4	Pylon support pipes	FIRE RED	
Air Conditioning System			
5	Refrigerant gas pipeline – at compressor suction	Canary Yellow	-
6	Refrigerant gas pipeline – at compressor discharge	Canary Yellow	Red
7	Refrigerant liquid pipeline	Dark Admiralty Green	-
8	Chilled water pipeline	Sea Green	-
9	Condenser water pipeline	Sea Green	Dark Blue

19.6 COLOUR SCHEME AND CODES FOR PIPE SERVICE

The Bidder shall propose a colour scheme for the those equipments/ items for which the colour scheme has not been specified in the specification. For the approval of

- | | | |
|--------|---|--|
| a) | For connecting ACSR/ AAC conductor | Aluminum alloy casting conforming to designation A6 of IS:617 and shall be tested for all tests as per IS:617 |
| b) | For connecting equipment terminals made of copper or ACSR conductor | Bimetallic connectors made from aluminum alloy casting conforming to designation A6 IS: 617 with 4mm thick cast copper lines and shall be tested as per IS:617 |
| c) | For connecting G.I.Shield wire | Malleable iron casting. |
| d) | Bolts, nuts and plain washers. | Hot dip galvanising mild steel |
| 20. e) | Spring washers for items 'a' to 'c' | Electrogalvanised-suitable for at least 3 service conditions as per IS:3063 & IS:1573 |
| f) | Misc. | Mild steel. |

21. CLAMPS AND CONNECTORS INCLUDING TERMINAL CONNECTORS

21.1 All power clamps and connectors shall conform to IS:5561 & NEMA CC1 and shall be made of materials listed below:

- | | | |
|-------|--|---|
| ε | For connecting ACSR conductors | Aluminum alloy casting, conforming to designation A6 of IS:617 and all test shall conform to IS:617 |
| k | For connecting equipment terminals made of copper with ACSR conductors | Bimetallic connectors made from aluminum alloy casting, conforming to designation A6 of IS:617 with 2mm thick bimetallic liner and all test shall conform to IS:617 |
| c | For connecting G.I | Galvanised mild steel shield wire |
| d) i) | Bolts, nuts & Plain, washers galvanised. | i) Electrogalvanised for sizes below M12, for others hot dip |
| ii) | Spring washers | ii) Electro-galvanised mild for |

	items 'a' to 'c' IS:1573	steel suitable for atleast service condition-3 as per
21.2	Necessary clamps and connectors shall be supplied for all equipment and connections. The requirement regarding external corona and RIV as specified for any equipment shall include its terminal fittings. If corona rings are required to meet these requirements they shall be considered as part of that equipment and included in the scope of work.	
21.3	Where copper to aluminum connections are required, bi-metallic clamps shall be used, which shall be properly designed to ensure that any deterioration of the connection is kept to a minimum and restricted to parts which are not current carrying or subjected to stress.	
21.4	Low voltage connectors, grounding connectors and accessories for grounding all equipment as specified in each particular case, are also included in the scope of Work.	
21.5	No current carrying part of any clamp shall be less than 10 mm thick. All ferrous parts shall be hot dip galvanised. Copper alloy liner of minimum 2 mm thickness shall be cast integral with aluminum body or 2 mm thick bi-metallic strips shall be provided for Bi-metallic clamps.	
21.6	All casting shall be free from blow holes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.	
21.7	Flexible connectors, braids or laminated straps made for the terminal clamps for bus posts shall be suitable for both expansion or through (fixed/sliding) type connection of 4" IPS AL. tube as required. In both the cases the clamp height (top of the mounting pad to centre line of the tube) should be same.	
21.8	Clamp shall be designed to carry the same current as the conductor and the temperature rise shall be equal or less than that of the conductor at the specified ambient temperature. The rated current for which the clamp/connector is designed with respect to the specified reference ambient temperature, shall also be indelibly marked on each component of the clamp/connector, except on the hardware.	
21.9	All current carrying parts shall be designed and manufactured to have minimum contact resistance.	
21.10	Clamps and connectors shall be designed to be corona controlled.	
21.11	Tests Clamps and connectors should be type tested as per IS:5561 and shall also be subjected to routine tests as per IS:5561. Following type test reports shall be submitted for approval as per clause 9.2 above except for sl. no. (ii) & (iii) for which type test once conducted shall be applicable (i.e. the requirement of test conducted within last ten years shall not be applicable). I. Temperature rise test (maximum temperature rise allowed is 35°C over 50°C ambient) II. Short time current test III. Corona (dry) and RIV (dry) test (for 220 KV and above voltage level clamps)	

