

SCOPE: SUPPLY, ERECTION & COMMISSIONING OF MULTI AXES (5 Axes) CNC MACHINING CENTER AS SPECIFIED BELOW					
SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATION	REMARKS
1.0	PURPOSE & WORKPIECE MATERIAL				
1.1	Purpose: Machining of components of Model Hydro Turbine like Francis runner, Kaplan blades, Pelton Buckets etc. with typical jobs as shown in sketch no HLE /A4 - 673 , involving complex 3D surfaces, particularly, with high accuracy and High surface finish.				
1.2	Work Piece Material: Mild Steel DIN EN10025 GR S275JR, Stainless Steel AISI 304, AISI 405, Gun Metal DIN 1705 -1973, Brass DIN 1709-1981. Maximum Hardness upto 350BHN or slightly higher	Vendor to Confirm			
1.3	Material Removal Capacity: While roughing, the machine should be able to take a depth of cut of 5 mm at a feed rate of 300 mm/min with a face mill cutter of diameter 100mm at cutting speed of 150m/min & Carbide cutter.	Vendor to Confirm			
1.4	Surface finish : In finishing operation, the achievable surface quality on finished profiles surface should be 0.4µRa or better for Stainless Steel AISI 304.	Vendor to Confirm			
2.0	MACHINE SPECIFICATION :				
2.1	MACHINE CONFIGURATION: VERTICAL / HORIZONTAL configuration , 5 AXIS SIMULTANEOUS with either 2.1.1 or 2.1.2 which is capable of successfully machining of BHEL Test-pieces with required accuracy and finish.	Vendor to Specify			

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2.1.1	Tilting & Rotary axes in Table:				
2.1.2.1	Longitudinal & Cross Travel, X-axis & Y-axis : 800 mm or more	Vendor to Confirm			
2.1.2.3	Z-axis Travel (in the direction of spindle axis) : 500 mm or more	Vendor to Confirm			
2.1.2.4	Tilting axis (Table) swivel range(C axis) : Total swivel angle 120 deg or more (typically, + 15 deg to -105 deg or more)	Vendor to Confirm			
2.1.2.5	Rotary axis (Table) swivel range : ± 360 degrees (Endless) Fully Programmable	Vendor to Confirm			
	OR				
2.1.2	Tilting axis in Spindle and rotary axis in Table:				
2.1.3.1	Tilting axis in Spindle should be such that spindle orientation can be changed from Vertical to Horizontal direction (Fully programmable) .	Vendor to Confirm			
2.1.3.2	Longitudinal & Cross Travel (X-axis & Y-axis) : 800 mm or more	Vendor to Confirm			
2.1.2.3	Z-axis Travel (in the direction of spindle axis) : 500 mm or more	Vendor to Confirm			
2.1.3.5	Tilting axis (Spindle) swivel range : Total tilt angle 120 deg or more (typically, + 15 deg to -105 deg or more)	Vendor to Confirm			
2.1.3.6	Rotary axis (Table) swivel range : ± 360 degrees (Endless) Fully Programmable	Vendor to Confirm			

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2.2	TABLE :					
2.2.1	Type: Indexing / Fully Programmable	: As required by 2.1	Vendor to Confirm			
2.2.2	Size of Clamping Surface	: Dia. 800 mm or more	Vendor to Confirm			
2.2.3	Max Job Envelope (LxBxH)	: Dia.750 x 400 (H)	Vendor to Confirm			
2.2.4	Max. Weight of workpiece	: 600 kg	Vendor to Confirm			
2.2.5	Max Swing Diameter of Workpiece	: 750 mm	Vendor to Confirm			
2.2.6	Maximum Rotating Speed of Table		Vendor to Specify			
2.2.7	Minimum Rotating Speed of Table		Vendor to Specify			
2.2.8	Table Clamping Mechanism		Vendor to Specify			
2.2.9	Holding moment		Vendor to Specify			
2.2.10	Details of T-Slots: No / Size / Pitch		Vendor to Specify			
2.2.11	Tapped Holes: Size / Pitch		Vendor to Specify			
2.2.12	Max. load carrying capacity of the table.		Vendor to Specify			
2.2.13	Central Slot tolerance		Vendor to Specify			
2.2.14	Lateral Slot size and tolerance		Vendor to Specify			
2.2.15	Details of C-Axis / B-Axis Servomotor like torque, rating, type, make etc.		Vendor to Specify			
2.2.16	Software/program for calculating new work zero position for rotation of table at any angle with reference to any existing work zero.		Vendor to Specify			

