

S. NO.	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
1.0	PURPOSE Automated PC based C, L, & tan δ (Dissipation Factor) Measuring Bridge is required for testing of electrical testing of coils.				
2.0	SPECIFICATION Tech specs of the machine / equipment				
2.1	Dissipation Factors (tan δ) , Range :- 0..100 (0 ...10000%) Resolution :- 0.0001 (0.01%) Accuracy :- ± 0.5 % rdg $\pm 1E-4$ (± 0.5 % rdg ± 0.01 %				
2.2	Power Factor (Cos ϕ) Range :- 0..1 (0...100%) Resolution :- 0.0001 (0.01%) Accuracy :- ± 0.5 % rdg $\pm 1E-4$ (± 0.5 % rdg ± 0.01 %				
2.3	Quality Factor Range :- 0.01..10000 Resolution :- 0.0001 (0.01%) Accuracy :- ± 0.5 % rdg $\pm 1E-4$ (± 0.5 % rdg ± 0.01 %				

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2.4	Capacitance Range :- >0.1 pF Resolution :- 0.01 pF Accuracy :- $\pm 0.05\%$ rdg ± 0.3 pF				
2.5	Inductance Range :- < 1000 kH Resolution :- 0.1 mH Accuracy :- $\pm 0.1\%$ rdg ± 3 mH				
2.6	Test Voltage Range :- 0.....1000 kV Resolution :- 1 V Accuracy :- $\pm 0.3\%$ rdg ± 1 V				
2.7	Test Current Range :- 20uA....15 A Resolution :- 0.000mA Accuracy :- $\pm 0.3\%$ rdg ± 0.1 Hz				
2.8	Test Frequency Range :- 15....1000Hz Resolution :- 0.01Hz Accuracy :- $\pm 0.1\%$ rdg ± 0.1 Hz				

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2.9	Apparent Power S Range :- 0m VA....1MVA				
2.10	Real Power P Range :- 0m W...1MW				
2.11	Reactive Power Q Range :- 0....mvar...1Mvar				
2.12	Operating Teamperature Range :- -10....50 ⁰ C				
2.13	Storage Temperature Range :- - 20.....70 ⁰ C				
2.14	Humidity Range :- 5 to 95 % RH.				
2.15	Protection Classes Range :- IP20 (IP54 in closed field case IEC 61010,CE mark general IEC 61326.1, IEC 61000-4 x, 61000-3-x,EN 55011,ANSI / IEEE C 37.90.				

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2.16	Weight of equipment	Vendor to Specify			
2.17	Size of equipment (W x H x D)	Vendor to Specify			
	Accuracy value should be for valid @ 50 Hz				
	Range is limited by test current and voltage of used power source.				
3.00	CONSTRUCTION :	Vendor to confirm			
3.10	Technical Features				
	The loss analyzing system to be designed for determining impedance and dielectric losses ($C, L, DF \tan \delta$ PF $\cos \phi$, QF etc.) of high voltage equipment and liquid or solid insulation. The instrument should operate on a combient bridge / vector meter principal.				
3.2	A large colour TFT touch screen display and a window XP™ user interface should be provided for easy and intractive operation of the instrument.				

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3.3	Advance software functionality like automatic test object temperature correction, programmable test sequences with pass/ fail limits, graphical result presentation in digrams for trending visualization, etc				
3.4	Loss measurement and analysis on high voltage equipment.				
3.5	Built - in standard interface (Ethernet, USB) should be provided to enable easy data exchange with another external computer. All measurements and related setting and test object data should be saved in XML format as well as conventional ASCII format. So it be further used in any other environment. The Instrument itself should produce fully automatic XML test reports.				
3.6	Instrument can be operated in a manual or in automatic (Sequencer) mode. The mode manual mode provided quick measurements without lots of definitions and pre settings while the automatic test mode should support complete automated test sequences. A graphic supply control window to support the adjustment of the external high voltage supply.				
3.7	Instrument to record all relevant value such as Capacitance,Inductance, Dissipation Factor $\tan \delta$, Power factor $\cos \phi$, Quality Factor,Equivalent series/parallel Impedances, Power, Current ,Frequency, Voltage, Temperature, Temp. correction Factor, Test connection Factor, Test connection Mode and all settings.				