IV. Resistance test and tensile test

**22. CONTROL CABINETS, JUNCTION BOXES, TERMINAL BOXES
& MARSHALLING BOXES FOR OUTDOOR EQUIPMENT**

- 22.1** All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS- 5039/ IS-8623, IEC-60439, as applicable, and the clauses given below.
- 22.2** Control cabinets, junction boxes, marshalling boxes and terminal boxes shall be made of sheet steel or aluminum enclosure and shall be dust, water and vermin proof. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braces to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. In case of aluminum enclosed box, the thickness of aluminum shall be such that it provides adequate rigidity and long life as comparable with sheet steel of specified thickness.
- 22.3** Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements. A canopy and sealing arrangements for operating rods shall be provided in marshalling boxes/ Control cabinets to prevent ingress of rain water.
- 22.4** Cabinet/boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of the gasket shall be such that it does not get damaged/cracked during the operation of the equipment.
- 22.5** All doors, removable covers and plates shall be provided gasket all around with suitably profiled EPDM/Neoprene gaskets. The gasket shall be tested in accordance with approved quality plan, IS: 11149 and IS: 3400. The quality of gasket shall be such that it does not get damaged/cracked during 10 (ten) years of operation of the equipment or its major overhaul whichever is earlier.
- All gasketed surfaces shall be smooth straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters, the screen shall be fine wire mesh made of brass.
- 22.6** All boxes/ cabinets shall be designed for the entry of cables from bottom by means of weather proof and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above the base of the marshalling kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland plate. Gland plate shall have provision for some future glands to be provided later, if required.
- 22.7** A 240V, single phase, 50 Hz, 15 amp AC plug and socket shall be provided in the cabinet with ON-OFF switch for connection of hand lamps. Plug and socket shall be of

industrial grade.

- 22.8** For illumination, a 20 Watts fluorescent tube or 15 watts CFL/LED bulb shall be provided. The switching of the fittings shall be controlled by the door switch.

For junction boxes of smaller sizes such as lighting junction box, manual operated earth switch mechanism box etc., plug socket, heater and illumination is not required to be provided.

- 22.9** All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

- 22.10** Positive earthing of the cabinet shall be ensured by providing two separate earthing pads. The earth wire/ strip shall be terminated on to the earthing pad and secured by the use of self etching washer. Earthing of hinged door shall be done by using a separate earth wire.

- 22.11** The bay marshalling kiosks shall be provided with danger plate and a diagram showing the numbering/connection/ earthing by pasting the same on the inside of the door.

- 22.12** The following routine tests along with the routine tests as per IS: 5039 shall also be conducted:

Check for wiring
Visual and dimension check

The enclosure of bay marshalling kiosk, junction box, terminal box shall be type tested for IP-55 as per IS: 13947. After IP-55 test, 2.5 kVrms for 1 (one) minute, insulation resistance and functional test should be conducted.

22.13 Auxiliary Switches

All the auxiliary switches shall be fully type tested as per relevant IS.

