Heavy Power Equipment Plant, **Bharat Heavy Electricals Limited,** Ramachandrapuram -502032, Andhra Pradesh, INDIA.	Enquiry No. & Dt.:	
	Due Date :	
	Supplier's Ref.:	
	Date :	

Specification cum Compliance Certificate for DYNAMIC BALANCING MACHINE

Note:-

1. The 'Offered' Column and where applicable, the 'Deviations' & 'Remarks' Column of this format shall be filled in by the Vendor and submitted along with the offer. Inadequate / incomplete, ambiguous or unsustainable information against any of the clauses of the specifications / requirements shall be treated as non-compliance.

2. The offer and all documents enclosed with offer should be in English language only.

Name & Address of the supplier:	**Name & Address of the Indian Agent:**
Telephone No.	**Telephone No.**
Fax No.	**Fax No.**
e-mail :	**e-mail :**

Scope: Supply, Erection & Commissioning of DYNAMIC BALANCING MACHINE complying with specification as below.

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
1.0	**REFERENCE LIST / QUALIFYING CONDITIONS :**				
1.1	Only those vendors, who have supplied and commissioned at least one Balancing Machine of same capacity (as mentioned in 3.1.1 to 3.1.6) or higher capacity with **sleeve bearings** in the past ten years (On the date of opening of tender) and such machine is presently working satisfactorily for more than one year after commissioning (On the date of opening of tender) should quote. However,if such machine(s) has been supplied to BHEL, then such machine should be presently working satisfactorily for more than six months after its commissioning and acceptance (On the date of opening of tender) in BHEL. The following information should be submitted by the vendor about the companies where such machines have been supplied. This is required from all the vendors for qualification of their offer.	Vendor to confirm and give details.			
1.2	Name of the customer / company where such equipment is installed.	Vendor to provide details			
1.3	Complete postal address of the customer	Vendor to provide details			
1.4	Month and Year of commissioning	Vendor to provide details			

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1.5	Parameters of supplied Balancing Machines : 1. Type of machine 2. Maximum weight of the rotor 3. Maximum Load per bearing 4. Maximum speed 5. Sensitivity of the balancing machine (in gm-mm/Kg of rotor weight) 6. Type of Bearing (**Sleeve Bearing**)	Vendor to provide details			
1.6	Name and Designation of the contact of the customer	Vendor to provide details			
1.7	Phone, Fax no., and E-mail address of the contact person of the customer.	Vendor to provide details			
1.8	Performance certificate from the customers regarding satisfactory operation of the equipment.	Vendor to provide details			
1.9	BHEL Reserves the right to verify the information provided by the vendor. In case the information provided by the vendor is found to be false / in-correct, the offer shall be rejected.	Vendor to confirm			
2.0	**PURPOSE & WORK PIECE**				
2.1	Purpose: Two plane Dynamic Balancing of Gas Turbine Rotors				
2.2	Work Piece : 1. Unit Rotor of Frame-5 Gas Turbine 2. Unit Rotor of Frame-6B Gas Turbine 3. Unit Rotor of Frame-6FA Gas Turbines 4. Turbine and Compressor rotors of Frame-9E 5. Unit Rotor of Fr-9F Gas Turbines **(see clause 3.2 for details)**				
3.0	**DETAIL SPECIFICATION OF MACHINE :**				
3.1	**CAPACITY & SIZE :**				
3.1.1	Type of machine	Two plane hard bearing dynamic balancing machine.			
3.1.2	Maximum weight of rotor	90000 Kg			
3.1.3	Maximum Load per bearing	45000 Kg			
3.1.4	Maximum speed	please refer **clause 3.2.1.1 to 3.2.1.6** for balancing speed			
3.1.5	Sensitivity of the balancing machine	0.5 gm-mm/Kg of rotor weight or better			