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2.3	SPINDLE:				
2.3.1	Spindle Outer Diameter: 100mm to 200 mm	Vendor to Confirm			
2.3.2	Spindle Motor Power (AC Continuous Duty S1) : Min 10 kW	Vendor to Confirm			
2.3.3	Spindle Motor & Drive Make: FANUC α i or SIEMENS 1PH series spindle motor with matching spindle drive	Vendor to Specify			
2.3.4	Spindle Encoder: FANUC/SIEMENS/HEIDENHAIN rotary encoders for direct reading of actual spindle rpm	Vendor to Confirm			
2.3.5	Spindle Bearing Diameters (Front / Rear) : Type / class / accuracy	Vendor to Specify			
2.3.6	Taper in Spindle : HSK A 63 / ISO 40	Vendor to Confirm			
2.3.7	Spindle speed (Infinitely variable) rpm : 20 - 15000 rpm or more	Vendor to Confirm			
2.3.8	Detail of speed ranges (Selectable through program) :	Vendor to Specify			
2.3.9	Range of spindle speed at constant power.	Vendor to Specify			
2.3.10	Torque/Power/Speed diagram of spindle motor is to be submitted with the offer.	Vendor to Specify			
2.4	TRAVERSES: (Exclusive of ATC travel, ATC travel to be further included)				
2.4.1	Longitudinal Travel (X-Axis) : 800 mm or more	Vendor to Confirm			
2.4.2	Column Cross Travel (Y-Axis) : 800 mm or more	Vendor to Confirm			
2.4.3	Spindle Head Vertical Travel (Z Axis) : 500 mm or more	Vendor to Confirm			

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	2.5 FEEDS AND DRIVE SYSTEM:				
2.5.1	Rapid Traverse X-Axis : 5000 mm/min or more	Vendor to Confirm			
2.5.2	Rapid Traverse Y-Axis : 5000 mm/min or more	Vendor to Confirm			
2.5.3	Rapid Traverse Z-Axis : 3000 mm/min or more	Vendor to Confirm			
2.5.4	Feed Rate of X Axis (Infinitely variable): 1 mm/min to 1000 mm / min or more	Vendor to Confirm			
2.5.5	Feed Rate of Y-Axis (Infinitely variable): 1 mm/min to 1000 mm / min or more	Vendor to Confirm			
2.5.6	Feed Rate of Z-Axis (Infinitely variable): 1mm/min to 1000 mm / min or more	Vendor to Confirm			
2.5.7	Min. & Max Feed Rate of Tilting Axis	Vendor to Specify			
2.5.8	Min. & Max Feed Rate of Rotary Axis (Tool)	Vendor to Specify			
2.5.9	Min. & Max Feed Rate of (Table)	Vendor to Specify			
2.5.10	Feed motors & drives: FANUC αi or SIEMENS 1FT/1FK series servo motors with matching servo drives	Vendor to Specify			
2.5.11	Feed back system for X, Y & Z axes : Heidenhain linear scales (Details to be submitted)	Vendor to Confirm			
2.5.12	Feed back system for B-axes / C-Axis: FANUC/SIEMENS/Heidenhain Rotary Encoder (Details to be submitted)	Vendor to Confirm			
2.5.13	Details of System to ensure zero backlash for the axes	Vendor to Specify			
2.5.14	Mechanism for locking / clamping the axes	Vendor to Specify			
2.5.15	Clamping force of each axes to be furnished	Vendor to Specify			
2.5.16	Complete details of axes feed mechanism to be submitted with offer.	Vendor to Confirm			

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2.5.17	All linear traversing axes shall be provided with Steel Telescopic covers of rust resistant material with wipers. Joints of telescopic covers should be so sealed to avoid mixing of coolant and other lubricating oil.	Vendor to Confirm			
2.6	CONSTRUCTION:				
2.6.1	Vendor to furnish material, hardness of guideways & constructional details, including explanatory drawings, of various components/ assemblies like Gear Box, Guideways/ slides, Telescopic covers, Accessories, Table, feed transmission system, hydraulic and lubrication system, feed back system etc. of the machine.	Vendor to Specify			
2.6.2	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 Confirm			
2.6.3	Machined guide-ways should be hardened and ground and should remain rust free while in contact with coolant /atmospheric moisture .	Vendor to Confirm			
2.7	AUTOMATIC TOOL CHANGER:	Vendor to Specify			
2.7.1	Type (Chain type / Drum type)	Vendor to Specify			
2.7.2	Tool selection method : Random and Shortest path	Vendor to Confirm			
2.7.3	Tool Taper : HSK A 63	Vendor to Confirm			
2.7.4	Number of Tools in the Magazine : 15 or more	Vendor to Confirm			
2.7.5	Maximum Diameter of Tool (a) With all Pockets Full: 80 mm or more : (b) With adjacent Pockets Empty: 115 mm or more	Vendor to Confirm			
2.7.6	Max Length of Tool: 300 mm in ATC	Vendor to Confirm			
2.7.7	Max Weight of Tool: 6 kg in ATC	Vendor to Confirm			
2.7.8	Limitation regarding length & weight of tool / tool holder clamped in different tool holders for trouble free operation	Vendor to Specify			

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2.7.9	Tool Change Time (Tool-to-Tool)	Vendor to Specify			
2.7.10	In addition, the machine should have manual Tool loading / unloading through push button provided on machine / auxiliary pendant.	Vendor to Confirm			
2.7.11	The spindle taper and tool pocket at changer station 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.	Vendor to Confirm			
2.7.12	Auxiliary Control, with suitable interlocks, for manual insertion / withdrawal of tool from the tool magazine shall be provided.	Vendor to Confirm			
2.7.13	Suitable arrangement should be provided to extract a tool trapped anywhere in the ATC through ATC recovery cycle.	Vendor to Confirm			
2.7.14	The Machine operation should be possible with or without referencing ATC. ATC bypass switch should be provided.	Vendor to Confirm			
2.7.15	One set of tool holder retention stud equal to Tool magazine capacity shall be provided as standard item with the machine.	Vendor to Confirm			
2.7.16	Working of Tool Changer Arm should be explained in details. Full ATC catalogue should be submitted with the offer.	Vendor to Confirm			
2.7.17	Tool pockets of ATC, components of ATC should be rust free while in contact with water-base cutting oils / atmospheric moisture.	Vendor to Confirm			