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3.8	Instrument should read Values absolute and corrected to standard temperature.				
3.9	The instrument should have Three select measuring channels to minimize the reconnecting of the object.				
3.10	The instrument should have Intergrated PC with screen to simplify test procedure.				
3.11	The instrument should have standard Interfaces to guarantee easy data exchange and intergration in to lab IT.				
3.12	The instrument should have Advanced interference suppression to allow for accurate measurement at local power line frequency.				
3.13	The instrument should have compact, reliable and safe contruction for factory and field use along with optional field case.				
4.00	EASY TO OPERATE	Vendor to confirm			
4.1	Self explanatory user interface with large graphical colour TFT touch screen. Manual and Automatic test operation. Software assisted test planning, preparation, execution and trending analysis.				

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5.0	OPRATION AND CONTROL SYSTEM	Vendor to confirm			
5.1	Connectivity				
	The integrated PC and its standard interfaces like Ethernet, Serial and USB should be available for an easy integration with any external IT system.				
5.2	Suitable software to be provided to efficiently performs test sequences, which can be programmed on the instrument itself or with optional software package on a separate computer.				
5.3	The test sequence should consist of typically six type of instruction (for illustration only).				
	(a) Setups :- Set all configuration values, type of DUT, insulation type, temperature correction function, limits, work order, serial numbers, test personal, etc.				
	(b) Test Level :- Set the desired different test level (voltage and frequency).				
	(c) Connections :- Set the different connections (EUT wiring) e.g. GSTg A+B.				

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	(d) Measuring Values :- Define the different values to be recorded. Eg. Voltage, Frequency, PF, Current, Temperature, PF @ 20° C, etc.				
	(e) Test instruction :- In every step that requires a rewiring of the test object, an instruction box with and pictures be defined to provided the test personal with a step by step guide of how to perform the connection, wiring and the test.				
	(f) Pass / Fail / Level :- Limits can be set absolute or relative (based on reference measurements) that will compares with the measured values and shown in the analysis diagram.				
	5.4 It should be possible to execute the predefined test sequences by test personal with lower skills or knowledge to reduce the test time for setup and wrong connection or misinterpretation of test result should not be possible.				

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5.5					
	Its should be possible to fully control the AC supplies.				
5.6	Built in temperature correction curves for different insulation materials are to be used to recalculate the measured results to reference conditions (20 ⁰ C, 68 ⁰ F) in a fully automatic way.				
5.7	The method of correction should depend on the type of insulation and relevant standard, and the predefined set of curves should be possible for easy expansion or change by the user.				

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6.0	EASY - OPERATION	Vendor To Confirm			
6.1	It should be possible to do all interaction with the instrument over the clear touch screen interface. It should be possible to connect an additional key board and mouse, if desired.				
6.2	It Should be possible to save all measurement results and test object data and handled in XML format which allows easy display, printing test report and transfer to database application. For further processing of the data (e.g. with MS EXCEL TM), it should be possible to save data as ASCII test file as well and then be transferred to a PC using a standard Ethernet connection or a USB memory stick.				
6.3	Values That Can Be Recorded Should Be :-	Vendor To Confirm			
	$DF(\tan \delta), / DF(\tan \delta) @_{20}^0C, / DF\%(\tan \delta), / DF\%(\tan \delta) @_{20}^0C,$				
	$PF(\cos \varphi), / PF(\cos \varphi) @_{20}^0c / PF\%(\cos \varphi), / PF\%(\cos \varphi) @_{20}^0c$				

