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<b><u>SPECIFICATION FOR</u></b>				
<b><u>CNC VERTICAL JIG-BORING MACHINE</u></b>				
<b>SCOPE: SUPPLY, ERECTION &amp; COMMISSIONING OF CNC VERTICAL JIG-BORING MACHINE AS SPECIFIED BELOW</b>				
<b>SNO</b>	<b>DESCRIPTION FOR BHEL REQUIREMENT</b>	<b>CONFIRMED BY</b>	<b>REMARKS</b>	
<b>1.0</b>	<b>PURPOSE &amp; WORKPIECE MATERIAL</b>			
1.1	Purpose: (Operation/Jobs involved)	<i>Annexure 01</i>		
1.2	Work Piece Material: (Material detail, Hardness etc.)	<i>Annexure 02</i>		
<b>2.0</b>	<b>MACHINE SPECIFICATION</b>			
<b>2.1</b>	<b>MACHINE CONFIGURATION</b>	<i>Annexure 03</i>		
2.1.1	Spindle Orientation	<i>Vertical</i>		

<b>2.2 TABLE :</b>			
2.2.1	Minimum Size of Clamping Surface (LxB)- 1700mm x 1200mm	Vendor to specify	
2.2.2	Table size- To suit the above clamping surface	Vendor to specify	
2.2.3	Maximum Job height: Minimum 1050 mm	Vendor to specify	
2.2.4	Max. Weight of Work-piece : 2500 kg or more	Vendor to specify	
2.2.5	Width of T-slot 18mm to 24 mm & Pitch of T-slot 80mm to 125mm	Vendor to specify	
2.2.6	No. of T slots	Vendor to specify	
2.2.7	Minimum Space between uprights: 1600 mm	Vendor to specify	
<b>2.3 SPINDLE:</b>			
2.3.1	Spindle Diameter	Vendor to specify	
2.3.2	Spindle Motor Power : Minimum 17 KW (AC	Vendor to specify	
2.3.3	AC Spindle Motor with AC drive : Siemens /Fanuc make , Model -	Vendor to specify	
2.3.4	Spindle Bearing Diameters (Radial & Axial)	Vendor to specify	
2.3.5	Taper in Spindle : ISO 50 / SK50	Vendor to specify	
2.3.6	Spindle speed (Infinitely variable): 10-6000 rpm	Vendor to specify	
2.3.7	Detail of speed ranges (Selectable through program)	Vendor to specify	
2.3.8	Range of spindle speed at constant power.	Vendor to specify	
2.3.9	Max Spindle Torque	Vendor to specify	
2.3.10	RPM at which max. permissible torque is available	Vendor to specify	
2.3.11	Torque/Power/Speed diagram of spindle motor is to be submitted with the offer.	Vendor to specify	
2.3.12	Minimum distance from Spindle Face to Table Top : 100 mm	Vendor to specify	

	<b>2.4 TRAVERSES:</b>			
2.4.1	Minimum Longitudinal Travel (X-Axis) : 1600mm		Vendor to specify	
2.4.2	Minimum Spindle Head Travel ( Y Axis) : 1100 mm		Vendor to specify	
2.4.3	Minimum vertical Travel (Z-Axis ) : 1000 mm		Vendor to specify	
	<b>2.5 FEEDS AND DRIVE SYSTEM:</b>			
	<b>The friction free guideway system of the X, Y &amp; Z axes. The axis drive systems should be backlash free</b>			
2.5.1	Minimum Rapid Traverse X-Axis & Y - axis: minimum 10000 mm/min		Vendor to confirm	
2.5.2	Minimum Rapid Traverse Z-Axis : minimum 6000 mm/min		Vendor to confirm	
2.5.3	Minimum range of Feed Rate in X, Y & Z Axes : 0.1-6000 mm/min (Infinitely variable)		Vendor to confirm	
2.5.4	minimum range of machining feed of Z -axis for boring operations: 0.01mm -1mm/rev		Vendor to confirm	
2.5.5	Feed drives/motors [AC digital servo motors] Either Siemens or Fanuc make - digital type (detail of model, make, type etc. to be submitted)		Vendor to specify	
2.5.6	Feed back system for X, Y & Z axes through Heidenhain linear scale (Details to be submitted)		Vendor to confirm	
2.5.7	Details of System to ensure zero backlash for the axes		Vendor to furnish	
2.5.8	Mechanism for locking / clamping the axes		Vendor to furnish	
2.5.9	Clamping force of each axes to be furnished		Vendor to specify	

2.5.10	Detail of axes feed mechanism (Details should include Ball Screw diameter, pitch & Accuracy of each axis if it is a ball-screw arrangement)	Vendor to furnish	
2.5.11	Traversing axis of table shall be provided with Steel Telescopic covers of rust resistant material with wipers. All other Traversing axes shall be provided with suitable Telescopic covers with wipers Joints of telescopic covers should be so sealed to avoid mixing of coolant and other lubricating oil.	Vendor to confirm	
<b>2.6 CONSTRUCTION:</b>			
2.6.1	Vendor to furnish material, hardness of guideways & constructional details, including explanatory drawings, of various components/ assemblies like Gear Box, Guideways/ slides, ball screw assemblies, Telescopic covers, Accessories, Table, feed transmission system, hydraulic and lubrication system, feed back system etc. of the machine.	Vendor to furnish	
2.6.2	Machine guideways, slides etc. should not get rusted while in contact with water-based coolant	Vendor to confirm	
2.6.3	Video images on CD including hard copy explaining the technical features / Literature with photographs, drawings explaining the technical features should be enclosed with the offer	Vendor to furnish	