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2.8	OPERATION AND CONTROL SYSTEM:				
2.8.1	OPERATOR'S PANEL:				
2.8.1.1	Swivelling and sliding type air conditioned operator's pendant of Rittal make (preferable) or equivalent. Internationally reputed make with complete CNC operator panel (OP) and machine control panel (MCP) of required configuration shall be provided on the operator's side for safe, convenient and efficient operation from both left and right sides of tool post. All switches should be within reach of operator of average height (170 cms) for easy operation. All displays/indications should also be conveniently placed accordingly. Layout showing complete details should be submitted along with the offer.	Vendor to Confirm			
2.8.2	CNC SYSTEM & FEATURES :				
2.8.2.1	Make: FANUC / SIEMENS	Vendor to Confirm			
2.8.2.2	The system should have full alphanumeric keyboard, TFT colour display (10.4" or larger), Machine Control Panel (MCP), RS232C serial interface, PCMCIA card / USB port for data input/output, network ready, graphic simulation and on-screen PLC Ladder display.	Vendor to Confirm			
2.8.2.3	Details of Standard features (List to be Submitted)	Vendor to Specify			
2.8.2.4	Details of optional features, recommended by vendor. (Including features required for Prove-Out Components)	Vendor to Specify			
2.8.2.5	Details of other optional features :				
	1. Axes Interpolation : Linear, Circular, Cylindrical, Helical, Spline	Vendor to Confirm			
	2. Part Program Memory: 256 MB or more	Vendor to Confirm			
	3. Technology Cycles : Geometry Calculation, standard Drilling, Tapping, . Milling cycles.	Vendor to Confirm			

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	4. Calibration and Measuring cycles.	Vendor to Confirm			
	5. Pitch Error compensation	Vendor to Confirm			
	6. Backless error compensation	Vendor to Confirm			
	7. Co-ordinate Transformation : Datum shift, rotation, mirror image, scaling factor, tilting the working plane.	Vendor to Confirm			
	8. 2-D & 3-D Tool radius compensation	Vendor to Confirm			
	9. Feed override switch 0-120%	Vendor to Confirm			
	10. Spindle speed override switch 50-120%	Vendor to Confirm			
	11. 3-D Graphical simulation of Part Program and Machining process.	Vendor to Confirm			
	12. Zero Offsets for all axes	Vendor to Confirm			
2.8.2.6	Provision for automatic safe shut down of CNC Control in case of Power Failure	Vendor to Confirm			
2.8.2.7	The Controller should have feature to accept USB Pen-Drives / PCMCIA Card for Part Program and Machine data transfer both ways.	Vendor to Confirm			
2.8.3	MANUAL CONTROL:				
2.8.3.1	Complete manual operation of machine should be possible through Machine Control Panel (MCP). The MCP should have Spindle & Feed override switches, +/- Jog keys for individual axis, Start/Stop keys for Cycle, Spindle & Feed and additional keys/switches for auxiliary functions. Diagram of complete operator pendant with full details of all the switches/keys should be submitted.	Vendor to Confirm			

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2.8.4	HAND HELD UNIT:				
2.8.4.1	Hand Held unit, alongwith sufficient length of interfacing cable is to be offered for handwheel (MPG) operation of individual axis in jog & increment mode and provision for spindle inch in c.w & c.c.w directions , cycle start / stop.	Vendor to Confirm			
2.8.5	UPS FOR CNC SYSTEM: (Only in case of PC based CNC systems)				
2.8.5.1	UPS of 10 minutes for CNC system with inbuilt cooling and charge status display is to be supplied only in case of PC based CNC systems. Preferable Make: Any make of International repute or APLAB /APC / EMERSON(LIEBERT)	Vendor to Confirm			
2.9	MACHINE LIGHTS:				
2.9.1	Machine Lights for sufficient illumination of complete working area on both sides of machine should be provided for clear visibility.	Vendor to Confirm			
2.9.2	A magnetic base portable spot light with sufficiently long cable should also be provided.	Vendor to Confirm			
2.9.3	Any light required in the foundation/pit area shall also be foreseen and supplied by the vendor.	Vendor to Confirm			
2.9.4	All light fittings, consumables, adapters/receptacles should have compatibility with Indian equivalents	Vendor to Confirm			
2.9.5	Flashing / rotary type End of Cutting and Program Stop Light should be provided.	Vendor to Confirm			
2.9.6	All lights should be protected from chips and coolant.	Vendor to Confirm			