The following type test reports on auxiliary switches shall be submitted:

- a) Electrical endurance test - A minimum of 2000 operation for 2A D. C. with a time constant greater than or equal to 20 millisecond with a subsequent examination of mV drop/visual defects/temperature rise test.
- b) Mechanical endurance test. A minimum of 1,00,000 operations with a subsequent checking of contact pressure test/visual examination.
- c) Heat run test on contacts.
- d) IR/HV test etc.

23. TERMINAL BLOCKS AND WIRING

- 23.1** Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All interphase and external connections to equipment or to control cubicles will be made through terminal blocks.

-
- 23.2** Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. These shall be of moulded piece, complete with insulated/barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals.
- 23.3** But preferably the terminal blocks shall be non-disconnecting stud type of Elmex type CATM4, phoenix cage clamp type or equivalent. The insulating material of terminal block shall be nylon which shall be free of halogens, fluorocarbons etc.
- 23.4** Terminal blocks for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
- 23.5** The terminals shall be such that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally.
- 23.6** The conducting part in contact with cable shall preferably be tinned or silver plated, however Nickel plated copper or zinc plated steel shall also be acceptable.
- 23.7** The terminal blocks shall be of extensible design.
- 23.8** The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.
- 23.9** The terminal blocks shall be fully enclosed with removable covers of transparent, non-deterioration type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers.
- 23.10** Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.
- a) All circuits except CT circuits - Minimum of 2 nos. of 2.5 sq. mm copper flexible
 - b) All CT circuits - Minimum of 4 nos. of 2.5 sq. mm copper flexible
- 23.11** The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live.
- 23.12** At least 20% spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminal rows.
- 23.13** There shall be minimum clearance of 250 mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm.
- 23.14** The Bidder shall furnish all wire, conduits and terminals for the necessary interphase electrical connections (where applicable) as well as between phases and common terminal boxes or control cabinets.
-

-
- 23.15** All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The Bidder shall also provide necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

24. LAMPS & SOCKETS

24.1 Lamps

All incandescent lamps shall use a socket base as per IS-1258, except in the case of signal lamps.

24.2 Sockets

All sockets (convenience outlets) shall be suitable to accept both 5 Amp & 15 Amp pin round Standard Indian plugs. They shall be switched sockets with shutters.

24.3 Hand Lamp

A 240 Volts, single Phase, 50 Hz AC plug point shall be provided in the interior of each cubicle with ON- OFF Switch for connection of hand lamps.

24.4 Switches and Fuses

Each panel shall be provided with necessary arrangements for receiving, distributing, isolating and fusing of DC and AC supplies for various control, signalling, lighting and space heater circuits. The incoming and sub-circuits shall be separately provided with miniature circuit breaker/ switchfuse units. Selection of the main and Sub-circuit fuse ratings shall be such as to ensure selective clearance of sub-circuit faults. Potential circuits for relaying and metering shall be protected by HRC fuses.

All fuses shall be of HRC cartridge type conforming to IS-9228 mounted on plug-in type fuse bases. Miniature circuit breakers with thermal protection and alarm contacts will also be accepted. All accessible live connection to fuse bases shall be adequately shrouded. Fuses shall have operation indicators for indicating blown fuse condition. Fuse carrier base shall have imprints to the fuse rating and voltage. All control switches shall be of rotary type. Toggle piano switches shall not be accepted.

25. Bushings, Hollow Column Insulators, Support Insulators:

- 25.1** Bushings shall be manufactured and tested in accordance with IS:2099 & IEC-60137 while hollow column insulators shall be manufactured and tested in accordance with IEC-62155/IS:5621. The support insulators shall be manufactured and tested as per IS:2544/IEC-60168 and IEC-60273. The insulators shall also conform to IEC-60815 as applicable. The bidder may also offer composite hollow insulators, conforming to IEC-61462.

- 25.2** Support insulators, bushings and hollow column insulators shall be manufactured from

high quality porcelain Porcelain used shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified tough and impervious to moisture.