<b>2.7</b>	<b>OPERATION AND CONTROL SYSTEM:</b>			
<b>2.7.1</b>	<b>OPERATOR'S PANEL:</b>			
2.7.1.1	Fixed / Swiveling type operator's panel having complete CNC and machine control system with minimum 10.4" Color TFT/LCD of required configuration shall be provided on the operators platform. All switches with suitable interlock with table rotation should be within reach of operator of average height (Indian) for easy & safe operation. All displays/indications should also be conveniently placed accordingly. <i>Machine Operator Panel with hard switches for selection of Mode, push buttons with LED indicator lamps, Axes, Feed/Spindle over-ride, Direction to be provided. Layout showing complete details should be submitted.</i>		Vendor to furnish	
<b>2.7.2</b>	<b>CNC SYSTEM &amp; FEATURES :</b>			
2.7.2.1	Make	: Fanuc / Siemens.	<b>Vendor to specify</b>	
2.7.2.2	Type	: <i>Digital</i> based latest version	Vendor to specify	
2.7.2.3	Latest SIEMENS/FANUC CNC System		Vendor to specify	
2.7.2.4	Details of Standard features including features required for optimum utilisation of all the facilities being procured along with this machine		Vendor to specify	

2.7.2.5	Details of optional features, recommended by vendor . Price to be quoted seperately.	Vendor to specify	
2.7.2.6	Details of other optional features which are to be selected by indenter. Price to be quoted seperately.	Vendor to specify	
2.7.2.7	Co-ordinate system selection of cartesian ( mm ) and Polar ( degree )	Vendor to confirm	
2.7.2.8	Programmable resolution 0.001mm for linear movement and 0.0001degree for rotary movement	Vendor to confirm	
2.7.2.9	Length and radius compensation for 150 tools	Vendor to confirm	
2.7.2.10	Simultaneous machining and program editing	Vendor to confirm	
2.7.2.11	Mirror programming	Vendor to confirm	
2.7.2.12	The system should have full alphanumeric keyboard, TFT colour display(10.4" or more), additional draw-out type Query Key Board and mouse in suitable enclosure, RS232C serial interfaces, parallel interface for printer, network ready with LAN, electronic hand wheels for all axes,IF PC based Hard disk of sufficient capacity minimum 320 GB ( <b>Largest size available at the time of order shall be supplied</b> ) & <b>USB port</b> . Static graphic simulation and preinstalled system software & other required softwares etc.(Details should be submitted by Vendor)	Vendor to specify	
2.7.2.13	Provision for automatic shut down of CNC Control in case of Power Failure	Vendor to specify	
2.7.2.14	Part program memory: minimum 1 GB	Vendor to confirm	

<b>2.7.3</b>	<b>AUTOMATIC SETTING OF PART REFERENCE POSITION for automatic reference setting of job on all the axes for straight &amp; circular form</b>			Vendor to confirm
2.7.3.1	Renishaw Measuring probe type ( Model to be specified )			Vendor to specify
2.7.3.2	Stylus length & ball Dia.			Vendor to specify
2.7.3.3	Details of Standard features			Vendor to specify
2.7.3.4	Details of optional features, recommended by vendor. Price to be quoted seperately.			Vendor to specify
2.7.3.5	Details of other optional features which are to be selected by indentor. Price to be quoted seperately.			Vendor to specify
<b>2.7.4</b>	<b>AUTOMATIC PART MEASURING SYSTEM for measurement of features like diameter, parallel distance, angular pitch, positional co-ordinates with respect to both m/c reference &amp; part reference positions</b>			Vendor to confirm
2.7.4.1	Renishaw measuring probe type - ( Model to be specified )			Vendor to specify
2.7.4.2	Stylus length & ball Dia.			Vendor to specify
2.7.4.3	Calibration accessories			Vendor to specify
2.7.4.4	Details of Standard features			Vendor to specify
2.7.4.5	Details of optional features, recommended by vendor. Price to be quoted seperately.			Vendor to specify

2.7.4.6	Details of other optional features which are to be selected by indentor. Price to be quoted seperately.		Vendor to specify	
	<b>2.7.5 PRINTER</b>			
2.7.5.1	Hard copy LASER printing of CRT measuring information on minimum A4 size paper		Vendor to specify	
2.7.5.2	Interface to the machine CNC system as per RS-232C		Vendor to specify	
2.7.5.3	Facility for installation of the printer and storage of the measuring system accessories		Vendor to confirm	
	<b>2.7.6 BLUM MAKE LASER TOOL DIMENSION CONTROL SYSTEM for tool setting &amp; breakage detection for tool diameter &gt; 4mm</b>		Vendor to confirm	
2.7.6.1	Details of Standard features		Vendor to specify	
2.7.6.2	Details of optional features, recommended by vendor. Price to be quoted seperately.		Vendor to specify	
2.7.6.3	Details of other optional features which are to be selected by indentor. Price to be quoted seperately.		Vendor to specify	
2.7.6.4	Suitable for Probing bar, Boring bar, Milling cutters, Reamers, Twist drills & center drills		Vendor to confirm	
2.7.6.5	Should control the tool dimensions in its dynamic ( rotation ) and in its static operating mode		Vendor to confirm	



<b>2.7.7</b>	<b>CAD/CAM PROGRAMMING SOFTWARE: ( optional ) ( To be quoted seperately )</b>		
2.7.7.1	<b>Dedicated m/c specific CAD / CAM Programming software to be provided with suitable postprocessor for the machine by the vendor for easy preparation of machining programme</b>	Vendor to specify	
2.7.7.2	Details of Standard features including features required for optimum utilisation of all the facilities being procured along with this machine	Vendor to specify	
2.7.7.3	Imported geometry can be used for programming	Vendor to confirm	
2.7.7.4	Should be compatible with Latest version of Autocad and Unigraphics software	Vendor to confirm	
2.7.7.5	Machining simulations 2D & 3D views	Vendor to confirm	
2.7.7.6	Suitable DNC package for programme transfer	Vendor to confirm	
2.7.7.7	Hardware configuration details for the CAD/CAM programming software	Vendor to confirm	
2.7.7.7	CAD/CAM training ( for 2 weeks ) to be provided	Vendor to confirm	
2.7.7.8	Details of optional features, recommended by vendor. Price to be quoted seperately.	Vendor to specify	
2.7.7.9	Details of other optional features which are to be selected by indentor. Price to be quoted seperately.	Vendor to specify	