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2.10	AIRCONDITIONERS:				
2.10.1	Air Conditioners with Dehumidifiers of suitable / sufficient capacity should be provided for all Electrical / Electronic Panels / Cabinets including Operator's Panel considering specified ambient conditions. Detailed specifications of the same to be submitted. Make : Any make of International repute or SPAN / WERNER FINLEY/ ADVANCE	Vendor to Confirm			
2.11	HYDRAULIC SYSTEM :				
2.11.1	System should be centralised. Hydraulic Tank shall preferably be located at floor level	Vendor to Confirm			
2.11.2	Make Rexroth / Vickers Sperry or equivalent from a reputed manufacturer. (Details to be submitted)	Vendor to Confirm			
2.11.3	Filtration System	Vendor to Confirm			
2.11.4	Failure indication	Vendor to Confirm			
2.11.5	Refrigerated type cooling system of sufficient capacity to maintain complete Hydraulic System, including lubrication oil, hydrostatic oil and gearbox oil, spindle etc. at a temperature not exceeding 40 deg C irrespective of the ambient conditions. Complete details should be submitted Make : Any make of International Repute	Vendor to Confirm			
2.11.6	Hydraulic pump capacity (flow / pressure)	Vendor to Specify			
2.11.7	Each pump should have an independent motor. Tandem pumps should not be used	Vendor to Confirm			
2.11.8	<u>First filling of all required oil & 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			

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2.12	COOLANT SYSTEM :				
2.12.1	Coolant System with all accessories for following variants shall be provided. Selection of all the variants shall be through program and push buttons as well.				
	a) Recirculating Type Flood Coolant System through adjustable trajectory multiple nozzles around the spindle	Vendor to Confirm			
	b) Mist coolant system (Using water based emulsion / coolant)	Vendor to Confirm			
	c) High Pressure Coolant through Spindle (Optional)	Vendor to Confirm			
	d) Air coolant system	Vendor to Confirm			
2.12.2	It shall have the provision so that coolant is available directly at the tool-cutting tip.	Vendor to Confirm			
2.12.3	Coolant collection and recirculation system should be leakproof & perfect to avoid any spillage on shop floor, trenches for cables & foundation pit of the machine etc.	Vendor to Confirm			
2.12.4	Coolant Filtration System: Recirculating type coolant system with centrifugal Hydrocyclone System/ Vacuum Rotary drum type System/ Cartridge Type Filtration System/ Paper filtration system.	Vendor to Specify			
2.12.5	Coolant Flow Diagram showing filters, pumps, valves, tanks etc.to be submitted with the offer.	Vendor to Confirm			
2.12.6	Pressure & rate of flow of coolant for different variants 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			
2.12.7	Coolant Tank Capacity	Vendor to Specify			
2.12.8	For finer control of Pressure and Coolant Flow Rate, after its activation through program or switches, Rotary/ potentiometer switches shall be provided.	Vendor to Confirm			

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2.12.9	Coolant pump and motor details for all variants		Vendor to Specify			
2.12.10	The coolant tank should be fitted with skimmer for regular cleaning of coolant from contamination with tramp oil.		Vendor to Confirm			
2.12.11	Coolant should not get mixed with lubricating oil. Coolant falling on job / table should not get mixed with machine table / bed lubricating oil. Necessary provision to be made.		Vendor to Confirm			
2.13	ELECTRICAL:					
2.13.1	415V +/- 10%, 50HZ +/- 3 %, 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 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 should be informed by vendor well in advance so that same could be incorporated during construction of foundation.		Vendor to Confirm			

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2.13.2	Tropicalisation: All electrical / electronic equipment shall be tropicalized	Vendor to Confirm			
2.13.3	Electrical cabinets should be of Rittal make(preferable)or equivalent Internationally reputed make, properly air conditioned and sealed from ingress of liquids and encroachment of rodents	Vendor to Confirm			
2.13.4	All electrical components should be mounted on DIN Rail	Vendor to Confirm			
2.13.5	All electrical and electronic panels including operator's panel should be provided with fluorescent lamps for sufficient illumination and power receptacles of 220Volts, 5 Amp AC. All adapters/receptacles should have compatibility with Indian equivalents.	Vendor to Confirm			
2.13.6	Motors shall conform to IEC or Indian Standards	Vendor to Confirm			
2.13.7	All cables outside the electrical cabinets and operator pendant must be routed through flexible conduits capable of withstanding stress, chip hazard and ingress of oil/coolant(armoured conduit). All cables through trenches to run on cable trays. Additionally, all cables moving with traversing axes should be of trailing type and installed in caterpillar / cable drag chain.	Vendor to Confirm			
2.13.8	Vendor should ensure the proper earthing for the machine and its peripherals.	Vendor to Confirm			
2.13.9	In-cycle hour counter with reset facility.	Vendor to Confirm			

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2.14	SAFETY ARRANGEMENTS: 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 and messages (with device identification) on CNC display and panels should be available.	Vendor to Confirm			
	2. A detailed list of all alarms / indications provided on machine along with cause and remedy 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 should be provided.	Vendor to Confirm			
	6. Oil & water pipe lines should not run with electrical cable in the same tray / trench.	Vendor to Confirm			