- 25.3** Glazing of the porcelain shall be uniform brown in colour, free from blisters, burrs and similar other defects.
- 25.4** Support insulators/bushings/hollow column insulators shall be designed to have ample insulation, mechanical strength and rigidity for the conditions under which they will be used.
- 25.5** When operating at normal rated voltage there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the insulators/bushings when operating at the normal rated voltage.
- 25.6** Bushing porcelain shall be robust and capable of withstanding the internal pressures likely to occur in service. The design and location of clamps and the shape and the strength of the porcelain flange securing the bushing to the tank shall be such that there is no risk of fracture. All portions of the assembled porcelain enclosures and supports other than gaskets, which may in any way be exposed to the atmosphere shall be composed of completely non hygroscopic material such as metal or glazed porcelain.
- 25.7** All iron parts shall be hot dip galvanised and all joints shall be air tight. Surface of joints shall be trued up porcelain parts by grinding and metal parts by machining. Insulator/bushing design shall be such as to ensure a uniform compressive pressure on the joints.
- 25.8 Tests**

In bushing, hollow column insulators and support insulators shall conform to type tests and shall be subjected to routine tests in accordance with IS: 2099 & IS:2544 & IS : 5621.

26. MOTORS

Motors shall be "Squirrel Cage" three phase induction motors of sufficient size capable of satisfactory operation for the application and duty as required for the driven equipment and shall be subjected to routine tests as per applicable standards. The motors shall be of approved make.

26.1 Enclosures

- a) Motors to be installed outdoor without enclosure shall have hose proof enclosure equivalent to IP-55 as per IS: 4691 For motors to be installed indoor i.e. inside a box, the motor enclosure, shall be dust

proof equivalent to IP-44 as per IS: 4691.

- b) Two independent earthing points shall be provided on opposite sides of the motor for bolted connection of earthing conductor.
- c) Motors shall have drain plugs so located that they will drain water resulting from condensation or other causes from all pockets in the motor casing.
- d) Motors weighing more than 25 Kg. shall be provided with eyebolts, lugs or other means to facilitate lifting.

26.2 Operational Features

- a) Continuous motor rating (name plate rating) shall be at least ten (10) percent above the maximum load demand of the driven equipment at design duty point and the motor shall not be over loaded at any operating point of driven equipment that will rise in service.
- b) Motor shall be capable at giving rated output without reduction in the expected life span when operated continuously in the system having the particulars as given in Clause 15.0 of this Section.

26.3 Starting Requirements:

- a) All induction motors shall be suitable for full voltage direct-on-line starting. These shall be capable of starting and accelerating to the rated speed alongwith the driven equipment without exceeding the acceptable winding temperature even when the supply voltage drops down to 80% of the rated voltage.
- b) Motors shall be capable of withstanding the electrodynamic stresses and heating imposed if it is started at a voltage of 110% of the rated value.
- c) The locked rotor current shall not exceed six (6) times the rated full load current for all motors, subject to tolerance as given in IS:325.
- d) Motors when started with the driven equipment imposing full starting torque under the supply voltage conditions specified under Clause 15.0 shall be capable of withstanding atleast two successive starts from cold condition at room temperature and one start from hot condition without injurious heating of winding. The motors shall also be suitable for three equally spread starts per hour under the above referred supply condition.
- e) The locked rotor withstand time under hot condition at 110% of rated voltage shall be more than starting time with the driven equipment of minimum permissible voltage by at least two seconds or 15% of the accelerating time whichever is greater. In case it is not possible to meet the above requirement, the Bidder shall offer centrifugal type speed switch mounted on the motor shaft which shall remain closed for speed lower than 20% and open for speeds above 20% of the rated speed. The speed switch shall be capable of withstanding 120% of the rated speed in either direction of rotation.

