

**TSGENCO
4 X 270 MW BHADRADRI TPS**

VOLUME II B

**TECHNICAL SPECIFICATION
FOR
ELECTRICAL LAB EQUIPMENT (CALIBRATION & DIAGNOSTICS)**

SPECIFICATION NO. : PE-TS-411-556-E002, REV. 0



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
NOIDA, 201301**

	TECHNICAL SPECIFICATION FOR ELECTRICAL LAB EQUIPMENT (CALIBRATION & DIAGNOSTIC)	Doc. No. PE-TS-411-556-E002	
		Volume	Section
		IIB	
CONTENTS		Rev. : 00 DATE-01.09.2017	

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COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in Annexure-A [BOQ-Cum-Price schedule] of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).
6. All essential accessories for each electrical laboratory equipment required for testing various electrical equipment /devices during Commissioning, Operation and Maintenance of power plant to be ensured by bidder in their offer.

 BIDDER'S STAMP & SIGNATURE

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1.0 SCOPE

- 1.1 Design, manufacture, inspection and testing at manufacturer's work, proper packing and delivery to site of Electrical Laboratory Equipment as mentioned in different sections of this specification.
- 1.2 General technical requirements of the Electrical Laboratory Equipment are indicated in Section – II. Project specific technical requirements/changes are listed in section-I.
- 1.3 Electrical Laboratory Equipment shall be supplied along with all essential accessories required for the successful operation of the equipment.
- 1.4 Detailed technical parameters of Electrical laboratory equipment are listed in Annexure – I of Section-I.
- 1.5 The requirement of section-1 shall prevail and govern in case of conflict between the corresponding requirements of Section-I and section-II.

2.0 BILL OF QUANTITIES

Quantity requirement shall be as per 'BOQ cum price schedule' enclosed in NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENT

S.No.	Reference Clause No. of Section-II (if any)	Specific Requirement/Change

4.0 DRAWING & DOCUMENTS TO BE SUBMITTED

- 4.1 Following documents/drawings for each Electrical Laboratory Equipment shall be submitted after placement of order for BHEL & customer's approval in addition to the documents/drawings listed in clause No. 8.2 of section-II:

Sl. No.	Drawings/Document description	Drawings/Document Number
1	Technical Data Sheet	PE-V0-411-556-E001
2	Catalogue	PE-V0-411-556-E002



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**Annexure-I of SECTION-I DETAILED TECHNICAL
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1. Substandard Frequency Meter: 1 No

Purpose:	For Frequency Measurement
Range:	45-55 Hz
Accuracy Class:	±0.2 %
Scale Length:	no less than 100 mm.
Input Voltage:	63.5/120/240/415 V AC
Accessories:	Rugged carrying case, Mains leads, Probes, etc.

2. High Voltage Discharge rods: up to 39.5 KV: 5 Nos

Purpose:	For Earthing of Equipment
Brief Description:	Class F insulated, having non-linear carbon film resistor with negative temperature co-efficient, Non Hygroscopic.
Dimensions:	
a. ID:	25 mm
b. OD	31 mm
c. Length:	1250 mm (main rod and each extension)
d. Total Length:	3.4 Meters (Up to 39.5 KV)
e. Discharge Hook:	100 mm dia on 12.5 mm dia copper rod.
f. Earth lead:	Flexible braided copper
g. Voltage rating:	up to 39.5 KV
h. Accessories:	Portable earthing equipment, Line clamps, Insulated Operating stick, earth leads etc.

3. High Voltage Discharge rods: Up to 420 KV 6 Nos.

Purpose:	For Earthing of Equipment
Brief Description:	Class F insulated, having non-linear carbon film resistor with negative temperature co-efficient, Non Hygroscopic.
Dimensions:	
i. ID:	25 mm
j. OD	31 mm
k. Length:	1250 mm (main rod and each extension)
l. Total Length:	5 Meters (Up to 420 KV)
m. Discharge Hook:	100 mm dia on 12.5 mm dia copper rod.
n. Earth lead:	Flexible braided copper
o. Voltage rating:	up to 420 KV
p. Accessories:	Portable earthing equipment, Line clamps, Insulated Operating stick, earth leads etc.



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4. Universal Bridge (LCR-Q Bridge): 1 No

Purpose: For measurement of capacitance, inductance, and resistance for precise accuracy by using ac bridges. These bridges are composed of capacitors, inductors, and resistors in a wide variety of combinations. These bridges are operated on the principle of a dc bridge called a WHEATSTONE BRIDGE.

Capacitance : 1pF to 1000 μ F
Accuracy : $\pm 0.3\%$ of the reading or better
Resolution : 1 pico farad
Inductance : 1 μ H to 1000H
Resolution : 1 micro henry
Accuracy : $\pm 0.3\%$ of the reading or better
Resistance : 0.001 Ω to 1M Ω
Resolution : 0.1 milli ohm
Accuracy : $\pm 0.3\%$ of the reading or better
Q-Factor : 0 to 10 at 1 kHz
Internal Oscillator : 1 kHz $\pm 5\%$
Frequency range for all measurements
Internal Oscillator : 1 kHz $\pm 5\%$
Mains Input 240V 50 Hz 1 Phase AC (and)/or Battery operated.

5. Standard Current transformer: 4 Nos

Primary current : 50-1500A in multiple ranges
Secondary current : 5A preferably with a duplicate 1A secondary
Voltage rating : 1000V /50Hz
Class of accuracy : $\pm 0.2\%$
VA burden : 10 VA
Suitable for primary conductor threading /terminal connections

6. Standard Potential transformer: 2 Nos

Voltage Grade : 650 V
Primary Voltage: 415/240/110 V
Secondary Voltage : 110V/63.5V
Frequency : 45-55Hz
Accuracy Class : ± 0.2
Burden : 10 VA

7. Primary Injection Kit: 1 No

Purpose: For Commissioning application requiring high current injection, fully automatic with display and trolley

Input Voltage: 0-240 V, 1 Ph.