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	QF (quality factor, / QF (quality factor)) _{@20 ° c}				
	$C_p (Z_x = C_p \parallel R_p),$				
	$R_p (Z_x = C_p \parallel R_p)$				
	$C_s (Z_x = C_s + R_s)$				
	$L_p (Z_x = L_s + R_s),$				
	$R_s (Z_x = L_s + R_s),$				
	$L_p (Z_x = L_s \parallel R_p),$				
	$R_p (Z_x = L_p \parallel R_p)$				
	Standard capacitor Cn,				
	$U_{RMS},$				
	$U_{RMS} \sqrt{3},$				
	$I_{test\ eff}$				
	$I_{ref\ eff}$				
	$I_{mr},$				
	I_{tev}				

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	Impedance Z_x ,				
	Phase angle ϕ -(Z_x),				
	Admittance. Y_x ,				
	Frequency f_{test} ,				
	Frequency f_{line} ,				
	App. Power S,				
	Real power P,				
	Reactive Power Q,				
	Real Power@ 2.5 kv ,				
	Real Power@ 10 kv ,				
	Temperature $T_{Ambient}$				
	Temperature $T_{Insulation}$,				
	Rel. Humidity ,				
	Temp. Corr. Factor K,				
	Connection mode,				
	Setting, all Notes and comments, Time, Date.				

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7.00	STANDARD CAPACITOR (1000 Pf +/- 1%, max 30 kV AC	Vendor to confirm			
7.1	It should be Gas Insulated standard capacitors to be used in high voltage instrumentation applications as pre- comparison standard capacitance and dissipation factor measurements are made on electrical apparatus and insulating materials of all type including cables, capacitors, brushings , instruments - transformers and power - transformers.				
7.2	It should be possible to use Standard capacitors as a high voltage section of a capacitive divisor to allow extremely accurate voltage measurements such as those required for loss measurements on power - transformers.				
7.3	The capacitor should be suitable for indoor operation.				
7.4	They should be optimally designed for modern different transformer measuring bridge such as described above. The built -in guard electrodes should permit the capacitor in conjunction with sharing bridge. The test voltage thus can be measured at the same time as the dissipation factor and capacitance measurements. The test voltage is determined by measuring the current flowing through the standard capacitor.				

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7.5	Standard capacitors with nominal voltage upto 30kV should have the polished metal plate electrodes built in to a metal pressure tank and insulated with SF6. The pressure gage and measuring connections should be located on cover plate for the above bridge. The high voltage shall be applied to the capacitor with a screened cable. It should have a high voltage bushing .				
7.6	It should have casters to ensure good mobility in the test facility.				
7.7	Technical Data / Design Data	Vendor to confirm			
	Op temp				
	Storage temp				
	Capacitance				
	Temp co eff at constant gas volume				
	Pressure coefficient at constant temp				
	Voltage drift (10- 100 Hz)				
	Frequency drift (10- 100Hz)				
	Stability over 1 year				
	Calibration accuracy				
	Tan delta				

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	Normal pressure of SF6	450+/- - 50kPa				
	Test pressure	1000 kPa				
	Gas loss per year	< 1 %				
	Insulation resistance	> 500 M Ohms				
	HV connection	Lemo RA3 Ht 415 / Suitable TC 200 matching connector - F3 Ht 415 TB 085				
	Low voltage connection	Lomo 1 P RA 3S 140 matching Lemo Connector 1 Pf 3 S 140 3 RG 11.				
	Colour of insulating cyclinder	Grey / white RAL 9002				
	Top electrode	aluminum				
	Mobile base	dip galvanized				
8.00	ELECTRICAL SYSTEM :		Vendor to confirm			
8.1	BHEL input supply 230 VAC \pm 10% , 50 Hz AC vendor has to provide suitable isolation / step down transformer for operation of the machine / equipment.					
8.2	It should be suitable for working under normal distortion in voltage at shop standards.					