26.4 Running Requirements:

- a) The maximum permissible temperature rise over the ambient temperature of 50 degree C shall be within the limits specified in IS:325 (for 3 - phase induction motors) after adjustment due to increased ambient temperature specified.
- b) The double amplitude of motor vibration shall be within the limits specified in IS: 4729. Vibration shall also be within the limits specified by the relevant standard for the driven equipment when measured at the motor bearings.
- c) All the induction motors shall be capable of running at 80% of rated voltage for a period of 5 minutes with rated load commencing from hot condition.

26.5 TESTING AND COMMISSIONING

An indicative list of tests is given below. Contractor shall perform any additional test based on specialities of the items as per the field Q.P./Instructions of the equipment Contractor or Purchaser without any extra cost to the Purchaser. The Contractor shall arrange all instruments required for conducting these tests alongwith calibration certificates and shall furnish the list of instruments to the Purchaser for approval.

- (a) Insulation resistance.
 - (b) Phase sequence and proper direction of rotation.
 - (c) Any motor operating incorrectly shall be checked to determine the cause and the conditions corrected.
-

CORONA AND RADIO INTERFERENCE VOLTAGE (RIV) TEST

1.0 General

Unless otherwise stipulated, all equipment together with its associated connectors, where applicable, shall be tested for external corona (for 400 kV & above) both by observing the voltage level for the extinction of visible corona under falling power frequency voltage and by measurement of radio interference voltage (RIV) for 132 kV above.

2.0 Test Levels

The test voltage levels for measurement of external RIV and for corona extinction voltage are listed under the relevant clauses of the specification.

3.0 Test Methods for RIV

3.1 RIV tests shall be made according to measuring circuit as per International Special-Committee on Radio Interference (CISPR) Publication 16-1(1993) Part -1. The measuring circuit shall preferably be tuned to frequency with 10% of 0.5 MHz but other frequencies in the range of 0.5 MHz to 2 MHz may be used, the measuring frequency being recorded. The results shall be in microvolts.

3.2 Alternatively, RIV tests shall be in accordance with NEMA standard Publication No. 107-1964, except otherwise noted herein.

3.3 In measurement of, RIV, temporary additional external corona shielding may be provided. In measurements of RIV only standard fittings of identical type supplied with the equipment and a simulation of the connections as used in the actual installation will be permitted in the vicinity within 3.5 meters of terminals.

3.4 Ambient noise shall be measured before and after each series of tests to ensure that there is no variation in ambient noise level. If variation is present, the lowest ambient noise level will form basis for the measurements. RIV levels shall be measured at increasing and decreasing voltages of 85%, 100%, and 110% of the specified RIV test voltage for all equipment unless otherwise specified. The specified RIV test voltage for 400kV, 220kV, 132kV is listed in the detailed specification together with maximum permissible RIV level in microvolts.

3.5 The metering instruments shall be as per CISPR recommendation or equivalent device so long as it has been used by other testing authorities.

3.6 The RIV measurement may be made with a noise meter. A calibration procedure of the frequency to which noise meter shall be tuned shall establish the ratio of voltage at the high voltage terminal to voltage read by noise meter.

4.0 Test Methods for Visible Corona

The purpose of this test is to determine the corona extinction voltage of apparatus, connectors etc. The test shall be carried out in the same manner as RIV test described above with the exception that RIV measurements are not required during test and a search technique shall be used near the onset and extinction voltage, when the test voltage is raised

and lowered to determine their precise values. The test voltage shall be raised to 110% of specified corona extinction voltage and maintained there for five minutes. In case corona inception does not take place at 110%, test shall be stopped, otherwise test shall be continued and the voltage will then be decreased slowly until all visible corona disappears. The procedure shall be repeated at least 4 times with corona inception and extinction voltage recorded each time. The corona extinction voltage for purposes of determining compliance with the specification shall be the lowest of the four values at which visible corona (negative or positive polarity) disappears. Photographs with laboratory in complete darkness shall be taken under test conditions, at all voltage steps i.e. 85%, 100%, and 110%. Additional photographs shall be taken at corona inception and extinction voltages. At least two views shall be photographed in each case using Panchromatic film with an ASA daylight rating of 400 with an exposure of two minutes at a lens aperture of f/5.6 or equivalent. The photographic process shall be such that prints are available for inspection and comparison with conditions as determined from direct observation. Photographs shall be taken from above and below the level of connector so as to show corona on bushing, insulators and all parts of energised connectors. The photographs shall be framed such that test object essentially, fills the frame with no cut-off.