Output current in Amps: 0- 4000A at 24 KVA



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No of Ranges:	3 or above
Period in Seconds:	0- 999.99
Resolution in Seconds:	0.001
Accuracy:	0.1% + 2 Digits
CTs:	Standard class CT's of accuracy 0.5
Accessory	10 M length cable

8. Secondary Injection Kits: 3 Nos

Power Supply:	240VAC, 50Hz, 1phase Output current: 0-5A/10A/100A continuously variable Selector switches provided
AC Voltage Output:	0-240V AC, 180VA
VA Rating (for current circuit):	500VA
Relay operation sensing:	Through NO/NC contacts of relay under test
Range of timer:	0-9999 seconds
Resolution of timer:	0.1 ms in lowest range
Accuracy of timer:	±0.1% of reading
AC voltage output:	0-240 V conti. Variable Continuous operation for 5 minutes in all ranges provided
Metering:	Ammeter (0-5A CT operated, CT Class 1.0) Class 1.5 FS, Analog Display Voltmeter 0-240V Class 1.5 FS, Analog Display Time Interval Meter 0 – 9999Sec Resolution in lowest range 0.1mSec. Digital LED Display
Accessory:	Input Power Cord, Spare Fuses, Neon Indicating Lamps, Standard length Test Leads
Secondary Injection kits shall have following features:	
1. Auxiliary output for testing directional relays.	
2. Integrated custom timer for testing IDMT relays or Circuit breakers.	
3. Automatic protection against current or thermal overloads.	
4. Digital display of output current or voltage and time.	

9. Single Phase Auto Transformer (Variac) : 10 Nos

Purpose:	For stepless, break less & continuous control of AC voltage & therefore for various parameters, dependent on AC voltage.
Input Voltage:	240 V, 1 Ph, 50/60 Hz.
Output Voltage:	0- 240/0-270 V Continuously variable.



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Current Rating: 20 A Continuous.
 Model Type: Portable type with sheet steel enclosure for floor / table use.
 Standards: Conforming to IS 5142.
 Accessories: The instrument shall be provided with Mains lead, Manual, Warranty certificate etc.

10. Three Phase Auto Transformer (Variac): 10 Nos

Purpose: For stepless, beakless & continuous control of AC voltage & therefore for various parameters, dependent on AC voltage.
 Input Voltage: 415 V, 3Ph, 4 wire, 50/60 Hz.
 Output Voltage: 0- 415/0-470 V Continuously variable.
 Current Rating: 15 A Continuous (Minimum).
 Model Type: Portable type with sheet steel enclosure for floor / table use.
 Standards: Conforming to IS 5142.
 Accessories: The instrument shall be provided Mains lead, Manual, Warranty certificate etc.

11. Di-Electric Loss Factor Test Set (Tan-Delta Test Kit): 1 No

Input Power Supply: 240V, 50Hz 1 Phase AC
 Output Voltage: 0 to 12 K Volts Continuously adjustable
 Capacitance range: 0.06 microfarad at 10kV up to 1. 2 μ F at 2.4 KV (with CTS-RE)
 Display: Backlit LCD Display for indicating Test Status & Test Results
 Data storage: can store up to 70 readings and memory can retain the readings even when instrument is switched off
 Interface port: RS 232
 Accessories: 1.Set of Range Extension Transformer and Reactors to achieve capacitance range up to 0.6 μ F at 10 KV.
 2. Oil Test Cell & Oil Test Cell Heater
 3. Mains power Cables and Test Cables
 4. Carrying Cases
 Calibrator: HV calibrator, 5KV
 Bridge: Self balancing type
 Features: The Bridge shall be designed for quick, simple and accurate low voltage capacitance and dissipation factor



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tests. The equipment shall be complete with accessories to measure sensitivity of insulating oil

12. 100 KV Fully Automatic Oil Breakdown Voltage Test Set : 1No

Purpose:	To test Di-electric strength of Transformer oil
Brief Description	Fully automatic, complete with transportation trolley, oil test vessel with electrodes, PTFE agitator/lift-off sticks, gap gauges, mains cable, Operation manual, calibration certificate, Warranty certificate etc.
Test Voltage	0-100 KV (RMS)
Accuracy:	±3%
Resolution:	0.1 KV
Switch off response current	< 4mA.
Switch off Response time	< 6 mS
Rate of rise of test voltage	0.5/1/2/3/5KV per Sec
Controls	Manual, Automatic, Mains ON/OFF, HT On/Off, Hold, Stirrer ON/Off, Reset Switch
Features:	Fully automatic option to select a) Stand time, b) Stir time, c) rate of rise of voltage, d) No of tests carried out as per standards
Indications:	Door open, Wait time, HT on, KV rise, Stir Time, Stand time, Temperature and BDV.
Beeps	Beeps on Break down and test completion.
Safety features	interlock on HV Test Chamber, Zero Start protection, Double Ground Protection.
Key Pad:	Quick test Selection through Key Pad.
Display	Alpha Numeric Digital display.
Applicable standards:	IEC 156, IS 6792, ASTM D 877, ASTM D1816, BS 5874,
EMI/EMC Standards	IEC

13. Power analyser : 1No

Purpose:	for Measurement of Power in Single and three phase Circuits at the same time.
Input Voltage	up to 600 V, AC/DC
Current:	up to 2000 A 0-5 A range shall also be provided for measuring power from CT Secondary.
Frequency range:	45-55 HZ
Accuracy:	±2.5%
Accessories:	The instrument shall be supplied with Rugged carrying case, Probes, Manuals, warranty certificate etc.



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14. High Voltage Testing Kit (5kVA (DC)) : 1 No.

Output: 15KVDC

Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.

Input voltage 220V/230V, 50 Hz, single phase

Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately.

15. High Voltage Testing Kit [1kVA (DC)] : 1 No.

Output: 25KVDC

Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.

Input voltage 220V/230V, 50 Hz, single phase

Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately

16. High Voltage Testing Kit [150kVA (AC)]: 1 No

Output: 0-70 KVAC

Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.