<b>2.7.8</b>	<b>MANUAL CONTROL:</b>		
2.7.8.1	Complete manual control of machine with required switches/ keys ( LED indication ) should be provided on operator's panel for selection of required axis, axis direction, cutting feed, table/ spindle speed, cutting feed on/off, display of axis position values etc. for manual operation without using CNC program, CNC option Manual Turn or MDI mode. Diagrams/ sketches witches for switches/ keys provided on operator's pendent should be submitted.	Vendor to confirm	
<b>2.7.9</b>	<b>HAND HELD UNIT:</b>		
2.7.9.1	Hand Held unit with display of Siemens/fanuc make or equivalent alongwith sufficient length of interfacing cable is to be offered with complete details.	Vendor to confirm	
<b>2.7.10</b>	<b>UPS FOR CNC SYSTEM:</b>		
2.7.9.1	IN CASE PC BASED CNC SYSTEM UPS of 30 minutes for CNC system with inbuilt cooling and charge status display (Battery charging /discharging time should be specified by vendor)	Vendor to confirm	

<b>2.8</b>	<b>AUTOMATIC TOOL CHANGER:</b>			
2.8.1	Type Chain Type / Drum Type		Vendor to specify	
2.8.2	Tool selection method-Random & Shortest Path		Vendor to specify	
2.8.3	Tool Taper: ISO 50/sk50		Vendor to specify	
2.8.4	Number of Tools in the Magazine Minimum 30		Vendor to confirm	
2.8.5	Maximum Diameter of Tool: (a) With all Pockets Full: 100 mm		Vendor to confirm	
	: (b) With adjacent Pockets Empty: 200mm		Vendor to confirm	
2.8.6	Max Length of Tool : 400 mm		Vendor to confirm	
2.8.7	Max Weight of Tool: 15 kg		Vendor to confirm	
2.8.8	Limitation regarding length & weight of tool / tool holder clamped in different tool holders for trouble free operation		Vendor to specify	
2.8.9	Tool Change Time (Tool-to-Tool): Maximum 5 sec		Vendor to confirm	
2.8.10	Tool Change Time (Chip-to-Chip): Maximum 12 sec		Vendor to confirm	
2.8.11	The machine shall have manual Tool loading / unloading through push button provided on machine / Auxilliary Hand pendant.		Vendor to confirm	
2.8.12	<i>The spindle taper will have the provision of cleaning by compressed air blow during ATC cycle . The spindle taper will also have the provision of compressed air blow through push button provided on machine for manual tool change.</i>		Vendor to confirm	
2.8.13	Auxiliary Control, with suitable interlocks, for manual insertion / withdrawal of tool from the spindle shall be provided.		Vendor to confirm	

2.8.14	<i>Manual key based pendant, should be provided to extract a tool trapped anywhere in the ATC cycle.</i>	Vendor to confirm	
2.8.15	The Machine operation should be possible with or without referencing ATC.	Vendor to confirm	
2.8.16	One set of tool holder retention stud equal to Tool magazine capacity shall be provided as standard item with the machine.	Vendor to confirm	
2.8.17	Working of Tool Changer Arm should be explained in details. Full ATC catalogue should be submitted with the offer.	Vendor to furnish	
2.8.18	Electric & Hydraulic liaison in corresponding overhead duct system of the machine	Vendor to confirm	
2.8.19	Material of ATC should be such that taper shank seats do not get rusted where tools are in contact with water based coolant	Vendor to confirm	
	<b>2.9 REMOVABLE HORIZONTAL INDEXABLE CNC ROTARY TABLE</b>		
2.9.1	The machine shall be provided with a removable programmable horizontal rotary table with suitable connectors for power supply from the main m/c. It should be easy to plug in.	Vendor to confirm	
2.9.2	Siemens/Fanuc AC servo motor drive	Vendor to confirm	
2.9.3	Table diameter: 1000 mm or larger	Vendor to confirm	
2.9.4	Height of table: 300 mm or less	Vendor to specify	
2.9.5	Permissible load: 2000 kg or more	Vendor to confirm	

2.9.6	Positional accuracy: within 0.001 degree	Vendor to confirm	
2.9.7	Programme resolution of the separate axis and position feedback display on the screen of the control panel: 0.0001 degree	Vendor to confirm	
2.9.8	Minimum range of rotation speed of the axis: 0 - 4 rpm	Vendor to confirm	
2.9.9	Minimum range of Feed rate of the axis: 0.1 to 1000 degrees / min	Vendor to confirm	
2.9.10	JOG, MDI & Programming of the axis rotation	Vendor to confirm	
2.9.11	Hydraulic equipment pressure	Vendor to specify	
2.9.12	Electric & Hydraulic liaison in corresponding overhead duct system of the machine	Vendor to confirm	
2.9.13	Sealing of rotary table should be perfect to avoid any coolant to enter inside gears & bearings of rotary table	Vendor to confirm	
2.10	<b>HYDRAULIC SYSTEM and CENTRALISED LUBRICATION SYSTEM: Details should be submitted by the vendor.</b>		
2.10.1	System should be centralised. Hydraulic Tank shall preferably be located at floor level	Vendor to confirm	
2.10.2	<b>Hydraulic system:</b> Make HAWE/Rexroth / Vickers Sperry or equivalent from a reputed manufacturer. <b>lubrication system:</b> Reputed make. (Details to be submitted)	Vendor to specify	

2.10.3	Filtration system		Vendor to specify	
2.10.4	Failure indication		Vendor to specify	
2.10.5	Automatic shut off provision (Details to be submitted)		Vendor to confirm	
2.10.6	Refrigerated type cooling system of sufficient capacity to maintain complete Hydraulic System, including lubrication oil, hydrostatic oil and gearbox oil, etc. at a temperature not exceeding 40 deg C irrespective of the ambient conditions. Complete details should be submitted		Vendor to confirm	
2.10.7	Hydraulic pump capacity (flow / pressure)		Vendor to specify	
2.10.8	Each pump should have an independent motor. Tandem pumps should not be used		Vendor to confirm	
2.10.9	<u>First filling of all required oil &amp; grease etc.</u> should be supplied by vendor. Indigenous (Indian) source, or Indian Equivalent, and specifications of oils/ greases also should be provided by the vendor.		Vendor to confirm	
<b>2.11</b>	<b>MACHINE LIGHTS:</b>			
2.11.1	Machine Lights for sufficient illumination of complete working area should be provided for clear visibility.		Vendor to confirm	
2.11.2	A magnetic base portable spot light with sufficiently long cable should also be provided.		Vendor to confirm	
2.11.3	All light fittings, consumables, adapters/receptacles should have compatibility with Indian equivalents		Vendor to confirm	