For recording purpose, modern devices utilizing UV recording methods such as image intensifier may also be used.

- 4.1 The test shall be recorded on each photograph. Additional photograph shall be taken from each camera position with lights on to show the relative position of test object to facilitate precise corona location from the photographic evidence.
- 4.2 In addition to photographs of the test object preferably four photographs shall be taken of the complete test assembly showing relative positions of all the test equipment and test objects. These four photographs shall be taken from four points equally spaced around the test arrangement to show its features from all sides. Drawings of the laboratory and test set up locations shall be provided to indicate camera positions and angles. The precise location of camera shall be approved by Purchaser's inspector, after determining the best camera locations by trial energisation of test object at a voltage which results in corona.
- 4.3 The test to determine the visible corona extinction voltage need not be carried out simultaneously with test to determine RIV levels.
- 4.4 However, both test shall be carried out with the same test set up and as little time duration between tests as possible. No modification on treatment of the sample between tests will be allowed. Simultaneous RIV and visible corona extinction voltage testing may be permitted at the discretion of Purchaser's inspector if, in his opinion, it will not prejudice other test.

5.0 Test Records

In addition to the information previously mentioned and the requirements specified as per CISPR or NEMA 107-1964 the following data shall be included in test report:

- a) Background noise before and after test.
- b) Detailed procedure of application of test voltage.
- c) Measurements of RIV levels expressed in micro volts at each level.

- d) Results and observations with regard to location and type of interference sources detected at each step.
- e) Test voltage shall be recorded when measured RIV passes through 100 microvolts in each direction.
- f) Onset and extinction of visual corona for each of the four tests required shall be recorded.

ANNEXURE – B

SEISMIC WITHSTAND TEST PROCEDURE

The seismic withstanding test on the complete equipment (for 132 kV and above) shall be carried out alongwith supporting structure.

The Bidder shall arrange to transport the structure from his Contractor's premises/UPPTCL sites for the purpose of seismic withstand test only.

The seismic level specified shall be applied at the base of the structure. The accelerometers shall be provided at the Terminal Pad of the equipment and any other point as agreed by the Purchaser. The seismic test shall be carried out in all possible combinations of the equipment. The seismic test procedure shall be furnished for approval of the Purchaser.

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
Customer: UPPTCL
Consultant: ----
400 kV and 220 kV Line Trap

Bharat Heavy Electricals Limited
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SECTION-4						
GUARANTEED TECHNICAL PARTICULARS						
LINE TRAPS				400kV	220kV	
1	Name of manufacturer and country			:		
2	Type Model and Catalogue No			:		
3	System Voltage Rating			:		
4	Continuous current rating at 50° C ambient			:		
5	Continuous current rating at 65° C ambient			:		
6	Maximum Symmetrical short circuit current rating for 1 sec Duration			:		
7	Asymmetric peak value of first half wave of rated short time current			:		
8	Rated Inductance			:		
9	Blocking Range			:		
10	Minimum Guaranteed Resistive Component in Blocking frequency range			:		
11	Type of Tuning			:		
12	Variation in 50Hz Impedance per Degree Centigrade variation in ambient temperture			:		
13	Variation in Resonant frequency band per degree centigrade variation in ambient temperature			:		
14	Details of protection of capacitors and coils against voltage surges indicate type of protective device.			:		
15	Basic Insulation level			:		
16	Standard Nominal Discharge Current of Protective Device for 8/20 Micro second wave impulse			:		
17	Rated voltage of the Arrestor (Protective device)			:		
18	Min. value of power frequency sparkover voltage (Dry and wet) of protective devices			:		
19	Maximum 1.2/50 usec Impulse Sparkover voltage of protective device			:		