Input voltage 220V/230V, 50 Hz, single phase

Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the



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leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately

17. High Voltage Testing Kit [10kVA (AC)] : 1 Nos

Output: 0-25 KVAC

Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.

Input voltage 220V/230V, 50 Hz, single phase

Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately.

18. DC Earth Fault locator : 2 Nos

Frequency of injected signal up to 20 Hz (lesser than specified value) to avoid interference with the DC ripples.

Open circuit signal strength not more than 15 volts (RMS)

Receiver sensitivity: 25 kilo ohms fault resistance

Frequency Resolution: 1 Hz

Frequency Accuracy: $\pm 0.1\%$ of full scale

It shall be capable of detecting earth faults where fault resistance is as high as 25-kilo ohms. The instrument shall operate by injecting a low frequency. Low voltage signal to the DC system

19. Portable Three phase substandard wattmeter : 6 Nos

Voltage Range: 110/240/440 Volts

Current Range: 1/5 Amps

Power factor: 1.0 (Unity)

Accuracy: 0.5% of full scale

Frequency : 45Hz to 55 Hz

With carrying case and connecting wires / leads

20. AC Voltage/Current Source : 1No

Purpose: for calibration of meters/ electrical instruments.

Input Power: 230 V, 50 Hz, 1 Phase

Voltage Ranges: 200mV, 2V, 20V, 200V, 1000V

Load: 10mA



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Current Range: 20mA, 200mA, 2A, 20A, 50A
Burden: 50VA
Frequency Range: 45 to 55 HZ
Accuracy: $\pm 1\%$ of Setting.
Accessories: The instrument shall be of Table Mounted type and shall be supplied with Rugged carrying case, test leads, Manuals, warranty certificate etc.,

21. Portable Hand Held infra-red Temperature Scanner: : 1No

Purpose: for precision measurement of Temperature.
Features:
i. Voice recording and alarm facility
ii. Double Ocular View finder and clear CCD Lens.
iii. Multi Spot (Min 4) Temperature measurement.
ii. High end image analysis software
iii. Generation of report and trend analysis.
iv. Alarm on Screen if Temp crosses set Temp.
Range: 10 °C to 1000°C in multiple ranges.
Detector Type: Uncooled Focal Plane Array.
Thermal Sensitivity: 0.08°C @ 30°C.
Frame Rate: 50 Hz
Field of View: 20" X 20" Spectral
Response: 8 to 14 Microns
Ambient Temperature: 0-50 Deg C.
Battery Operation: at least for two hours.
Accuracy: $\pm 4\%$ of reading.
Accessories: The instrument shall be supplied with Rugged carrying case, Battery, Software, Manuals, warranty certificate etc.

22. Portable reference meter and Phantom Load test set: 1 set

Solid state portable reference meter suitable for calibration of commercial grade energy meters (both active and reactive). Accuracy class of commercial grade energy meter shall be 0.5% or better.

Accuracy class of the reference meter.

- Active 0.2% or better.
- Reactive 0.2% or better

Range of current : 10 mA to 10 A direct, 50 mA to 100 A

Range of test voltage : Star connected 50-280 volts.

Delta-connected 90-490 volts

Suitable for single phase - 2 wire and 3-phase - 3 & 4 wires. At the time of calibration of the energy meters, it should be possible to read the following:



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- Test Voltage
- Test Current
- Power

The portable reference meter must be furnished with compatible single phase /three phase phantom load test set of up to 10 Ampere rating with phase shift of -30° lead to $+120^\circ$ lag in suitable steps along with necessary accessories and carrying case. Power supply of Single phase 240 V and 110 / 440 V, 3 phase shall be used for the phantom load test set.

23. Transformer Turns ratio Tester : 1No

Purpose:	To test Turns ratio, Phase deviation, excitation current of 1 Phase and Three phase Power/Instrument Transformers and shall be suitable to use in places having EHV interference.
Brief Description:	Fully automatic, Micro-processor based, with local digital display complete with transportation case, Operation manual, calibration certificate, Warranty certificate etc.
Ratio Range	0.8:1 to 1000:1
Excitation Voltage	8V, 40 V and 80 V
Excitation current:	0-500 mA with accuracy of $\pm 2\%$ of the reading.
Single Phase Test	Yes
Automatic Three Phase test	yes
Vector Group	Yes
Display	8.4 "VGA Display.
Ratio accuracy:	$\pm 0.1\%$ to $\pm 0.3\%$.
Safety/EMC/Vibration	
Standards:	IEC 1010-1, CE& ASTM D999.75
Interface:	RS 232/USB
Ingress Protection:	IP 65
Data Storage	>10000
Power Source:	230 V, 1 Phase, AC, 45-55 HZ.
Data Displayed:	Vector Group, Phase, Tap Position, Ratio, Ratio Deviation, % error V/s Name plate with pass/fail indication.
Accessories:	HV/LV cables, Mains lead, clamps, 15M test leads, Full version Software etc.

24. Three Phase Shifter: 1 No

Power Supply (Input Voltage): 415, 50Hz
Output Voltage: Same as input voltage $\pm 3\%$
Phase Shift: 0 to $\pm 180^\circ$ or 0 to 360°
VA Rating: 500VA



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25. Kelvin Double Bridge: 2 Nos

Resistance range:	0.02 micro ohm – 1.1 ohm
Resolution	0.02 micro ohm
Accuracy	±0.5% of reading or ± 1 slide wire division whichever is greater
Maximum test current	25 A
Power supply for DC Source:	1 Phase, 240 V AC.

26. Portable Protective Relay Test Kit (4 Voltages and 6 currents): 1 Nos

Purpose: For testing various types of electromechanical, static and numerical/microprocessor based protective relays, MCCBs etc.