2.11.4	Flashing / rotary type End of Cutting and Program Stop Light.	Vendor to confirm	
	<b>COOLANT SYSTEM :</b>		
<b>2.12</b>			
2.12.1	Programmable & manual coolant supply control	Vendor to confirm	
2.12.2	Coolant System with all accessories for "Recirculating Type Flood Coolant System through adjustable trajectory multiple nozzles around the spindle" shall be provided.	Vendor to confirm	
2.12.3	All attachments, tool holders, adapters etc. shall have the provision so that coolant is available directly at the tool-cutting tip.	Vendor to confirm	
2.12.4	Coolant collection and recirculation system should be through suitable steel pipes and trays and should be leakproof & perfect to avoid any spillage on shop floor, trenches for cables & foundation pit of the machine etc.	Vendor to confirm	
2.12.5	<b>Coolant Filtration System:</b> Recirculating type coolant system with Cartridge Type Filtration System and magnetic separator.	Vendor to confirm	
2.12.6	Coolant Flow Diagram showing filters, pumps, valves, tanks etc.to be submitted.	Vendor to furnish	
2.12.7	Pressure & rate of flow of coolant should be furnished in the offer. The Pressure should be sufficient for the coolant to reach the tool tip at full pressure.	Vendor to confirm	
2.12.8	Coolant Tank Capacity ( in litres )	Vendor to specify	

2.12.9	For finer control of Pressure and Coolant Flow Rate, after its activation through program or switches, Rotary/ potentiometer switches shall be provided on the Operator's Panel.	Vendor to confirm	
2.12.10	Coolant pump and motor details for all variants	Vendor to specify	
2.12.11	The coolant tank should be fitted with skimmer for regular cleaning of coolant from contamination with tramp oil.	Vendor to confirm	
2.12.12	The coolant system should be fitted with refrigeration equipment with manual temp. control and automatic temp. control within +/- 1 degree of the selected ambient temp..	Vendor to confirm	
<b>2.14</b>	<b>MACHINE PROTECTION</b>		
2.13.1	The lateral operated sliding shields of sheet metal & Plexiglass structure along with shield interlocking safety system should have sufficient opening both in the front and in the top for loading of a job upto 2000mm X 1600mm.	Vendor to confirm	
2.13.2	Details to be submitted by vendor	Vendor to confirm	



<b>2.14</b>	<b>ELECTRICAL:</b>		
2.14.1	<p>415V <math>\pm</math> 10%, 50HZ <math>\pm</math>3% HZ, 3 Phase AC (3 wire system <b>with out neutral</b>) Power Supply Voltage will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor. All types of cables, connections, circuit breakers etc. required for connecting BHEL's power supply point to different parts of the machine/control cabinets, shall be the responsibility of vendor. Requirement of grounding/earthing with required material details is to be informed by vendor well in advance so that same could be incorporated during construction of foundation.</p>	Vendor to confirm	
2.14.2	<b>Tropicalisation:</b> All electrical / electronic equipment shall be tropicalized	Vendor to confirm	
2.14.3	All electrical & electronic control cabinets & panels should be dust and rodent proof	Vendor to confirm	
2.14.4	All electrical components should be mounted on DIN Rail	Vendor to confirm	
2.14.5	All electrical and electronic panels including operator's panel should be provided with fluorescent lamps for sufficient illumination and power receptacles of 220Volts, 5/15 Amp AC. All adapters/receptacles should have compatibility with Indian equivalents.	Vendor to confirm	

2.14.6	Motors shall conform to IEC or Indian Standards	Vendor to confirm	
2.14.7	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	
2.14.8	Vendor should ensure the proper earthing for the machine and its peripherals.	Vendor to confirm	
2.14.9	In-cycle hour counter with reset facility.	Vendor to confirm	
<b>2.15 SAFETY ARRANGEMENTS:</b>			
Following safety features in addition to other standard safety features should be provided on the machine:			
1. Machine should have adequate and reliable safety interlocks / devices to avoid damage to the machine, workpiece and the operator due to the malfunctioning or mistakes. Machine functions should be continuously monitored and alarm / warning indications through lights/ alarm number with messages (on CNC display and panels) should be available.		Vendor to confirm	
2. A detailed list of all alarms / indications provided on machine should be submitted by the supplier.		Vendor to confirm	
3. All the pipes, cables etc. on the machine should be well supported and protected. These should not create any hindrance to machine operator's movement for effective use of machine.		Vendor to confirm	

	4. All the rotating parts used on machine should be statically & dynamically balanced to avoid undue vibrations.	Vendor to confirm	
	5. Emergency Switches at suitable locations as per International Norms are to be provided.	Vendor to confirm	
	6. Oil & coolant pipe lines should not run with electrical cable in the same tray / trench.	Vendor to confirm	
	<b>2.16 ENVIRONMENTAL PERFORMANCE OF THE MACHINE :</b>		
	The Machine shall conform to following factors related to environment :		
	(a) Maximum noise level shall be 85 dB(A) at normal load condition, 1 M away from the machine 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 so required.	Vendor to confirm	
	(b) There shall not be any emissions from the machine except fumes of cutting fluid during machining.	Vendor to confirm	
	(c) There should not be any effluent from the machine. In case there are any effluents from the machine, requisite effluent treatment plant or pollution control device should be built into the machine by the supplier.	Vendor to confirm	
	(d) No hazardous chemicals shall be required to be used in the machine.	Vendor to confirm	
	(e) If any safety / environmental protection enclosure is required it should be built in the machine by the vendor.	Vendor to confirm	
	(f) Paint of the machine should be oil / coolant resistant and should not peel off and mix up with coolant.	Vendor to confirm	