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
 Customer: UPPTCL
 Consultant: ----
 400 kV and 220 kV Line Trap

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SECTION-4						
GUARANTEED TECHNICAL PARTICULARS						
LINE TRAPS				400kV	220kV	
20	Virtual steepness and max front of wave impulse sparkover voltage of protective device			:		
21	Max. residual discharge voltage of protective device for 8/20 usec impulse discharge current of			:		
	(a) 5000 Amps			:		
	(b) 10000 Amps			:		
22	Class of Insulation of line traps as per table - 1 of IEC 353			:		
23	Temperture Rise in line trap under rated continuous current			:		
24	Visual corona Extinction voltage			:		
25	Radio Interference voltage			:		
26	Type of incoming and outgoing terminals			:		
27	Visual corona Extinction voltage for terminal concurrence			:		
28	Radio interference voltage in terminal connectors			:		
29	Continuous current rating of terminal connector at 50° C ambient			:		
30	Short time current rating of terminals connectors			:		
31	Temperature rise in terminal connector under rated continuous current over 50° C ambient			:		
32	Type of Mounting			:		
33	Maximum working stress			:		
34	Ultimate tensile strength			:		
35	Material of main coil			:		
36	Material of terminal connector			:		
37	Material of pedestal			:		
38	Material of mounting hardware			:		
39	Net weight (Approx)			:		
40	Whether corona rings are provided			:		
41	Whether Bird Barries are provided			:		

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
 Customer: UPPTCL
 Consultant: ----
 400 kV and 220 kV Line Trap

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SECTION-4						
GUARANTEED TECHNICAL PARTICULARS						
LINE TRAPS				400kV	220kV	
42	Overall Dimensions provided			:		
	(a) Diameter			:		
	(b) Height			:		
43	Any other feature			:		
44	No of turns in the line trap main coil			:		
45	Type of conductor whether solid or standard			:		
46	Overall conductor size			:		
47	Cross sectional area of conductor of one layer			:		
48	Type of construction (no of coils and whether open type or covered with insulating material)			:		

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
Customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)
Consultant: -----
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SECTION-5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

A) 400kV LINE TRAP

S.No.	Parameters	Data		Yes / No	Remarks
1.	Applicable Standard	IEC: 60353 with amendment, IS:8792, IS: 8793, IEC: 60099 (Part I&IV), IS : 3072 (Part -I) and IS : 5561			
2.	Type				
3.1	Rated Inductance	1 mH			
3.2	Rated Frequency	50 Hz			
3.3	System Voltage	400 kV			
3.4	Rated current	3150 Amp			
3.5	Rated Short Circuit Current	50 kA for 1 sec.			
3.6	Tuning device type (Inductor to tick)	Factory fixed	Field adjustable		
3.7	Type of tuning	Broad Band			
3.8	Tuning range	50 to 500 kHz			
3.9	Minimum resistive component of impedance within the rated blocking band-width	Not less than 570 ohm			
3.10	Visual Corona Extinction voltage	Not less than 320 kV (rms) (for 400 kV system)			

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
Customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)
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S.No.	Parameters	Data	Yes / No	Remarks
3.11	Radio Interference voltage	Not exceed 500 μ V at 280 kV (rms) (for 400 kV system)		
3.12	Material of main coil	Non magnetic		
3.13	Mounting arrangement	Pedestal mounting		
3.14	Line Trap shall be mechanically strong enough to withstand the stresses due to maximum wind pressure 260 Kg /m ²	260 Kg /m ²		
4.1	Station class current limiting type Lightning arrestor.	Provided		
4.2	Rated discharge current of lightning arrestor	As per Annexure-I, Section-1		
5.1	Terminal connectors	Provided		
5.2	Terminal connection	Suitable for TWIN MOOSE conductor in line side & TWIN MOOSE conductor in station side		
5.3	Visual Corona Extinction voltage for clamps and connectors	Not less than 320 kV (rms) (for 400 kV system)		
5.4	Radio Interference voltage for clamps and connectors	Not exceed 500 μ V at 280 kV (rms) (for 400 kV system)		
5.5	Material of clamp and connector	Non magnetic		
6.0	Bird barriers	Provided		