Brief Description: Microprocessor-based user-friendly with digital signal processing. Having large LCD display with programmable menu. Having programmable output current & voltage waveforms and phase angles. Having following additional features and specifications:

Input Power	: 90-250V, 1 Ph, 50 Hz
Outputs	: One ac Current 0-100A
One ac Voltage	: 0-300V
One ac Voltage/Current	: 0-240V/0-2.5A
Output Frequency	: Selectable from 16.66 Hz – 300 Hz
Output ac Voltage	: 0-360 deg. independently controlled
Phase shift	
Reading Accuracy	: ±1% for AC/DC Volts, Current ±0.5 deg. In phase angle ±0.02% in power factor ±1.5% in active/reactive power ±0.005% in time
Memory	: Nonvolatile RAM
Interface	: RS port for PC and parallel printer port

27. AC Cable Fault Locator (up to 11kV): 1No

Purpose: For locating cable fault

Brief Description: Working on pulse reflection (echo) technique. Capable of discriminating between inter-core and core to earth fault with facility to detect high resistance faults (>10 ohms) complete with surge generator, acoustic receiver, input filters, head phones etc.

Input	: 240V, 1 phase, 50 Hz
Range	: 10 nano sec. To 2000 ns
Impedance range	: 25 ohms to 100 ohms



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Surge Generator : 15KV, 100 mA, <512 joules,
Capacity : 10-20 pulses per minute
Display : Backlit LCD

28. Portable Hand held Hydrogen Gas Leakage Detector: 1 No

Purpose: For detection of TP Hydrogen gas leakage

With audio visual indication

Sensitivity : 50 to 100 ppm

29. Portable Circuit Breaker Motion Analyser: 1 No

Purpose: Measuring opening & closing time of circuit breaker

Brief Description: For analyzing performance of SF6/Vacuum/air Circuit breakers. Microprocessor-based capable of measuring, recording and printing opening/closing times and velocity, coil currents, dynamic contact resistance of main/aux. & arcing contacts, pole discrepancy etc. The instrument shall have user-friendly menu driven software for easy operation and reduced set up time. It shall have communication ports for down loading of data from memory on to a PC. It should have a built-in DC battery and printer.

Other specifications shall be as follows:

Input Supply : 110-240V, 50Hz with built in DC battery backup with charger
Current injection : up to 100A DC
Timing Range : 0-9.99 S. with a resolution of 0.1 ms and accuracy of $\pm 0.01\%$
Number of channels : 12 analog 24 digital
Display : 16 character alphanumeric LCD

30. DIGITAL STROBOSCOPE: 1 No

Purpose: RPM Measurement, inspection & observation of rotating parts.

Input Supply : 110-240V, 50Hz
RPM : 100 – 10000
Display : LCD or LED
Accuracy : 0.1%



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SECTION-II

STANDARD TECHNICAL SPECIFICATION



TECHNICAL SPECIFICATION FOR ELECTRICAL LABORATORY (CALIBRATION & DIAGNOSTICS) EQUIPMENT

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1.0 TECHNICAL REQUIREMENTS

- 1.1 Basic technical requirements for Electrical Lab Equipment shall be as indicated in this section, in addition to technical requirements specified in Section-I.
- 1.2 The intent of specification is not to specify herein all the details of design and manufacture. However, the equipment shall confirm in all respect to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to vendors guarantee.
- 1.3 The Bidder may note that the equipment range, rating, quantities as detailed herein, are the minimum requirement only. All accessories for the equipment not covered here, if necessary for satisfactory and trouble free operation of the equipment, shall be quoted by the Bidder.
- 1.4 The instrument shall be suitable for satisfactory operation at an ambient temperature from 0°C to 55°C.
- 1.5 The Analog instruments shall be provided with knife-edge pointer and anti – parallax mirror.
- 1.6 The Bidder to quote only ‘one’ make/model against each equipment best to suit specification requirement.
- 1.7 The instrument shall be suitable for hand held operation, rugged in construction and suitable for field use.
- 1.8 All the equipment components shall be procured from reputed manufacturers and make of equipment shall be subject to the approval of BHEL/ BHEL’s Customer.
- 1.9 **Bidder to note that "In case any offered make / model becomes obsolete or is stopped manufacturing by manufacturer, next higher model of the same make may be considered for ordering / supply at contract stage, without any price implication. In such cases, bidder is required to furnish valid confirmation letter from OEM as proof of change of model (citing reason: obsolete technology or stopping of manufacturing with date of effect) and that the offered model is “technically equivalent or better”.**

2.0 CODES AND STANDARDS

Some of the standards, which shall generally be followed, are listed below. Other applicable relevant standards for any component part, even if not covered in listed standards shall be followed.

- i) IS – 6103 Method of test for specific resistance (resistivity) of electrical insulating fluid.
- ii) IS – 6700 Requirements of general purpose Cathode Ray Oscilloscope.
- iii) IS – 722 Specification for AC electricity meters.
- iv) IS – 8143 Specification for plugs & keys for resistance boxes.
- v) IS – 6104 Method of test for interfacial tension of oil against water.
- vi) IEC-51 Direct acting indicating analogue electrical measuring instruments and their accessories.
- vii) Any other relevant National/ International standards as mentioned in Section-II with technical specification.



**TECHNICAL SPECIFICATION FOR
ELECTRICAL LABORATORY
(CALIBRATION & DIAGNOSTICS)
EQUIPMENT**

SPECIFICATION NO. PE-TS-411-556-E002

VOLUME II

SECTION II

REVISION 00

DATE: 01.09.2017

SHEET 2 of 3

3.0 DESIGN CRITERIA:

- 3.1 Electrical Laboratory Equipment shall be used for calibration & diagnostics of various electrical equipment/ devices during Commissioning, Operation and Maintenance of power plant.
- 3.2 The Equipment will be kept in a clean but hot, humid and tropical atmosphere when not in use. Equipment will be placed in dust laden, hot, humid atmosphere during its use.
- 3.3 For continuous operation at specified rating, temperature rise of various equipment/ components shall be limited to the permissible value stipulated in the relevant standards and this specification.

4.0 TEST REQUIREMENTS:

- 4.1 All equipment to be tested as per latest edition of relevant standards. Further, testing shall include verification of physical, functional & technical parameters of equipment & accessories, in line with approved datasheet.
- 4.2 The tests shall be carried out by the vendor at in-house lab/ OEM lab/ Third party govt. accredited lab. Charges for all these tests shall be deemed to be included in the bid price.
- 4.3 Vendor to furnish test report to BHEL for review/ acceptance. BHEL/BHEL's customer may witness the testing of equipment.