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2.15	ENVIRONMENTAL PERFORMANCE OF THE MACHINE :				
	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) No hazardous chemicals shall be required to be used in the machine.	Vendor to Confirm			
	(d) If any safety / environmental protection enclosure is required it should be built in the machine by the vendor.	Vendor to Confirm			
	(e) Paint of the machine should be oil / coolant resistant and should not peel off and mix up with coolant.	Vendor to Confirm			
	(f) 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			

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3.0	CHIP CONVEYOR:				
3.1	A chip conveyor to carry both short and curly chips efficiently and effectively(at a capacity twice of that specified in Clause 1.3) to the chip bin on the floor, should be provided at the side of the machine. Two chip bins of appropriate size of Indian make, with wheels and handle for movement, should also be supplied.	Vendor to Confirm			
3.2	Type of chip conveyor	Vendor to Specify			
3.3	Width of conveyor	Vendor to Specify			
3.4	Elevation of chip conveyor for chip bin	Vendor to Specify			
3.5	Material of chip conveyor (to be rust resistant)	Vendor to Specify			
3.6	Provision for smooth flow of chips to the conveyor.	Vendor to Specify			
3.7	Operation of chip conveyor (forward & reverse) through push buttons on operator's panel and at Chip Conveyor	Vendor to Confirm			
3.8	Layout showing location of chip conveyor should be submitted.	Vendor to Confirm			
4.0	ULTRA ISOLATION TRANSFORMER				
4.1	Indian make Ultra Isolation Transformer (TTN configuration) suitable for complete machine shall be supplied	Vendor to Specify			
4.2	Make: Reputed Indian make (NEEL/AEI/SAIGON)	Vendor to Specify			
4.3	Model and Rating	Vendor to Specify			
4.4	Catalogue of the Ultra Isolation Transformer shall be submitted with the offer.	Vendor to Confirm			

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5.0	PNEUMATIC SYSTEM:				
5.1	AIR COMPRESSOR:	Vendor to Confirm			
5.1.1	Independent Air Compressor (Make : ELGI /ATLAS/ CPOCO/ INGERSOLL RAND) 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 (6 bar) could be used as and when required. The compressor unit should be suitable for continuous duty. Indications for over/under pressure should be provided.	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			
5.2	COMPRESSED AIR POINTS:				
5.2.1	Compressed Air Point with manual ON/ OFF Valve and flexible pipe of suitable length for work piece cleaning.	Vendor to Confirm			
6.0	TOOLINGS:				
6.1	All supplied tool holders, Cutting Tools, adapters etc. shall have built in system for the coolant so that coolant is available directly on the cutting tip during all possible operations. Provision for external coolant shall also be provided.	Vendor to Confirm			
6.2	All types of tool holders, adapters, sleeves, pull studs, Centering Devices etc. required for the machine including those included in clause 6.4 to be supplied.	Vendor to Specify			

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6.3	All cutting tools, adaptors,sleeves & tool holders recommended for machining of proveout components to be supplied.	Vendor to Specify			
6.4	Tooling from SANDVIK, SECO, WIDIA or any reputed international company operating in India. Following Tools are required with the machine:	Vendor to Confirm			
6.4.1	Indexable Square End mills :Dia. 12, 25, 40 mm Qty 02 no. each	Vendor to Confirm			
6.4.2	Indexable Ball Nose Endmills:Dia. 6,12,16, 20,25 mm Qty 02 no. each	Vendor to Confirm			
6.4.3	Face Mill : Dia. 60, 100, 150 mm Qty 02 no. each	Vendor to Confirm			
6.4.4	Copy mill (Bull Nose) nom. Dia 16, 30 Qty 02 no. each	Vendor to Confirm			
6.4.5	Indexable Drill :Dia. 6.5, 9.5, 10.5, 11.5, 14, 18 Qty 02 no. each	Vendor to Confirm			
6.4.6	T-slot cutters : Max Dia. 30, 40 Qty 02 no. each	Vendor to Confirm			
6.4.7	Mandrel for centrerling Qty 01 no.	Vendor to Confirm			
6.4.8	Adaptors : Collet system upto 32 mm dia. Qty 01 set.	Vendor to Confirm			
6.4.9	Tool Holders : Basic holders Qty 04 No.	Vendor to Confirm			
6.4.10	Inserts for each tool (For all the above tools) Qty 50 No.	Vendor to Confirm			
6.4.11	Standard spare for each tool (For all the above tools) 01 set	Vendor to Confirm			
	Note : Cylindrical shank tools should of Weldon type, Tools should be quoted with proper adaptors	Vendor to Confirm			
6.5	Job Fasteners 1 Set	Vendor to Confirm			

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7.0	In Process & Post process Gauging System:				
7.1	In process & post process gauging system comprising Latest RENISHAW probe system or equivalent interfaced to CNC system shall be offered. Vendor to specify the type of signal transmission. It should have following items/features:	Vendor to Confirm			
7.1.1	Latest RENISHAW probe or equivalent	Vendor to Confirm			
7.1.2	Holder for probe with taper suitable to the machine	Vendor to Confirm			
7.1.3	Probe stylus (2 sets of all types)	Vendor to Confirm			
7.1.4	Calibration master including the calibrating programs.	Vendor to Confirm			
7.1.5	Requisite electronic interface .	Vendor to Confirm			
7.1.6	Receiver module .	Vendor to Confirm			
7.1.7	Service Kit.	Vendor to Confirm			
7.2	The measured result file shall be generated on the machine only (not dependent on any external software/PC) & shall contain all relevant information such as nominal values, measured values, tolerances. Printing of the file with suitable interfacing to Printer should be possible.	Vendor to Confirm			
7.3	In addition to Clause 7.2 , all programs / software including customization required for In-process gauging & Post-process measurement of blade profile (in form of scanned point cloud data), converting data into a neutral CAD format & exporting the file , shall be supplied along with the machine.	Vendor to Confirm			