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
Customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)
Consultant: -----
Technical Specification: 400 kV & 220 kV Line Trap

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B) 220kV LINE TRAP

S.No.	Parameters	Data		Yes / No	Remarks
1.	Applicable Standard	IEC: 60353 with amendment, IS:8792, IS: 8793, IEC: 60099 (Part I&IV), IS : 3072 (Part -I) and IS : 5561			
2.	Type				
3.1	Rated Inductance	0.5 mH			
3.2	Rated Frequency	50 Hz			
3.3	System Voltage	220 kV			
3.4	Rated current	1600 Amp			
3.5	Rated Short Circuit Current	40 kA for 1 sec.			
3.6	Tuning device type (Indenter to tick)	Factory fixed	Field adjustable		
3.7	Type of tuning	Broad Band			
3.8	Tuning range	50 to 500 kHz			
3.9	Minimum resistive component of impedance within the rated blocking band-width	Not less than 570 ohm			
3.10	Visual Corona Extinction voltage	Not less than 156 kV (rms) (for 220 kV system)			

Project: 400/220/132 kV GIS Substation at Rasara, Ballia
 Customer: Uttar Pradesh Transmission Corporation Ltd (UPPTCL)
 Consultant: -----
 Technical Specification: 400 kV & 220 kV Line Trap

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S.No.	Parameters	Data	Yes / No	Remarks
3.11	Radio Interference voltage	Not exceed 500 μ V at 163 kV (rms) (for 220 kV system)		
3.12	Material of main coil	Non magnetic		
3.13	Mounting arrangement	Pedestal mounting		
3.14	Line Trap shall be mechanically strong enough to withstand the stresses due to maximum wind pressure 260 Kg /m ²	260 Kg /m ²		
4.1	Station class current limiting type Lightning arrestor.	Provided		
4.2	Rated discharge current of lightning arrestor	As per Annexure-I, Section-1		
5.1	Terminal connectors	Provided		
5.2	Terminal connection	Suitable for SINGLE ZEBRA conductor in line side & SINGLE ZEBRA conductor in station side		
5.3	Visual Corona Extinction voltage for clamps and connectors	Not less than 156 kV (rms) (for 220 kV system)		
5.4	Radio Interference voltage for clamps and connectors	Not exceed 500 μ V at 163 kV (rms) (for 220 kV system)		
5.5	Material of clamp and connector	Non magnetic		
6.0	Bird barriers	Provided		

C) TYPE TESTS

i) Whether type test reports of all tests as per relevant IEC conducted earlier on identical or similar material are available (type test reports shall not be older than ten years from 17.04.18)

(YES / NO)

ii) If type test reports are not acceptable to BHEL/End Customer then above tests shall be conducted by the bidder free of cost.

(YES)

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D)

S.No.	Description	Confirmation of Supplier
1.	Bidder to confirm that there are no deviations and the offer is in full compliance with the specification. a) Bidder to confirm that there are no deviations in any other form such as comments, variations and/ or exceptions. b) Bidder to confirm that at all drawings / data sheets/QP/ valid type tests reports/ all relevant information shall be submitted to BHEL for organising approval of ultimate customer.	
2.	Bidder to confirm that it will offer approved Make of the components and fitments at contract stage. In case the offered make is not approved by the customer, then alternate make shall be supplied without any commercial implications to BHEL.	

Date:

Signature of the authorized representative of Bidder

Company Seal