5.0 PACKING:

All equipment shall be properly packed in Galvanized sheet steel trunk/ box with proper lock & key arrangement except for equipment which are trolley mounted or are already available in rugged steel/wooden box packing. Further, any damage (reading error/calibration error/broken parts/missing parts etc) found on receipt at site, leading to replacement of parts/whole item, shall be to bidder's account.

6.0 DEMONSTRATION TO BHEL / BHEL'S CUSTOMER

- 6.1 The vendor shall be responsible for demonstration of the supplied equipment at site, conforming the satisfactory operation.
- 6.2 The equipment for which demonstration is required at site shall be intimated by BHEL.
- 6.3 The charges for visit to site for demonstration at site shall be in-line with Annexure- I of Section-II.

7.0 PERFORMANCE GUARANTEE

The bidder shall guarantee that the equipment offered shall meet the requirement as stipulated in this specification and as confirmed by them in Technical Data Sheet. In case the performance of equipment is not as per performance guarantee, the bidder will have to replace the equipment at site free of cost.

8.0 DRAWING DATA & MANUAL

- 8.1 To be submitted with the bid as technical offer:



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a) Compliance to Technical parameters of various equipment as specified in Annexure-I of Section-I in Data Sheet – B (as enclosed).

b) Technical leaflets/ Catalogues/Product Manual of the Equipment

The Bidder may note that the drawing, data and manual listed herein are minimum requirement only. The Bidder shall ensure that the other necessary write-ups, curves and information required to fully describe the equipment are submitted with the bid.

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

- a) Technical Datasheet for each equipment
- b) Technical leaflets/ Catalogues/Product Manual of the Equipment
- c) Tests Reports and calibration certificate
- d) General arrangement drawing showing constructional features, accessories, connections, range and rating, mounting arrangement, space requirement etc.
- e) Detail instructions for application, assembly & testing of equipment.
- f) Wiring and schematic diagrams (if applicable).
- g) Instruction manual/ O&M manual of individual equipment

8.3 Instruction manual/O&M Manual of individual equipment

The manual shall clearly indicate in English the installation and connection method, check list of the tests to be carried out before commissioning of equipment. Maintenance and Calibration method shall also be provided in the manual.

8.4 Bidder to furnish all user instruction manuals, maintenance, handling, installation manuals & all test reports complete in all respect in bound volumes & soft copies to BHEL / BHEL's customer at the time of handing over the same to BHEL / BHEL's Customer.

8.5 Bidder to note that quoted item cost shall include cost of main item, cost of all accessories required for successful operation of equipment and testing cost of all equipment test as per relevant standard.

	4X270 MW BHADRADRI TPS TECHNICAL SPECIFICATION FOR ELECTRICAL LABORATORY EQUIPMENTS (CALIBRATION & DIAGNOSTIC)	Doc. No. PE-TS-411-556-E002	
		Volume	IIB
		Section	II
	<u>ANNEXURE-I OF SECTION – II</u> <u>DEMONSTRATION & HANDING OVER CHARGES</u>	Rev. : 00 DATE-04.07.2017	

**SCHEDULE OF PRICES FOR DEMONSTRATION & HANDING OVER TO
BHEL / BHEL'S CUSTOMER**

SL. NO.	DETAILS	ACTIVITY	UNIT CHARGES
1	LUMP SUM ALL INCLUSIVE CHARGES PER VISIT FOR EXPERIENCED / CAPABLE ENGINEER (EXCEPT DAILY CHARGES)	1 VISIT	20000/-
2	LUMP SUM ALL INCLUSIVE CHARGES FOR EXPERIENCED / CAPABLE ENGINEER PER DAY	1 DAY	5000/-

Note:

- TOTAL CHARGES = (Charges as per S.No.1) + [No. of Days(*) x Unit Charges as per Sl. No. 2]
- *: To be certified by BHEL site
- Bidder to note that provision of maximum 3 visits amounting to total 9 man days is envisaged for respective bidders.