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7.4	The probing system shall be completely demonstrated & established on all supplied machines during pre- acceptance at supplier's works as well as during commissioning of the machines at BHEL, by using it for In-process measurements with automatic correction of tool/ work offsets & post process measurement of complete prove out blades after machining as per Clause no. 18).	Vendor to Confirm			
7.5	The backup of all programs/ installation copy of softwares (if any) for the above probing system shall be supplied on CDs.	Vendor to Confirm			
7.6	The calibration procedure shall be completely demonstrated & established on the supplied machine by the vendor during pre-acceptance at supplier's works as well as during commissioning of the machines at BHEL .	Vendor to Confirm			
7.7	Complete technical support for its smooth usage during the warranty period of the machines shall be provided by the vendor.	Vendor to Confirm			
7.3	Tool Collision Monitoring system	Vendor to Confirm			
8.0	LEVELING & ANCHORING SYSTEM				
8.1	Complete anchoring system including foundation bolts, anchoring materials, fixators, leveling shoes etc should be supplied by Vendor.	Vendor to Confirm			
9.0	TOOLS FOR ERECTION, OPERATION & MAINTENANCE :				
9.1	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 with offer	Vendor to Confirm			
9.2	Test mandrel for checking run-out/taper & alignment should be supplied	Vendor to Confirm			

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10.0 ACCESSORIES:					
10.1	Centering Device (Hole & Edge)	Vendor to Confirm			
10.2	Full Enclosure for Machine with Visiport spin Window.	Vendor to Confirm			
10.3	Tool Cabinet	Vendor to Confirm			
11.0 SPARES:					
	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.	Vendor to Specify			
11.1	The list to include following, in addition to other recommended spares: (Unit Price of each item of spare should be offered)				
	a) Mechanical & Hydraulic Spares: All types of Pumps, Valves, Pressure Switches, Transducers, Flow Switches, Filters, Seals, O-rings, Hydraulic Hoses etc.	Vendor to Specify			
	b) Electrical /Electronic / CNC Spares: All types of Relays, Contactors, Proximity Switches, Push Buttons, Indicating Lamps, Semiconductor Fuses, Special Fuses, Circuit Breakers, Main Power Switch, Encoders, Scanning Heads for Linear Scales, CNC Controller, Operator's panel with Display Unit, I/O Cards for PLC, Servo Motors for Feed Drives, Power Module & Control Cards for Main Drive as well as Feed Drives etc.	Vendor to Specify			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATION	REMARKS
11.2	All types of spares including software backup 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 Confirm			
11.3	Recommended set of spares for all attachments are to be offered with details.	Vendor to Specify			
11.4	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 Confirm			
12.0	DOCUMENTATION : Five sets of following documents (Hard copies) in English language should be supplied along with the machine				
12.1	Operating manuals of Machine & CNC system	Vendor to Confirm			
12.2	Programming Manuals of Machine & CNC system	Vendor to Confirm			
12.3	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			
12.4	Maintenance, Interface & commissioning manuals for CNC system, spindle & feed drives and position feedback system.	Vendor to Confirm			

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12.5	Manufacturing drawings for all supplied tool holders, coolant connections, tailstock center, adapters, sleeves, fixtures etc.	Vendor to Confirm			
12.6	Catalogues, O&M Manuals of all bought out items including drawings, wherever applicable.	Vendor to Confirm			
12.7	Detailed specification of all rubber items and hydraulic/lube fittings	Vendor to Confirm			
12.8	Operating Manuals, Maintenance Manuals & Catalogues for supplied Automatic Tool Offset & Job Measuring Systems, Isolation Transformer, Air-Compressor and all supplied Accessories.	Vendor to Confirm			
12.9	Hard copy (Print-out) as well as soft copy (in PDF format) of Electrical Schematics of the machine with comments in English	Vendor to Confirm			
12.10	Hard copy (Print-out) of PLC program with comments in English.	Vendor to Confirm			
12.11	Soft copy of PLC program and complete machine data.	Vendor to Confirm			
12.12	Complete back-up of hard disk on GHOST CD (only in case of PC based CNC system)	Vendor to Confirm			
12.13	Complete Master List of parts used in the machine shall be submitted by the vendor.	Vendor to Confirm			
12.14	One additional set of all the above documentation on CD ROM, wherever possible.	Vendor to Confirm			