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3.1.6	Type of Bearing	Sleeve bearing			
3.1.7	Maximum Diameter of rotor	3500 mm			
3.1.8	Maximum journal diameter	600 mm			
3.1.9	Maximum speed variation allowed	± 5 rpm			
3.1.10	Maximum start up time for Variable speed motor for any of the rotor listed in clauses 3.2.1.1 to 3.2.1.6	20 minutes			
3.1.11	Maximum distance from centerline of front bearing to rear bearing (Bearing span)	The balancing machine shall be able to accomodate all rotors in 3.2.1.1 to 3.2.1.6			
3.1.12	Minimum unbalance readout	1 mg			
3.2	**ROTOR DETAILS**				
3.2.1.1	Frame-5 Unit Rotor : FWD Journal Diameter : 203.17 mm FWD Journal Length : 208 mm AFT Journal Diameter : 203.17 mm AFT Journal Length : 250 mm Bearing Span : 3963 mm Rotor Wt. : 11000 Kg **Balancing Speed : 500 rpm**	Rotor drawing number GT-FR5-UR enlosed (Annexure-I)			
3.2.1.2	Frame-6B Unit Rotor : FWD Journal Diameter : 203.20 mm FWD Journal Length : 203.20 mm AFT Journal Diameter : 241.30 mm AFT Journal Length : 241.30 mm Bearing Span : 4140.20 mm Rotor Wt. : 11000 Kg **Balancing Speed : 500 rpm**	Rotor drawing number GT-FR6B-UR enlosed (Annexure-I)			
3.2.1.3	Frame-6FA Unit Rotor : FWD Journal Diameter : 288.29 mm FWD Journal Length : 288.75 mm AFT Journal Diameter : 228.29 mm AFT Journal Length : 288.75 mm Rotor Wt. : 16000 Kg **Balancing Speed : 500 rpm**	Rotor drawing number GT-FR6FA-UR enlosed (Annexure-I)			

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3.2.1.4	Frame-9E Compressor Rotor : FWD Journal Diameter : 400.00 mm FWD Journal Length : 267.00 mm AFT Journal Diameter : 426.70 mm AFT Journal Length : 163.00 mm Bearing Span : 3482 mm Rotor Wt. : 28000 Kg **Balancing Speed : 310 rpm**	Rotor drawing number GT-FR9E-CR enlosed (Annexure-I) Maximum witdth of 250 mm of sleeve brg including support assy can only be accomodated in aft support.			
3.2.1.5	Frame-9E Turbine Rotor : FWD Journal Diameter : 467.56 mm FWD Journal Length : 398.52 mm AFT Journal Diameter : 396.21 mm AFT Journal Length : 267.72 mm Bearing Span : 4400 mm Rotor Wt. : 25000 Kg **Balancing Speed : 310 rpm**	Rotor drawing number GT-FR9E-TR enlosed (Annexure-I)			
3.2.1.6	Frame-9F Unit Rotor FWD Journal Dia : 551.36 mm FWD Journal Length : 375.52 mm AFT Journal Dia : 551.36 mm AFT Journal Length : 375.52 mm Bearing Span :8254 Rotor Wt. : 80000 Kg **Balancing Speed : 310 rpm**	Rotor drawing number GT-FR9F-UR enlosed (Annexure-I)			
3.3	**BALANCING PEDESTALS**				
3.3.1	Pedestals shall be with suitable arrangement for adjusting the support for different spans.	Vendor to confirm			
3.3.2	Pedestals shall have height adjustment system (if required) for different rotors so that it can accommodate journal dia up to 600mm and maximum rotor Diameter 3500 mm.	Vendor to confirm and give details.			
3.3.3	Bearings shall be **sleeve bearings** with top cover (for the rotors at serial number 3.2.1.1 to 3.2.1.6) to prevent oil spillage and including all necessary connectors for connecting with lube oil supply unit. Connectors shall be quick connect type.	Vendor to confirm.			