4X270 MW BHADRADRI TPS								
TECHNICAL SPECIFICATION FOR ELECTRICAL LABORATORY EQUIPMENTS								
PE-TS-411-556-E002								
DATA SHEET-B (Annexure-II of Section-II)								
NOTE :-								
1) EQUIPMENT TO BE SUPPLIED ALONG WITH ESSNTIAL ACCESSORIES FOR SUCCESSFUL OPERATION OF EQUIPMENT AT SITE .i.e. CLAMPS, CLIPS,LEADS ,CARRYING CASE etc.								
2) ALL EQUIPMENTS SHALL BE SUPPLIED WITH VALID CALIBRATION CERTIFICATE, WHEREVER APPLICABLE.								
3) All equipment shall be properly packed in Galvanized sheet steel trunk/ box with proper lock & key arrangement except for equipment which are trolley mounted or are already available in rugged steel/wooden box packing. Further, any damage (reading error/calibration error/broken parts/missing parts etc) found on receipt at site, leading to replacement of parts/whole item, shall be to bidder's account								
Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requiremnets as specified in technical specification	Catalogue (attached or not)	Remarks
1. Substandard Frequency Meter: 1 No								
Purpose: For Frequency Measurement								
Range: 45-55 Hz								
Accuracy Class : $\pm 0.2\%$								
Scale Length: no less than 100 mm.								
Input Voltage: 63.5/120/240/415 V AC								
Accessories: Rugged carrying case, Mains leads, Probes, etc.,								
2. High Voltage Discharge rods: upto 39.5 KV : 5 Nos								
Purpose: For Earthing of Equipments								
Brief Description: Class F insulated, having non-linear carbon film resistor								
Dimensions:								
a. ID: 25 mm								
b. OD 31 mm								
c. Length: 1250 mm (main rod and each extension)								
d. Total Length: 3.4 Meters (Upto 39.5 KV)								
e. Discharge Hook: 100 mm dia on 12.5 mm dia copper rod.								
f. Earth lead: Flexible braided copper								
g. Voltage rating: up to 420 KV								
h. Accessories: Portable earthing equipment, Line clamps, Insulated operating stick, earth leads etc.,								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
3. High Voltage Discharge rods: Upto 420 KV 6 Nos.								
Purpose: For Earthing of Equipments								
Brief Description: Class F insulated, having non-linear carbon film resistor with negative temperature co-efficient, Non Hygroscopic.								
Dimensions: a. ID: 25 mm b. OD 31 mm c. Length: 1250 mm (main rod and each extension) d. Total Length: 5 Meters(Upto 420 KV) e. Discharge Hook: 100 mm dia on 12.5 mm dia copper rod. f. Earth lead: Flexible braided copper g. Voltage rating: up to 420 KV h. Accessories: Portable earthing equipment, Line clamps, Insulated operating stick, earth leads etc.,								
4. Universal Bridge (LCR-Q_Bridge): 1 No								
Purpose: For measurement of capacitance, inductance, and resistance for precise accuracy by using ac bridges. These bridges are composed of capacitors, inductors, and resistors in a wide variety of combinations. These bridges are operated on the principle of a dc bridge called a WHEATSTONE BRIDGE.								
Capacitance : 1pF to 1000µF								
Accuracy : +/-0.3% of the reading or better								
Resolution : 1 pico farad								
Inductance : 1µH to 1000H								
Resolution : 1 micro henry								
Accuracy : +/- 0.3% of the reading or better								
Resistance : 0.001Ω to 1MΩ								
Resolution : 0.1 milli ohm								
Accuracy : +/- 0.3% of the reading or better								
Q-Factor : 0 to 10 at 1 kHz								
Internal Oscillator : 1 kHz +/- 5%								
Frequency range for all measurements								
Internal Oscillator : 1 kHz @ 5%								
Mains Input 240V 50 Hz 1 Phase AC (and)/or Battery operated.								
5. Standard Current transformer : 4 Nos								
Primary current : 50-1500A in multiple ranges								
Secondary current : 5A preferably with a duplicate 1A secondary								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
Voltage rating : 1000V /50Hz								
Class of accuracy : +/- 0.2%								
VA burden : 10 VA								
Suitable for primary conductor threading /terminal connections								
6. Standard Potential transformer : 2 Nos								
Voltage Grade : 650 V								
Primary Voltage : 415/240/110 V								
Secondary Voltage : 110V/63.5V								
Frequency : 45-55Hz								
Accuracy Class : ±0.2								
Burden : 10 VA								
7. Primary Injection Kit: 1 No								
Purpose: For Commissioning application requiring high current injection, fully automatic with display and trolley								
Input Voltage: 0-240 V, 1 Ph.								
Output current in Amps: 0- 4000A at 24 KVA								
No of Ranges: 3 or above								
Period in Seconds: 0- 999.99								
Resolution in Seconds: 0.001								
Accuracy: 0.1% + 2 Digits								
CTs: Standard class CT's of accuracy 0.5								
Accessory :10 M length cable								
8. Secondary Injection Kits: 3 Nos								
Power Supply: 240VAC,50Hz, 1phase								
Output current: 0-5A/10A/100A continuously variable Selector switches provided								
AC Voltage Output: 0-240V AC, 180VA								
VA Rating (for current circuit): 500VA								
Relay operation sensing: Through NO/NC contacts of relay under test								
Range of timer: 0-9999 seconds								
Resolution of timer: 0.1 ms in lowest range								
Accuracy of timer: ±0.1%of reading								
AC voltage output: 0-240 V conti. Variable Continuous operation for 5 minutes in all ranges provided								
Metering: Ammeter (0-5A CT operated, CT Class 1.0)								
Class 1.5 FS, Analog Display								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
Voltmeter 0-240V								
Class 1.5 FS, Analog Display								
Time Interval Meter 0 – 9999Sec								
Resolution in lowest range 0.1mSec.								
Digital LED Display								
Accessory: Input Power Cord , Spare Fuses , Neon Indicating Lamps,Standard length Test Leads								
Secondary Injection kits shall have following features:								
1. Auxiliary output for testing directional relays.								
2. Integrated custom timer for testing IDMT relays or Circuit breakers.								
3. Automatic protection against current or thermal overloads.								
4. Digital display of output current or voltage and time.								
9. Single Phase Auto Transformer (Variac) : 10 Nos								
Purpose: For stepless, breakless & continuous control of AC voltage & therefore for various parameters, dependent on AC voltage.								
Input Voltage: 240 V, 1 Ph, 50/60 Hz.								
Output Voltage: 0- 240/0-270 V Continuously variable.								
Current Rating: 20 A Continuous.								
Model Type: Portable type with sheet steel enclosure for floor / table use.								
Standards: Conforming to IS 5142.								
Accessories: The instrument shall be provided with Mains lead, Manual, Warranty certificate etc.								
10. Three Phase Auto Transformer (Variac) : 10 Nos								
Purpose: For stepless, breakless & continuous control of AC voltage & therefore for various parameters, dependent on AC voltage.								