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13.0	TRAINING				
	BHEL Persons should be trained at supplier's Works for period two weeks in the area of (a) CNC Part Programming (preferably using UG-NX 6 or latest version) / Technology, Use of all CNC Features, Programming for Measuring Systems & supplied accessories etc. 13.1 (b) Electrical, Electronic & CNC maintenance for machine & other supplied equipments (c) Mechanical & Hydraulic maintenance of the machine & other supplied equipments (d) Operation of the machine & other supplied equipments.	Vendor to Confirm			
13.2	Air-fare, boarding & lodging for the trainees shall be borne by BHEL.				
13.3	Competent, English speaking experts shall be arranged by the vendor during training for satisfactory & effective training of BHEL personnel.	Vendor to Confirm			
13.4	Vendor to quote for training on man / week basis	Vendor to Specify			
13.5	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			
13.6	Vendor should confirm Training for Programming of five axes (or more as quoted by vendor) machine with particular stress on BHEL Test-piece on the offered Control system and the CAM software.	Vendor to Confirm			
13.7	Job prove-out and measurement as per clause 19.1.6	Vendor to Confirm			

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14.0	FOUNDATION :				
	For facilitating foundation design by BHEL / it's Consultant, the Vendor is required to submit the following within one month from the date of Letter of Intent (LOI): a) Foundation layout plan. b) Mounting details. c) Loading detail (static as well as dynamic) d) Any other relevant information/ input required for the design.	Vendor to Confirm			
14.1	The Vendor is required to provide missing information / clarification on priority to BHEL designer/ Consultant as and when asked for with respect to the design of Foundation.				
15.0	ERECTION & COMMISSIONING				
	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.				
15.1	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 material movement equipment shall also be provided by BHEL. Details of these requirements should be informed by vendor one month from date of LOI.	Vendor to Confirm			
15.2	Erection & Commissioning of Isolation Transformer & Air Compressor shall also be responsibility of the vendor.	Vendor to Confirm			
15.3	Successful proving of BHEL components by the supplier shall be considered as part of commissioning. All tests, as mentioned at clause 19 (Machine Acceptance) shall form part of the commissioning activity.	Vendor to Confirm			

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15.4	Test mandrel for checking run-out/taper & alignment should be supplied	Vendor to Confirm			
15.5	Tools, Tackles, 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			
15.6	Commissioning spares, required for commissioning of the machine within stipulated time, shall be brought by the supplier on returnable basis.	Vendor to Confirm			
15.7	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 Specify			
15.8	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			
15.9	Schedule of Erection and Commissioning shall be submitted with the offer.	Vendor to Confirm			
15.10	Charges, duration, terms & conditions for E&C should be furnished in detail	Vendor to Specify			

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16.0	ACCURACY TESTS:				
16.1	GEOMETRICAL ACCURACIES :				
16.1.1	Submit test chart for all accuracies as per DIN 8609 standard or equivalent applicable standard(which ever is finer).	Vendor to Confirm			
16.1.2	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			
16.2	MACHINE POSITIONING ACCURACIES & REPEATABILITY: Should be measured as per VDI/DGQ 3441 (Latest Revision) using LASER INTERFEROMETER.				
16.2.1	Positioning accuracy in X / Y axis (Pa) : 0.01mm /1000 mm or better	Vendor to Confirm			
16.2.2	Positioning accuracy in Z axis : 0.01mm /1000 mm or better	Vendor to Confirm			
16.2.3	Positioning accuracy in Tilting axis(A/B) : 10 arc-sec or better	Vendor to Confirm			
16.2.4	Positioning accuracy in C-Axis : 10 arc-sec or better	Vendor to Confirm			
16.2.5	Repeatability in X / Y axis : 0.006 mm/1000 or better	Vendor to Confirm			
16.2.6	Repeatability in Z axis : 0.006 mm/1000 or better	Vendor to Confirm			
16.2.7	Repeatability in Tilting axes (A/B) : 6 arc-sec or better	Vendor to Confirm			
16.2.8	Repeatability in C-Axis : 6 arc-sec or better	Vendor to Confirm			

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16.3	Surface finish as indicated in Clause 1.4		Vendor to Confirm			
	All the above accuracies should be demonstrated to BHEL engineers during pre-acceptance at Suppliers works and during Erection & Commissioning at BHEL Works					
	Note : 1. LC of DRO should be better than values mentioned above		Vendor to Confirm			
	Note 2. Accuracy should remain within specified tolerance over a time period of 24 hours (Maximum temperature variation is 25 degree centigrade during peak summer)		Vendor to Confirm			
17.0	OPERATING CONDITIONS & THERMAL STABILITY :					
	Total machine including CNC system and all supplied items should work trouble free and efficiently under following operating conditions and should give specified accuracies. Power Supply: Voltage: 415 V ± 10% Frequency: 50 Hz± 3%		Vendor to Confirm			
17.1	No. of phases = 3 Ambient Conditions: Temperature = 5 to 48 degree celsius Relative Humidity = 95% 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)					