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3.3.4	Suitable numbers of hydrostatic bearing sleeves to cover the entire range of rotors (for the rotors at serial number 3.2.1.1 to 3.2.1.6) shall be supplied.	Vendor to confirm and submit itemized breakup prices for different sleeves			
3.3.5	Suitable alignment systems to be provided.	Vendor to confirm and give details.			
3.4	**BALANCING MACHINE DRIVE SYSTEM**				
3.4.1	Drive motor with Variable speed drive system	Vendor to confirm.			
3.4.2	Type of Drive Motor	Vendor to specify			
3.4.3	Type of Variable drive system	Vendor to specify			
3.4.5	Machine shall have bi-directional rotation and speed shall be suited as per balancing speed details in clause 3.2.1.1 to 3.2.1.6	Vendor to confirm and comply.			
3.5	**MEASURING HEAD FOR BALANCING MACHINE**				
3.5.1	Computerised unbalance measurment system shall be provided with following features:				
3.5.2	User selectable Unbalance display in Polar or Cartisian co-ordinate system.	Vendor to confirm.			
3.5.3	User selectable Unbalance display in two dynamic force mode or Static/Couple force mode	Vendor to confirm.			
3.5.4	User selectable Unbalance unbalance display in add/remove mode	Vendor to confirm.			
3.5.5	Feature for index balancing	Vendor to confirm.			
3.5.6	Storage and retrieval of rotor configration data in the measurement system database.	Vendor to confirm.			
3.5.7	Calibration features	Vendor to confirm.			
3.5.8	Suitable printer shall be part of measuring system	Vendor to confirm.			
3.6	**LUBE OIL MODULE**				
3.6.1	Suitable Lube oil module for supply of lubricant to sleeve bearings installed on the pedastals shall be supplied.	Vendor to confirm & furnish details			
3.6.2	Main Lube Oil Tank & Capacity	Vendor to confirm and furnish details.			
3.6.3	100% capacity motor driven oil pump	Vendor to confirm.			
3.6.4	Filters and valves if required	Vendor to confirm.			
3.6.5	Heat exchanger to cool lube oil (if required)	Vendor to confirm.			
3.6.6	Emergeny oil supply unit in case of Power failure/bearing lube oil pressure low. This should also include Interconnecting cables and piping/hoses between Emergeny oil supply unit to balancing machine/lube oil module.	Vendor to confirm.			
3.6.7	Flexible hose from module to bearing with quick connect coupling.	Vendor to confirm.			

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3.6.8	Necessary interlock in control shall be provided to safe guard the machine and rotor under balancing in case there is a failure in lube oil supply.	Vendor to confirm.			
3.6.9	Lift oil system with lift oil pump and filter with pressure transmitter and digital pressure indicator , filters etc. (if required).	Vendor to confirm.			
3.6.10	Detail drawing, schemes, all equipment data sheets and lube oil specification to be submitted with the offer	Vendor to comply.			
3.6.11	Supplier shall provide one fill of oil along with equipment.	Vendor to comply.			
3.7	**CONTROL PANEL**				
	The control system shall have following control features:				
3.7.1	Speed control potentiometer / speed set point raise lower push button for speed adjustment with digital speed indicator	Vendor to confirm.			
3.7.2	Direction of rotation switch for drive	Vendor to confirm.			
3.7.3	ON/OFF switch of machine	Vendor to confirm.			
3.7.4	Pumps ON/OFF switches with indicator.	Vendor to confirm.			
3.7.5	Drive motor Voltage and Current indicator	Vendor to confirm.			
3.7.6	Bearing Lube oil pressures, temperatures and digital flow readers, lift oil pressures (if supplied seperetly) etc.	Vendor to confirm.			
3.7.8	The measuring head shall be mounted in the control panel.	Vendor to confirm.			
3.7.9	Front panel shall be ergonomically designed and shall have suitable projection for keeping weighing machine, writing pads, keyboard, mouse etc.	Vendor to confirm.			
3.7.11	The panel shall comprise of rigid welded structural steel frames enclosed completely with specially selected smooth finished cold rolled sheet steel. Panel shall be metal enclosed dust and moisture proof, water tight suitable to IP 42 environment as per IEC 144	Vendor to confirm.			
3.7.12	Panel shall be of standard construction and have stainless steel plain hinges, chrome plate, die cast high quality handle locks etc. The door shall be at the back of the panel (rear entry). All the doors, removable covers etc shall be gasketed all around with neoprene gaskets	Vendor to confirm.			
3.7.13	Suitable Anti-vibration pads shall be provided.	Vendor to confirm.			
3.7.14	Panel shall have bottom entry for electrical cables. Suitable no. of cable glands (weather proof) shall be supplied by the vendor.	Vendor to confirm.			
3.8	**ELECTRICAL SYSTEM**				