Input Voltage: 415 V, 3Ph, 4 wire, 50/60 Hz. Output Voltage: 0- 415/0-470 V Continuously variable.								
Current Rating: 15 A Continuous (Minimum).								
Model Type: Portable type with sheet steel enclosure for floor / table use.								
Standards: Conforming to IS 5142.								
Accessories: The instrument shall be provided Mains lead, Manual, Warranty certificate etc.								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
11. Di-Electric Loss Factor Test Set (Tan-Delta Test Kit): 1 No								
Input Power Supply: 240V, 50Hz 1 Phase AC								
Output Voltage: 0 to 12 K Volts Continuously adjustable								
Capacitance range: 0.06 microfarad at 10kV up to 1. 2μF at 2.4 KV (with CTS-RE)								
Display: Backlit LCD Display for indicating Test Status & Test Results								
Data storage: Can store up to 70 readings and memory can retain the readings even when instrument is switched off								
Interface port: RS 232								
Accessories 1.Set of Range Extension Transformer and Reactors to achieve capacitance range up to 0.6μF at 10 KV. 2.Oil Test Cell & Oil Test Cell Heater 3.Mains power Cables and Test Cables 4.Carrying Cases								
Calibrator: HV calibrator, 5KV								
Bridge: Self balancing type								
Features: The bridge shall be designed for quick, simple and accurate low voltage capacitance and dissipation factor tests. The equipment shall be complete with accessories to measure sensitivity of insulating oil								
12. 100 KV Fully Automatic Oil Breakdown Voltage Test Set : 1No								
Purpose: To test Di-electric strength of Transformer oil Brief Description Fully automatic, complete with transportation trolley, oil test vessel with electrodes, PTFE agitator/lift-off sticks,gap gauges, mains cable, Operation manual, calibration certificate, Warranty certificate etc.								
Test Voltage 0-100 KV (RMS)								
Accuracy: ±3%								
Resolution: 0.1 KV								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
Switch off response current < 4mA.								
Switch off Response time < 6 mS								
Rate of rise of test voltage 0.5/1/2/3/5KV per Sec								
Controls Manual, Automatic, Mains ON/OFF, HT On/Off, Hold,Stirrer ON/Off, Reset Switch								
Features: Fully automatic option to select a) Stand time, b) Stir time, c) rate of rise of voltage, d) No of tests carried out as per standards								
Indications: Door open, Wait time, HT on, KV rise, Stir Time, Stand time, Temperature and BDV.								
Beeps:Beeps on Break down and test completion.								
Safety features: interlock on HV Test Chamber, Zero Start protection, Double Ground Protection.								
Key Pad: Quick test Selection through Key Pad.								
Display: Alpha Numeric Digital display.								
Applicable standards: IEC 156, IS 6792, ASTM D 877, ASTM D1816, BS 5874,								
EMI/EMC Standards: IEC								
13. Power analyser : 1No								
Purpose: for Measurement of Power in Single and three phase Circuits at the same time.								
Input Voltage upto 600 V,AC/DC								
Current: upto 2000 A , 0-5 A range shall also be provided for measuring power from CT Secondary.								
Frequency range: 45-55 HZ								
Accuracy: ±2.5%								
Accessories: The instrument shall be supplied with Rugged carrying case, Probes, Manuals, warranty certificate etc.,								
14. High Voltage Testing Kit [5kVA (DC)] : 1 No								
Output: 15KVDC								
Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.								
Input voltage 220V/230V, 50 Hz, single phase								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately.								
15. High Voltage Testing Kit [1kVA (DC)] : 1 No								
Output: 25KVDC								
Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.								
Input voltage 220V/230V, 50 Hz, single phase								
Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately.								
16. High Voltage Testing Kit [150kVA (AC)] : 1 No								
Output: 0-70 KVAC								
Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.								
Input voltage 220V/230V, 50 Hz, single phase								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately.								
17. High Voltage Testing Kit [10kVA (AC)] : 1 No								
Output: 0-25 KVAC								
Duty cycle of all the High Voltage Kits shall be 15 Min ON & 15 Min OFF.								
Input voltage 220V/230V, 50 Hz, single phase								
Brief Description: The HV transformer shall be either dry type or hermetically sealed liquid filled type. The equipment shall be portable roller / trolley mounted shall be protected against short-circuits and overloads. A control desk incorporating all necessary indication, annunciation, protection and control equipment shall be provided. It shall be possible to switch on the high voltage only when the control setting is at the minimum. The instrument shall be provided with accurate indications of high voltage and the leakage current. Discharge rods and supplied along with the instrument. Any other essential accessory may be quoted separately.								
18. DC Earth Fault locator : 2 Nos								
Frequency of injected signal upto 20 Hz (lesser than specified value) to avoid interference with the DC ripples.								
Open circuit signal strength not more than 15 volts (RMS)								
Receiver sensitivity: 25 kilo ohms fault resistance								
Frequency Resolution: 1 Hz								
Frequency Accuracy: $\pm 0.1\%$ of full scale								
It shall be capable of detecting earth faults where fault resistance is as high as 25-kilo ohms. The instrument shall operate by injecting a low frequency, Low voltage signal to the DC system.								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
19. Portable Three phase substandard wattmeter : 6 Nos1								
Voltage Range: 110/240/440 Volts								
Current Range: 1/5 Amps								
Power factor: 1.0 (Unity)								
Accuracy: 0.5% of full scale								
Frequency : 45Hz to 55 Hz								
with carrying case and connecting wires / leads								
20. AC Voltage/Current Source : 1No								
Purpose: for calibration of meters/ electrical instruments.								
Input Power: 230 V, 50 Hz, 1 Phase								
Voltage Ranges: 200mV, 2V, 20V, 200V, 1000V								
Load: 10mA								
Current Range: 20mA, 200mA, 2A, 20A, 50A								
Burden: 50VA								
Frequency Range: 45 to 55 HZ								
Accuracy: ±1% of Setting.								
Accessories: The instrument shall be of Table Mounted type and shall be supplied with Rugged carrying case, test leads, Manuals, warranty certificate etc.,								
21. Portable Hand Held infra-red Temperature Scanner: : 1No								
Purpose: for precision measurement of Temperature.								
Features: i. Voice recording and alarm facility								
ii. Double Ocular View finder and clear CCD Lens.								
iii. Multi Spot (Min 4) Temperature measurement.								
ii. High end image analysis software								