<b>3.0</b>	<b>OPTIONAL FEATURES</b>			
3.1	Details of optional features of the machine and accessories recommended by vendor- Price to be quoted seperately.		Vendor to specify	
3.2	Details of other optional features of the machine and accessories which are to be selected by indentor- Price to be quoted seperately.		Vendor to specify	
<b>4.0</b>	<b>ULTRA ISOLATION TRANSFORMER</b>			
4.1	Indian make Ultra Isolation Transformer suitable for complete machine, its drives, controls, PLC etc.		Vendor to confirm	
4.2	Make (To be specified by indentor as per the practice of units.)		M/s NEEL make	
4.3	Model & Rating		Vendor to specify	
4.4	Catalogue/ Electric drawing of the Ultra Isolation Transformer shall be		Vendor to furnish	

<b>5.0</b>	<b>PNEUMATIC SYSTEM:</b>		
<b>5.1</b>	<b>AIR COMPRESSOR: ( If required- in case air pressure is more than 5 bar )</b>		
5.1.1	Independent Air Compressor (of reputed Indian make viz. Elgi, Atlas Capco. Ingarsolrand ) with refrigerated type Dryer & Filter of suitable capacity for the total compressed air requirements of the machine & accessories and to suit required air quality should be supplied. The system should be so designed to have additional provision and required accessories so that BHEL compressed air supply having pressure (to be specified by indentor) could be used as and when required. The compressor unit should be suitable for continuous duty.	Vendor to confirm	
5.1.2	Make & Model of Air Compressor	Vendor to specify	
5.1.3	Make & Model of Refrigerated Air Dryer	Vendor to specify	
5.1.4	Capacity (Flow, Pressure & KW)	Vendor to specify	
<b>5.2</b>	<b>COMPRESSED AIR POINTS:</b>		
5.2.1	Compressed Air Point with manual ON/ OFF Valve and flexible pipe of suitable length for work piece cleaning.	Vendor to confirm	

<b>6.0</b>	<b>LEVELLING &amp; ANCHORING SYSTEM :</b>				
6.1	Complete anchoring system including foundation bolts,anchoring materials,fixators,leveling shoes etc should be supplied		Vendor to confirm		
<b>7.0</b>	<b>TOOLS FOR ERECTION,OPERATION &amp; MAINTENANCE</b>				
7.1	Special Tools and equipment required for erection and necessary tools like Torque Wrench,Spanners,Keys,grease guns etc, for operation and maintenance of the machine should be supplied. List of such tools should be submitted.		Vendor to confirm		
7.2	Test Mandrel for checking run-out/taper & alignment should be supplied,		Vendor to confirm		
<b>8.0</b>	<b>TOOLING AND ACCESSORIES :</b>				
<b>8.1</b>	<b>TOOLING:( Details of items along with qty. being offered to be specified against each clause in the offer</b>				
8.1.1	Axial dial indicator holder along with dial indicator ( div.-0.002 mm ) : Qty.- 1 no.		Vendor to confirm		
8.1.2	Locating dial indicator holder along with dial indicator ( div.-0.002 mm ). Range: Internal dia. : 10-180mm & external dia. 0-160mm: Qty.- 1 no.		Vendor to confirm		

8.1.3	Long Probing bar: Qty.- 1 no.		Vendor to confirm	
8.1.4	Complete set of tools including holders for drills having taper MT1 to MT5, drill chuck, boring tools, insert holders, adapters, reducers and any other items required for drilling / rough boring, champhering, fine boring of dia. from 5 mm to 200 mm. Quantity required is 5 no.s of adapters (varieties in suitable proportion), 2 no.s of each reducers and 1 no. of all other items.		Vendor to confirm	
8.1.5	Drills required to cover range from 5 upto 50 mm. ( Sizes in mm: 5.5, 7.5,9.5,11.5,15.5,19.5,25.5, 29.5,35.5, 40, 45, 50). Quantity required is 2 no.s of each variety		Vendor to confirm	
8.1.6	Carbide tipped cutters ( if required ) for boring to cover range: 6 mm to 200 mm dia. Quantity required is 2 no.s of each variety		Vendor to confirm	
8.1.7	Indexable inserts of ISO grade for roughing, champhering & fine boring. Quantity required is: 10 no.s of each variety ( for steel ) 02 no.s of each variety ( for Aluminium )		Vendor to confirm	
8.1.8	Complete range of extention for boring extra deep for dia. 25 mm to 200 mm. Quantity required is 1 no. of each variety ( <b>Optional: To be quoted seperately</b> )		Vendor to confirm	
8.1.9	Complete range of holders for end mill cutters ( Range 6mm to 34 mm dia.) , shell end mill cutters ( having bore dia. 16mm & 32 mm), face milling cutter ( having bore dia. 40mm). Quantity required is 1 no. of each variety		Vendor to confirm	
8.1.10	All items like spanner, torks, eleen keys etc. required for smooth working of the complete tooling range supplied. Quantity required is 2 no.s of each variety		Vendor to confirm	
8.1.11	All assembly items required for smooth working of the complete tooling range supplied. Quantity required is 1 no.s of each variety		Vendor to confirm	

8.1.12	Suitable tool cabinet / racks with sufficient capacity for proper keeping of the tools	Vendor to confirm	
8.1.13	Tools trolley	Vendor to confirm	
<b>8.2</b>	<b>ACCESSORIES</b>		
8.2.1	<b>Programmable auxiliary Horizontal Head with suitable spindle taper and required adaptation</b>	Vendor to confirm	
8.2.1.2	Details of Standard features	Vendor to specify	
8.2.1.3	Details of optional features, recommended by vendor. To be quoted seperately	Vendor to specify	
8.2.1.4	Details of other optional features which are to be selected by indentor. To be quoted seperately.	Vendor to specify	
8.2.2	<b>Ray Make GRINDING ATTACHMENTfor internal &amp; external grinding:</b>		
8.2.2.1	<i>The machine shall be provided with a jig grinding attachment capable to provide back taper upto +/- 1 degree</i>	Vendor to confirm	
8.2.2.2	<i>Spindle speed Range- 10000 - 40000 rpm</i>	Vendor to specify	
8.2.2.3	<i>Collets to suit the mounted CBN grinding wheels as mentioned below</i>	Vendor to specify	