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3.8.1	415V + 10% / -10%, 50 Hz +/-3 Hz, 3 Phase AC (3 wire system without Neutral) Power Supply will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor. All types of switches, cables, connections, circuit breakers etc. required for connecting BHEL's power supply point to different parts of the machine/control cabinets including lube oil module shall be supplied by the vendor. Vendor shall supply single phase preventor, under voltage preventor and over voltage preventor.	Vendor to confirm			
3.8.2	Tropicalisation: All electrical / electronic equipment shall be tropicalized.	Vendor to confirm			
3.8.3	All electrical & electronic control cabinets & panels should be dust and vermin proof.	Vendor to confirm			
3.8.4	All electrical components in the cabinets should be mounted on DIN Rail.	Vendor to confirm			
3.8.5	All electrical / electronic panels to be provided with adequate door locks. All electrical & electronic panels including operator's panel should have sufficient illumination and power receptacles/plug points of 220Volts, 5/15 Amp AC with on/off switch. All electrical adapters/receptacles, fittings, consumables etc. should be Indian or should have compatibility with Indian	Vendor to confirm			
3.8.6	All motors shall conform to IEC or Indian Standards	Vendor to confirm			
3.8.7	All cables moving with traversing axes should be installed in Caterpillar/ Drag chain . Additionally, all the cable trays required for laying of cables should be included in the offer.	Vendor to confirm			
3.8.8	Vendor should ensure the proper earthing for the machine and its peripherals/accessories. Any material requirement for the same should be informed with foundation design/drawings. The vendor can take earthing connection from the nearest column of the production shop.	Vendor to confirm			
3.8.9	All the equipment / cards / modules shall be identified with appropriate permanent name plates with equipment description and designation	Vendor to confirm			
3.8.10	All electrical cables shall be identified by cable makers on terminal boards and at the panel mounted equipment. All the control, power and signal cable shall separately run to protect from induced voltages.	Vendor to confirm			
3.8.11	There shall be separate conduit for power cable and control cables	Vendor to confirm			
4.0	**FOUNDATION:**				

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4.1	Detailed foundation design/drawings to be supplied by the vendor. BHEL will provide the foundation as per vendor design. The vendor shall supply 3 copies of equipment General Arrangement and foundation drawings within 3 months of placement of purchase order. Vendor shall also indicate detailed specifications of grouting compound & grouting procedure if any specifically desired.	Vendor to confirm			
5.0	**SAFETY ARRANGEMENTS**				
	Following safety features in addition to other standard safety features should be provided on the equipment:				
5.1	All the rotating parts used on equipment should be statically & dynamically balanced to avoid undue vibrations & noise.	Vendor to confirm			
5.2	Emergency Switches at suitable locations should be provided.	Vendor to confirm			
5.3	Automatic over load protection	Vendor to confirm			
5.4	Adequate protection for all moving and rotating parts to be ensured.	Vendor to confirm			
6.0	**ENVIRONMENTAL PERFORMANCE OF THE MACHINE**				
	The machine should confirm to following factors related to environment:				
6.1	Maximum noise level shall be 85 dB (A) at 1 meter away from the complete drive system with correction factor for back ground noise, if necessary. This will be measured as per international standards like DIN 45635-16. Supplier to demonstrate compliance to noise level, if asked for.	Vendor to confirm			
6.2	There shall not be any emissions from the equipment.	Vendor to confirm			
6.3	No hazardous chemicals shall be used in the equipment.	Vendor to confirm			
6.4	If any safety /environmental protection enclosure is required it should be built in the equipment by the vendor.	Vendor to confirm			
6.5	Paint of the equipment should be oil/ coolant resistant and should not get peeled off and mixed up with coolant.	Vendor to confirm			
7.0	**SPARES & ACCESSORIES**				
7.1	The supplier shall supply following items as spares, with itemised price breakup: 1. Speed pickup - 1 number 2. Force pickup - 2 numbers 3. Belts - 2 sets (if required) 4. Filter cartridges - 1 set (if filter is provided in Lube Oil Module) 5. One set of power supply card of measuring system.	Vendor to confirm and provide itemised cost			
7.2	Angle locating device.	Vendor to confirm and provide detail			