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8.3	All the electrical and electronic components should be suitably tropicalized to work at an ambient temperature of 50°C maximum and relative up to 95 % maximum for three shift working.				
8.4	All the electrical and electronic panels including operator's panel should be provided with fluorescent lamps for sufficient illumination and power receptacles of 220 Volts, 5/15 Amp AC.				
8.5	Output voltage shall be through a flexible HV screened cable of proper voltage grade with a good quality crocodile clip. Measurements of output voltage shall be through a stable and precision to the output terminal.				
8.6	Vendor should ensure the proper earthing for the machine and it peripherals.				
8.7	In - cycle digital preset timer with reset facility should be provided.				
8.8	4½ digit digital LED display output voltmeter and ammeter for easy reading even in direct sunlight.				

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8.9	The equipment shall be provided with (a) remote fuses / MCB/ Contactor for control panel, (b)Voltage control automatic / manual.(c) Oil if required (d)Electrical interlocking (e) Zero / maximum limite switch indication,(f) protection for over load and short circuit, (f) Carbon roller assembly for variac mechanism, (g) 40mA setable by potentio meter and voltage trip in conjunction with timer setting.				
9.0	SAFETY ARRANGEMENTS :	Vendor to confirm			
	Following safety feature in addition to other standard safety features should be provided on the machine / equipment :				
9.1	Equipment should have adequate and reliable safety interlocks / devices to avoid damage to the equipment , workpiece and the operator due to the malfunctioning or mistakes.Equipment function should be continuously monitored and alarm / warning indication through light / alarm number with messages should be available.				
9.2	A detailed list of all alarms / indications provided on equipment should be submitted by the supplier.				
9.3	All the cables etc. on the equipment should be well supported and protected.				

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10.0	MEASURING SYSTEMS :	Vendor to confirm			
10.1	Single range voltmeter: 0-50 KV AC. Accuracy 0.2% Single range ammeter: 0-40 mA. Accuracy 0.2% The equipment should be provided with LED digital meters for voltage and current readings (including leakage current). The meters should be of required accuracy.				
11.0	ENVIRONMENTAL PERFORMANCE OF THE EQUIPMENT :	Vendor to confirm			
	The equipment shall conform to following factors related to environment :				
	(a) If any safety / environmental protection enclosure is required it should be built in the equipment by the Vendor.				
	(b) Paint of the equipment should be oil resistant and should not peel off.				
12.0	TOOLS FOR ERECTION, OPERATION & MAINTANANCE.	vendor to confirm			
12.1	Special tools and equipment required for erection of the equipment shall be brought by the vendor. Necessary tools like, spanners, keys, etc. for operation and maintenance of the equipment should be supplied. List of such tools should be submitted with offer.				

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13.0	ACCESSORIES	Vendor to Specify			
14.0	SPARES : Item wise breakup of mechanical, electrical and electronic spares used on the Machine/ equipment in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis should offered by vendor. The list to include following in addition to other recommended spares: (Unit Price of each item of spare should be offered)	Vendor to confirm			
14.1	Electrical / Electronic : All types of Relays,Contractors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductors Fuses, Special Fuses, Circuit Breakers, Main Power Switch ,Operator's panel with Display Unit, Power Module, P.C.Bs etc.				
14.2	Vendor to Confirm that complete list of spares for machine / equipment and accessories, along with specification / type / model and name & address of the spare supplier shall be supplied along with documentation to be supplied with the machine / equipment.				
15.0	DOCUMENTATION :- Five sets of following documents(Hard Copies) in English language should be Supplied along with the machine /equipment.	Vendor to confirm			
15.1	Operating manuals of equipment with general arrangements drawings.				