8.2.2.4	Grinding Arbor		Vendor to specify	
8.2.2.5	Set of mounted CBN grinding wheels dia. 6, 8, 12, 16, 24 mm - no.s each	Qty. 2	Vendor to confirm	
8.2.2.6	Maximum bore grinding dia.- 250 mm or more		Vendor to specify	
8.2.2.7	Centering Devices		Vendor to specify	
8.2.2.8	Adjusting Gauges		Vendor to specify	
8.2.2.9	All necessary attachments & accessories required for proper functioning of the sytem and troublefree grinding of jobs.		Vendor to confirm	
8.2.2.9	All necessary instruction manuals and guarranty certificates		Vendor to confirm	
	<b>9.0 SPARES:</b>			
9.1	Itemised breakup of mechanical, hydraulic, electrical and electronic spares used on the machine in sufficient quantity as per recommendation of Vendor for 2 years of trouble free operation on three shifts continuous running basis should be offered by vendor. The list to include following, in addition to other recommended spares:		Vendor to furnish	
	<b>a) Mechanical &amp; Hydraulic Spares:</b> All types of Valves, Pressure Switches, Transducers, Flow Switches, Filters, Seals, O-rings, Hydraulic Hoses etc.		Vendor to furnish	

	<b>b) Electrical /Electronic / CNC Spares:</b> All types of Proximity Switches, Push Buttons, Indicating Lamps, Scanning Heads for Linear Scales, CNC system PCBs, Operator's panel with Display Unit, I/O Cards for PLC, single/ Dual axis control card of drives, single/dual axis power card for drives	Vendor to furnish	
9.2	All types of spares for total machine and accessories should be available for atleast ten years after supply of the machine. If machine or control is likely to become obsolete in this period, the vendor should inform BHEL sufficiently in advance and provide drawings of parts / details of spares & suppliers to enable BHEL to procure them in advance, if required	Vendor to furnish	
9.3	Recommended set of spares for all attachments are to be offered with details.	Vendor to furnish	
9.4	Vendor to confirm that complete list of spares for machine and accessories, along with specification / type / model, and name & address of the spare supplier shall be furnished along with documentation to be supplied with the machine	Vendor to furnish	

<b>10.0</b>	<b>DOCUMENTATION :</b>		Vendor to confirm	
10.1	Operating manuals of Machine & CNC system		Vendor to confirm	
10.2	Programming Manuals of Machine & CNC system		Vendor to confirm	
10.3	Detailed Maintenance manual of machine with all drawings of machine assemblies/sub-assemblies/parts including Electrical / Pneumatic/ Coolant / Hydraulic circuit diagrams. All Assembly/ Sub Assembly Drawings shall be supplied with the part list also		Vendor to confirm	
10.4	Maintenance, Interface & commissioning manuals for CNC system, spindle & feed drives.		Vendor to confirm	
10.5	Manufacturing drawings for all supplied tool holders, coolant connections, adapters, sleeves, fixtures etc.		Vendor to confirm	
	Detailed fabrication drawing of the machine enclosure		Vendor to confirm	
10.6	Catalogues, O&M Manuals of all bought out items including drawings, wherever applicable.		Vendor to confirm	
10.7	Detailed specification of all rubber items and hydraulic/lube fittings		Vendor to confirm	

10.8	Operating Manuals, Maintenance Manuals & Catalogues for Voltage Stabilizer, Isolation Transformer, Air-Compressor and all supplied Accessories.	Vendor to confirm	
10.9	Hard copy of PLC program print-outs with comments in English.	Vendor to confirm	
10.10	PLC program on CD, NC data & PLC data on CD	Vendor to confirm	
10.11	Complete back-up of hard disk in case pc based system on GHOST CD and clear written Instructions (3 copies) to take back-up and reloading of a new hard disk& a spare hard disk with complete backup to be supplied	Vendor to confirm	
10.12	Complete Master List of parts used in the machine shall be submitted by the vendor.	Vendor to confirm	
10.13	One additional set of all the above documentation on CD ROM, wherever possible.	Vendor to confirm	
<b>11.0</b>	<b>TRAINING</b>		
11.1	BHEL Persons should be trained at supplier's Works for approximately 2 to 3 weeks seperately in the areas of: (a) CNC Part Programming / Technology, Use of all CNC Features, Programming for Measuring Systems & supplied accessories etc. (b) Electrical & Electronic maintenance for machine & other supplied equipments. (c) CNC maintenance for machine & other supplied equipments (d) Mechanical & Hydraulic maintenance of the machine & other supplied equipments (e) Operation of the machine & other supplied equipments.	Vendor to confirm	

11.2	Air-fare, boarding & lodging for the trainees shall be borne by BHEL.		
11.3	Competent, English speaking experts shall be arranged by the vendor during training for satisfactory & effective training of BHEL personnel.	Vendor to confirm	
11.4	Vendor to quote for training on man / week basis	Vendor to confirm	
11.5	Vendor should commit to organize training of Electronics Engineer and Programmer at the CNC System Manufacturer's works for advanced features and specialised training if so required by BHEL	Vendor to confirm	
11.6	Vendor should commit to organize on the job training of to BHEL persons after commissioning of the machine at BHEL works for programming, operation & maintenance	Vendor to confirm	

<b>12.0 FOUNDATION :</b>			
12.1	<p>Vendor shall submit the preliminary layout drawing for getting BHEL's approval within one month from the date of Letter of Intent (LOI) / P.O. whichever is earlier. Soil condition data will be furnished by BHEL along with the approval. Complete Foundation Design including details of reinforcements, structures &amp; embedment etc. and Final Layout drawings shall be submitted by the supplier within three months after getting BHEL's approval. The layout should consist of all requirements pertaining to complete machine including space requirement for Voltage Stabilizer, Isolation Transformer, Air compressor, Chip Bin &amp; any other accessories. BHEL shall construct complete foundation for the machine. Vendor should arrange equipments required for the testing of foundation, if required by the vendor. The vendor shall also indicate detailed specifications of grouting compound and Grouting procedure etc. for foundation bolts of the machine.</p>	Vendor to confirm	