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7.3	Suitable Carden Shafts shall be provided by vendor .	Vendor to confirm and provide itemised cost			
8.0	**DOCUMENTATION:**				
8.1	**ALONG WITH THE OFFER**				
8.1.1	Technical description of complete system with detailed write ups/sketches/figures wherever necessary.	Vendor to confirm			
8.1.1	All catalogues of different sub-systems wherever applicable.	Vendor to confirm			
8.2	**AFTER AWARD OF PURCHASE ORDER**				
8.2.1	Final GA drgs, data sheets, schematics, circuit diagrams, electrical system write-up, bill of materials (BOM) indicating all loose items, component detail drgs, catalogues etc. . Cable schedules, Interconnection diagrams, termination details shall also be submitted within 3 months of placement of	Vendor to confirm			
8.2.2	2-sets of Operation & Maintenance Manuals in hard copy and one set in soft copy shall be supplied by supplier along with equipment. The manuals shall be in English language and shall contains all revised drgs, sub-vendors catalogues, O&M instructions, DO's & Don'ts, warnings & the spares information duly identified.	Vendor to confirm			
9.0	**MACHINE ACCEPTANCE:**				
9.1	**AT VENDORS' WORKS BEFORE DISPATCH OF EQPT**				
9.1.1	Vendor shall submit detailed test procedure before 60 days from date of despatch for BHEL approval .The testing at suppliers works shall be witnessed by BHEL representative. Vendor to give intimation one month in advance. The inspection/testing at vendor works shall consists of the				
9.1.1.1	Demostration of all features of equipment including controls	Vendor to confirm			
9.1.1.2	Review of Test reports of all sub systems	Vendor to confirm.			
9.1.1.3	Following tests shall be conducted (as per ISO-2953) on the machine at suppliers works with test rotor :	Vendor to confirm.			
9.1.1.3.1	Umar Test to confirm the sensitivity of machine is 0.5 gm-mm/Kg wt. of rotor or better.	Vendor to confirm.			
9.1.1.3.2	URR Test (95% accuracy in URR test or better)	Vendor to specify and confirm			
9.1.1.3.3	Compensator test.	Vendor to confirm.			
9.1.2	The above tests under clause 9.1.1.3 shall be done under normal machine setup. The extreme values of unbalance readout out shall be taken for accuracy measurement. Machine shall confirm to specified accuracy level.	Vendor to confirm.			

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9.2	**AT BHEL WORKS AFTER ERECTION & COMMISSIONING**				
9.2.1	Training of BHEL personals on complete system and accessories by supplier experts during their stay at BHEL				
9.2.2	After completion of commissioning activities at BHEL works, Machine shall undergo test with job rotor as per ISO2953 (mentioned in 9.1.1.3).	Vendor to confirm.			
10.0	**ERECTION & COMMISSIONING**				
10.1	Supplier to take full responsibility for carrying out the erection, start-up, testing of the system, its control & all types of other supplied equipment / accessories etc. Service requirement like Power & water shall be provided by BHEL at only one point to be indicated by supplier in their foundation / layout drawings. Other requirements like crane shall also be provided by BHEL	Vendor to confirm			
10.2	Broad Schedule of Erection and Commissioning shall be submitted with the offer.	Vendor to comply.			
10.3	Charges, duration, terms & conditions for Erection & Commissioning should be furnished in detail separately by vendor along with offer.	Vendor to confirm and quote separately			

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10.4	Portion, if any, of the equipment, accessories and other supplied items where paint got rubbed or peeled off during transit or erection should be repainted and matched with the original adjoining paint by the vendor before final acceptance.	Vendor to confirm			
11.0	**PACKING**				
11.1	Sea worthy & rigid packing shall be provided for system, control and all other supplied items to avoid any damage/loss in transit. All small loose items should be suitably packed in boxes.	Vendor to offer & confirm			
12.0	**GENERAL :**				
12.1	Total connected load (KVA):	Vendor to specify			
12.2	Floor area required (Length, Width, Height) for complete system & accessories.	Vendor to specify			
12.3	Painting of Complete system / Electrical Panels : Colour as per vendor standard	Vendor to confirm			
12.4	Total weight of the system	Vendor to specify			
12.5	Weight of heaviest part of equipment	Vendor to specify			
12.6	Weight of the heaviest assembly/ subassembly of the equipment	Vendor to specify			
12.7	Dimensions of largest part/ subassembly/ assembly of the equipment	Vendor to specify			
12.8	Detailed catalogues , sketch/ photographs of the system & its accessories/ attachments should be submitted with the offer.	Vendor to specify			
12.9	Hydraulic, Pneumatic & oil pipings should be preferably metallic except places where flexible pipings are essential.All the pipes required for the same shall be included in the standard scope of the equipment.	Vendor to specify			