iii. Generation of report and trend analysis.								
iv. Alarm on Screen if Temp crosses set Temp.								
Range: 10 0C to 10000C in multiple ranges.								
Detector Type: Uncooled Focal Plane Array.								
Thermal Sensitivity: 0.080C @ 300C.								
Frame Rate: 50 Hz								
Field of View: 20" X 20" Spectral								
Response: 8 to 14 Microns								
Ambient Temperature: 0-50 Deg C.								
Battery Operation: at least for two hours.								
Accuracy: ±4% of reading.								
Accessories: The instrument shall be supplied with Rugged carrying case, Battery, Software, Manuals, warranty certificate etc.								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
22. Portable reference meter and Phantom Load test set: 1 set								
Solid state portable reference meter suitable for calibration of commercial grade energy meters (both active and reactive). Accuracy class of commercial grade energy meter shall be 0.5% or better.								
Accuracy class of the reference meter. - Active 0.2% or better. - Reactive 0.2% or better								
Range of current : 10 mA to 10 A direct, 50 mA to 100 A								
Range of test voltage : Star connected 50-280 volts. Delta-connected 90-490 volts								
Suitable for single phase - 2 wire and 3-phase - 3 & 4 wires. At the time of calibration of the energy meters, it should be possible to read the following: -Test Voltage -Test Current - Power								
The portable reference meter must be furnished with compatible single phase /three phase phantom load test set of up to 10 Ampere rating with phase shift of -30° lead to +120° lag in suitable steps along with necessary accessories and carrying case. Power supply of Single phase 240 V and 110 / 440 V, 3 phase shall be used for the phantom load test set.								
23. Transformer Turns ratio Tester : 1No								
Purpose: To test Turns ratio, Phase deviation, excitation current of 1 Phase and Three phase Power/Instrument Transformers and shall be suitable to use in places having EHV interference.								
Brief Description: Fully automatic, Micro-processor based, with local digital display complete with transportation case, Operation manual, calibration certificate, Warranty certificate etc.								
Ratio Range 0.8:1 to 1000:1								
Excitation Voltage 8V, 40 V and 80 V								
Excitation current: 0-500 mA with accuracy of ±2% of the reading.								
Single Phase Test Yes								
Automatic Three Phase test Yes								
Vector Group Yes								
Display 8.4 " VGA Display.								
Ratio accuracy: ±0.1% to ±0.3%.								
Safety/EMC/Vibration								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
Standards: IEC 1010-1, CE & ASTM D999.75								
Interface: RS 232/USB								
Ingress Protection: IP 65								
Data Storage >10000								
Power Source: 230 V, 1 Phase, AC, 45-55 HZ.								
Data Displayed: Vector Group, Phase, Tap Position, Ratio, Ratio Deviation, % error V/s Name plate with pass/fail indication.								
Accessories: HV/LV cables, Mains lead, clamps, 15M test leads, Full version Software etc.								
24. Three Phase Shifter: 1 No								
Power Supply (Input Voltage): 415, 50Hz								
Output Voltage: Same as input voltage $\pm 3\%$								
Phase Shift: 0 to $\pm 180^\circ$ or 0 to 360°								
VA Rating: 500VA								
25. Kelvin Double Bridge: 2 Nos								
Resistance range: 0.02 micro ohm – 1.1 ohm								
Resolution 0.02 micro ohm								
Accuracy $\pm 0.5\%$ of reading or ± 1 slide wire division whichever is greater								
Maximum test current 25 A								
Power supply for DC Source: 1 Phase, 240 V AC.								
26. Portable Protective Relay Test Kit (4 Voltages and 6 currents): 1 Nos								
Purpose: For testing various types of electromechanical, static and numerical/microprocessor based protective relays, MCCBs etc.								
Brief Description: Microprocessor-based user-friendly with digital signal processing. Having large LCD display with programmable menu. Having programmable output current & voltage waveforms and phase angles. Having following additional features and specifications:								
Input Power : 90-250V, 1 Ph, 50 Hz								
Outputs : One ac Current 0-100A								
One ac Voltage : 0-300V								
One ac Voltage/Current : 0-240V/0-2.5A								
Output Frequency : Selectable from 16.66 Hz – 300 Hz								
Output ac Voltage : 0-360 deg. independently controlled Phase shift								
Reading Accuracy : $\pm 1\%$ for AC/DC Volts, Current								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
±0.5 deg. In phase angle								
±0.02% in power factor								
±1.5% in active/reactive power								
±0.005% in time								
Memory : Nonvolatile RAM								
Interface : RS port for PC and parallel printer port								
27. AC Cable Fault Locator (upto 11kV): 1No								
Purpose: For locating cable fault								
Brief Description: Working on pulse reflection (echo) technique. Capable of discriminating between inter-core and core to earth fault with facility to detect high resistance faults (>10 ohms) complete with surge generator, acoustic receiver, input filters, head phones etc.								
Input : 240V, 1 phase, 50 Hz								
Range : 10 nano sec. To 2000 ns								
Impedance range : 25 ohms to 100 ohms								
Surge Generator : 15KV, 100 mA, <512 joules,								
Capacity : 10-20 pulses per minute								
Display : Backlit LCD								
28. Portable Hand held Hydrogen Gas Leakage Detector: 1 No								
Purpose: For detection of TP Hydrogen gas leakage With audio visual indication								
Sensitivity : 50 to 100 ppm								
29. Portable Circuit Breaker Motion Analyser: 1 No								
Purpose: Measuring opening & closing time of circuit breaker								
Brief Description: For analyzing performance of SF6/Vacuum/air Circuit breakers. Microprocessor-based capable of measuring, recording and								
Other specifications shall be as follows:								
Input Supply : 110-240V, 50Hz with built in DC battery backup with charger								
Current injection : up to 100A DC								
Timing Range : 0-9.99 S. with a resolution of 0.1 ms and accuracy of ±0.01%								
Number of channels : 12 analog 24 digital								
Display : 16 character alphanumeric LCD								

Item description	Whether Quoted or not (Yes/No)	Make	Model no	Country of Manufacture	Authorization letter (attached or not)	Bidder to indicate the parameters of offered model against each parameter mentioned in the tender specification so that it can be concluded that offered model is meeting all requirements as specified in technical specification	Catalogue (attached or not)	Remarks
30. DIGITAL STROBOSCOPE: 1 No								
Purpose: RPM Measurement, inspection & observation of rotating parts.								
Input Supply : 110-240V, 50Hz								
RPM : 100 – 10000								
Display : LCD or LED								
Accuracy : 0.1%								