<b>13.0</b>	<b>ERECTION &amp; COMMISSIONING</b>			
13.1	Supplier to take full responsibility for carrying out the erection, start up, testing of machine, it's control & all types of other supplied equipment, machining of test pieces etc. Service requirement like power, air & water shall be provided by BHEL at only one point to be indicated by supplier in their foundation/layout drawings. Other requirements like crane and helping personnel shall also be provided by BHEL. Details of these requirements should be informed by vendor in advance.	Vendor to confirm		
13.2	Erection & Commissioning of Voltage stabilizer, Isolation Transformer & Air Compressor shall also be responsibility of the vendor.	Vendor to confirm		
13.3	All tests, as mentioned at <b>clause 16</b> (Machine Acceptance) shall form part of the commissioning activity.	Vendor to confirm		
13.4	Test mandrel for checking run-out/taper & alignment should be supplied	Vendor to confirm		
13.5	Tools, Tackels, Test Mandrels, instruments and other necessary equipment including Laser equipment required to carry out all above activities should be brought by the supplier. .	Vendor to confirm		

13.6	Commissioning spares, required for commissioning of the machine within stipulated time, shall be brought by the supplier on returnable basis.	Vendor to confirm	
13.7	All Cover Plates required for the machine and its peripherals including pits, if any, shall be supplied and installed by the vendor. The plates should be sourced from India	Vendor to confirm	
13.8	Portion, if any, of the machine, accessories and other supplied items where paint has rubbed off or peeled during transit or erection should be repainted and merged with the original surrounding paint by the vendor. For this purpose, the vendor should supply sufficient quantity of touch-up paint of various colours of paint used.	Vendor to confirm	
13.9	Schedule of Erection and Commissioning shall be submitted with the offer.	Vendor to confirm	
13.10	Charges, duration, terms & conditions for E&C should be furnished in detail separately by vendor along with offer.	Vendor to confirm	



<b>14.0</b>	<b>ACCURACY TESTS:</b>			
14.1	<b>GEOMETRICAL ACCURACIES :</b>			
14.1.1	Submit test chart for all accuracies as per DIN 8609/ ISO 10791/VDI3441 standard or equivalent applicable standard.	Vendor to furnish		
14.1.2	All the above accuracies should be demonstrated to BHEL engineers during pre-acceptance at supplier's works and during erection & commissioning at BHEL works.	Vendor to confirm		
<b>14.2</b>	<b>MACHINE POSITIONING ACCURACIES &amp; REPEATABILITY:</b> Should be measured as per VDI 3441 (Latest Revision) using LASER INTERFEROMETER.			
<b>14.2.1.0</b>	<b>Main machine ( Including operations by Jig-grinding attachment and Horizontal head attachment )</b>			
14.2.1.1	Positioning accuracy in X , Y & Z axis over entire travel- 0.006mm or better	Vendor to confirm		
14.2.1.2	Positioning accuracy in B axis ( angular movement of rotary table ) over	Vendor to confirm		
14.2.1.3	Backlash- 0.002 mm or better	Vendor to confirm		
14.2.1.4	Resolution of measuring system- 0.0001mm or better	Vendor to confirm		
14.2.1.5	Repeatability in X , Y & Z axis- 0.003 mm or better	Vendor to confirm		

14.2.1.7	Ovality of bore should be within :		
	Upto 100 mm hole dia - 0.005 mm or better	Vendor to confirm	
	Above 100mm hole dia - 0.01mm or better	Vendor to confirm	
14.2.1.8	Accuracy in precision surface milling:		
	Flatness on the entire surface of maximum size - 0.01 mm or better	Vendor to confirm	
	Parallelism on the entire thickness of maximum size- 0.01 mm or better	Vendor to confirm	
14.2.1.9	Squareness between all the three axes over a span of 500 mm- 0.01mm or better	Vendor to confirm	
14.2.1.10	Perpendicularity of spindle axis over a length of 300 mm- 0.005mm or better	Vendor to confirm	
14.2.1.11	Spindle Parallelism - 0.006mm or better	Vendor to confirm	
14.2.1.12	Spindle runout - 0.003mm or better :	Vendor to confirm	
<b>14.2.2.0</b>	<b>Rotary table</b>		
14.2.2.1	Runout of center hole- 0.003mm or better	Vendor to confirm	
14.2.2.2	Wobble of the table surface- 0.005mm or better	Vendor to confirm	
14.2.2.3	Flatness of the surface- 0.006mm or better	Vendor to confirm	

<b>15.0</b>	<b>AMBIENT CONDITIONS &amp; THERMAL STABILITY :</b>		
<b>15.1</b>	<p>Total machine including CNC system and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies.</p> <p>Power Supply:  Voltage: 415 V - 10%, + 10%  50 Hz +3%, - 3%  No. of phases = 3  Relative Humidity = 80% max.  (Vendor to confirm that machine is suitable for above and details of provisions on the machine for the same are to be furnished by Vendor)</p> <p>Frequency:</p>	Vendor to confirm	
15.2	<p>Weather conditions are tropical, Atmosphere may be dust laden during some part of the year. Machine shall be kept in the normal shop floor condition. Max. temperature variation is up to 2 deg Celsius in 24 hours.  (Vendor to confirm that machine is suitable for above and details of provisions on the machine for the same are to be furnished by Vendor)</p>	Vendor to confirm	
15.3	<p>Thermal Stability of the complete machine keeping in view specified Ambient Conditions and accuracy requirements of BHEL components and trouble free operation of the machine should be ensured by vendor.  (Confirm that machine is suitable for above and details of provisions on the machine for the same should be furnished)</p>	Vendor to confirm	

15.4	Ambient Temp. condition		Vendor to specify	
15.5	Relative humidity		Vendor to specify	
16.0	<b>MACHINE ACCEPTANCE: (Tests/Activities should be Performed by Vendor)</b>		Should be accepted & confirmed by Vendor	
16.1	<b>Tests/Activities should be carried out at supplier's works on the machine before dispatch :</b>			
16.1.1	Geometrical accuracies as per DIN 8609/ ISO 10791 test chart.		Vendor to confirm	
16.1.2	Positioning accuracies as per VDI-DGQ/3441		Vendor to confirm	
16.1.3	The machine should be tested for continuous running of 48 hrs. If any break down occurs during this test, the test should be repeated for 48 hrs from that time.		Vendor to confirm	