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15.2	Detailed Maintenance manual of equipment with all drawings of equipment assemblies / Sub - assemblies / parts including Electrical / Electronic circuit diagrams / PCB details/ schematic and wiring diagrams. All Assembly / Sub Assembly Drawing Shall be supplied with the part list also.				
15.3	Catalogues, Operation & Maintenance Manuals of all bought out items including drawings, wherever applicable.				
15.4	Complete Master list of parts used in the equipment shall be submitted by the vendor.				
16.0	ERECTION & COMMISSIONING	vendor to confirm			
16.1	Supplier to take full responsibility for carrying out the erection, start up, testing of equipment, it's control system & all type of other supplied equipment.				
16.2	Successful proving of BHEL components by the supplier shall be considered as part of commissioning. All tests, as mentioned at clause 19 (Equipment Acceptance) shall form part of the commissioning activity.				
16.3	Commissioning spares, required for commissioning of the equipment within stipulated time, shall be brought by the supplier on returnable basis.				
16.4	Schedule of Erection and Commissioning shall be submitted with the offer.				

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17.0	ACCURACY TESTS :				
17.1	Accuracy test required for the parameters mentioned in the specification shall be done and the machine /equipment supplied should be proved for the required parameters.				
18.0	AMBIENT CONDITIONS & THERMAL STABILITY :	Vendor to confirm			
18.1	Total equipment and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Power Supply : - Voltage : 230 ± 10 % VAC Frequency : 50 Hz ± 5 % No. of phases = 1 Ambient Conditions : Temperature = 50° Celsius Relative Humidity = 95 % max.				
18.2	Weather conditions are tropical. Atmosphere may be dust laden during some part of the year. Equipment shall be kept in the normal shop floor condition. Max. temperature variation is up to 25 deg Celsius in 24 hours.				

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18.3	Thermal stability of the complete equipment keeping in view specified Ambient Conditions and accuracy requirements of BHEL components and trouble free operation of the machine /equipments should be ensured by vendor.				
18.4	The equipment, including attachments and accessories, should be suitable for 24 hrs. Continuous operation to its full capacity for 24 hour a day and 7 days a week throughout.				
19.0	EQUIPMENT ACCEPTANCE : (Test / Activities to be Performed by Vendor)	Vendor to confirm			
19.1	The equipment should be tested and inspected completely before dispatch by BHEL Engineers at supplier's works and 5 copies of test and inspection certificates are to be furnished.				
19.2	Demonstration by actual use of all supplied attachments and accessories to their full capacity.				
19.3	Training of BHEL machine operators in operation of complete equipment & accessories etc. by the supplier.				
20.0	PACKING :				
20.1	Rigid packing for all items of complete equipment, all accessories and other supplied items to avoid any damage / loss in transit.				

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22.0	GUARANTEE :	Vendor to confirm			
22.1	The equipment should be guaranteed in respect of design. Material construction operation and against any manufacturing defects for a period of 24 months. from the date of supply or 18 months from the date of commissioning, whichever is later and 4 copies of guarantee certificates are to be furnished Free after sales service is to be provided during the guarantee period.				
22.2	GENERAL : The vendor should submit the following information				
22.3	Equipment Model				
22.4	Total Connected Load (KVA)				
22.5	Painting of Equipment / Electrical Panels : Ivory (Polyurethane Paint)				
22.6	Overall size and weight of the equipment				
22.7	List of standard accessories.				
22.8	Vendor to submit, along with offer, the reference list of customers where similar equipment has been supplied mentioning the customer, equipment model, major specifications of the supplied equipment control system detail, year of supply etc.				
22.9	Detailed catalogues, sketches/ photographs of the equipment and accessories should be submitted with the offer.				
30.0	QUALIFYING CONDITIONS :	Vendor to confirm			

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30.1	Only those vendors, who have supplied and commissioned atleast one Tan Delta Bridge for similar applications in the past Ten years and such is presently working satisfactorily for more than one year (more than six months if supplied to BHEL) after commissioning should quote.				
30.2	Hippotronics, Stacs, Superior electrical, Phonix Technology and equivalent make will be acceptable.				
30.3	The following information is to be submitted by the vendor about the companies where similar equipment has been supplied. This is required from all the vendors for qualification of their offer.				