16.1.4	Demonstration of all features of the machine, control system & accessories	Vendor to confirm	
16.1.5	Machining of <b>test piece as per NAS/ISO</b> . Vendor to supply test piece and tooling for it's machining	Vendor to confirm	
	<b>16.2 Tests/Activities should be carried out at BHEL works while commissioning the machine :</b>		
16.2.1	Geometrical accuracies as per DIN 8609/ ISO 10791 test chart.	Vendor to confirm	
16.2.2	Positioning accuracies as per VDI-DGQ/3441	Vendor to confirm	
16.2.3	Full load test to demonstrate the maximum power & cutting capacity of the machine.	Vendor to confirm	
16.2.4	The machine should be tested for continuous running of 48 hrs. If any break down occurs during this test, the test should be repeated for 48 hrs from that time.	Vendor to confirm	
16.2.5	Demonstration of all features of the machine, control system & accessories to the satisfaction of BHEL for efficient and effective use of the machine	Vendor to confirm	
16.2.6	Two weeks supervision of independent operation of machine by BHEL after Tests & demonstration mentioned at 16.2.3 to 16.2.5	Vendor to confirm	
16.2.7	Machining test piece as per NAS/ISO and the job mentioned in tender or similar to it. Vendor to arrange Test pieces and tooling for it's machining. Indentor will arrange for the test jobs.	Vendor to confirm	

16.2.8	Training of BHEL machine operators in operation of complete machine & accessories etc by the supplier's experts / engineers during their stay at BHEL works	Vendor to confirm	
16.2.9	Demonstration by actual use of all supplied attachments and accessories to their full capacity.	Vendor to confirm	
16.2.10	Machining of proveout component at BHEL. The required tooling shall be supplied by Vendor. Vendor to specify the time required to complete operations of all the jobs as mentioned in the annexure no. 1.	Vendor to furnish	
<b>17.0</b>	<b>PACKING:</b>		
<b>17.1</b>	Sea worthy & rigid packing for all items of complete machine, CNC System, all Accessories and other supplied items to avoid any damage/loss in transit. When machine is despatched in containers, all small loose items shall be suitably packed in boxes	Vendor to confirm	
<b>18.0</b>	<b>GUARANTEE :</b>		
18.1	24 months from the date of acceptance of the machine.	Vendor to confirm	
<b>19.0</b>	<b>GENERAL :</b>		
19.1	Machine Model	Vendor to specify	
19.2	Total connected load (KVA):	Vendor to specify	

19.3	Floor area required (Length, Width, Height) for complete machine & accessories	Vendor to specify	
19.4	Total weight of the machine	Vendor to specify	
19.5	Weight of heaviest part of machine	Vendor to specify	
19.6	Weight of the heaviest assembly / sub-assembly of the Machine	Vendor to specify	
19.7	Dimensions of largest part/ sub-assembly/ assembly of the machine	Vendor to specify	
19.8	Vendor to submit, along with offer, reference list of customers where similar machines have been supplied mentioning broad specifications of the supplied machine i.e. Model, table size, Spindle power, Load Capacity, Max job Envelope, CNC System etc	Vendor to furnish	
19.9	Detailed catalogues , sketch/ photographs of the m/c and accessories/ attachments should be submitted with the offer.	Vendor to furnish	
19.10	Hydraulic, Pneumatic & oil pipings should be preferably metallic except places where flexible pipings are essential.All pipes required for the same shall be included in the standard scope of the machine.	Vendor to specify	

<b>20.0</b>	<b>OTHER FEATURES:</b>			
20.1	Networking: Machine should have necessary hardware & software for interfacing with gigabit Ethernet local Area Network with 100MB/sec through UTP cables for NC programme & other related data transfer. This network to be connected to wide area network /Internet. The networking shall have following capabilities:		Vendor to specify	
	a) The machine shall appear as a node in the entire network. ( Network neighbourhood )			
	b) The program transfer shall be by simple copy & paste provided sharing			
	c) The programme transfer between CNC system and network should also be possible in CNC mode			
20.2	<b>MACHINE MONITORING SYSTEMS ( MMS ) SIGNALS</b>		Vendor to specify	
20.2.1	Following MMS signals would be made available on a specifically earmarked terminal strip. These MMS signals would be sourced from PLC output card separately			



	a) Control ON		Vendor to confirm	
	b) Cycle ON		Vendor to confirm	
	Spindle running		Vendor to confirm	
	Feed active ( any of the axes moving )		Vendor to confirm	
	M30 ( programme stop )		Vendor to confirm	
	<b>21.0 REFERENCE LIST / QUALIFYING CONDITIONS :</b>			
21.1	Only the machine mentioned as Jig-boring m/c in the standard catalogue of the vendor shall be considered.		Vendor to confirm	
21.2	Only those vendors, who have supplied and commissioned at least one CNC Vertical Jig Boring M/c with Axes movements ( X axis, Y axis & Z axis ) 1200 mm X 1000 mm X 800 mm or higher with positional accuracy within 0.01 mm in both X & Y axes for similar applications in the past ten years and such machine is presently working satisfactorily for more than one year (more than six months if supplied to BHEL) after commissioning should quote. The following information should be submitted by the vendor about the companies where similar machines have been supplied. This is required from all the vendors for qualification of their offer. If needed, the vendor should arrange for the visit of experts from indenter to verify the performance of the said machine. The expenditure shall be borne by the vendor if the machine is outside India.		Vendor to confirm	
	1. Name of customer/company where similar machine is installed.			
	2. Complete postal address of the customer.			
	3. Year of commissioning.			
	4. Application for which the machine is supplied			

	5. Name and designation of the contact person of the customer.			
	6. Phone, FAX no.& email address of contact person of customer.			
	7. Performance certificate from the customers regarding satisfactory performance of the above mentioned machine supplied to them			