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17.2	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 25 deg Celsius in 24 hours. (Vendor to confirm that the machine is suitable for above else details of provisions on the machine for the same are to be furnished by Vendor)	Vendor to Confirm			
17.3	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 else details of provisions on the machine for the same should be furnished)	Vendor to Confirm			
18.0	PROVEOUT OF BHEL COMPONENTS :				
18.1	Drawings of proveout components are enclosed (Sketch No. HLE/A4-673). Vendor to submit preliminary process, time study & tool list recommended by them along with the offer. Change in process/tools may be mutually discussed and agreed. Complete machining of prove out components shall be done by Vendor at BHEL works to the specified design accuracy and surface finish, using cutting tools and CNC programs to be provided by the vendor to prove the machine after complete erection, tests & test piece machining etc. Material for the proveout components shall be provided by BHEL. Vendor should submit the CNC programs, setting schemes, process sheets, tooling layouts, time studies etc. in advance for the prove out components. Vendor shall be fully responsible for machining of proveout components as per drawing and other requirements specified by BHEL to the full satisfaction of BHEL. Clarifications, if any required by vendor, regarding accuracy requirements of the proveout components, whether specified or not, should be discussed and cleared by vendor during initial technical discussions.	Vendor to Confirm			

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18.2	During proveout, all tools shall be set by using supplied Tool Measuring System and final job inspection shall be done by supplied Job Measuring System. Vendor shall be responsible for any deviation/rejection in proveout component due to wrong machining or malfunctioning of the machine during proveout machining and also for the delay in machining due to improper recommended tooling etc. The cost of such deviation / rejection, if any, shall be refunded by the vendor to BHEL.	Vendor to Confirm			
19.0	MACHINE ACCEPTANCE: (Tests/Activities to be Performed by Vendor)				
19.1	Tests/Activities to be carried out at supplier's works on the machine before dispatch :				
19.1.1	Geometrical accuracies in accordance with clause 16.1.1	Vendor to Confirm			
19.1.2	Positioning accuracies as per VDI-DGQ/3441	Vendor to Confirm			
19.1.3	The machine should be tested for continuous running of 8 hrs. If any breakdown occurs during this test, the test should be repeated for 8 hrs from that time.	Vendor to Confirm			
19.1.4	Demonstration of all features of the machine, control system & accessories	Vendor to Confirm			
19.1.5	Full load test to demonstrate the maximum power & cutting capacity of the machine.	Vendor to confirm			

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19.1.6	Machining of test piece as per NAS/AFNOR/ISO. Vendor to supply test piece and tooling for it's machining	Vendor to Confirm			
19.1.7	Machining of proveout component (BHEL test piece, sketch no. HLE/A4/673) at vendor's works. The required raw material, tooling & CAM program shall be arranged by Vendor. During pre-acceptance, all accuracy tests & satisfactory machining of prove-out component shall be witnessed by BHEL team including verification by automatic job measurement system.	Vendor to Confirm			
19.2	Tests/Activities to be carried out at BHEL works while commissioning the machine :				
19.2.1	Geometrical accuracies in accordance with clause 16.1.1	Vendor to Confirm			
19.2.2	Positioning accuracies as per VDI-DGQ/3441 using LASER INTERFEROMETER.	Vendor to Confirm			
19.2.3	Full load test to demonstrate the maximum power & cutting capacity of the machine.	Vendor to Confirm			
19.2.4	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			
19.2.5	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			
19.2.6	Proveout machining as per clause 18.0	Vendor to Confirm			
19.2.7	Two weeks supervision of independent operation of machine by BHEL after job proveout	Vendor to Confirm			
19.2.8	Machining test piece as per NAS/AFNOR/ISO. Vendor to arrange Test pieces and tooling for it's machining.	Vendor to Confirm			

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19.2.9	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			
19.2.10	Demostration by actual use of all supplied attachments and accessories to their full capacity.	Vendor to Confirm			
20.0	PACKING:				
20.1	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			
21.0	GUARANTEE :				
22.1	24 months from the date of acceptance of the machine at BHEL Bhopal.	Vendor to Confirm			
22.0	GENERAL :				
22.1	Machine Model	Vendor to Specify			
22.2	Total connected load (KVA):	Vendor to Specify			
22.3	Floor area required (Length, Width, Height) for complete machine & accessories	Vendor to Specify			
22.4	Painting of Machine / Electrical Panels : RAL 6011 Apple Green (Polyurethane Paint)	Vendor to Specify			
22.5	Total weight of the machine	Vendor to Specify			
22.6	Weight of heaviest part of machine	Vendor to Specify			
22.7	Weight of the heaviest assembly / sub-assembly of the Machine	Vendor to Specify			
22.8	Dimensions of largest part/ sub-assembly/ assembly of the machine	Vendor to Specify			

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22.9	Vendor to submit, along with offer, reference list of customers where similar machines have been supplied mentioning broad specifications of the supplied machine.	Vendor to Confirm			
22.10	Detailed catalogues , sketch/ photographs of the m/c and accessories/ attachments should be submitted with the offer.	Vendor to Confirm			
22.11	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 machine.	Vendor to Confirm			
23.0	REFERENCE LIST / QUALIFYING CONDITIONS :				
	Only those vendors, who have supplied and commissioned at least one 5 axes CNC machine of same or higher sizes (X=800 mm, Y=800mm & Z=500 mm) for similar applications 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/had been supplied to BHEL, then such machine should be presently working satisfactorily for more than six months after is commissioning and acceptance (on the date of opening of tender) in BHEL 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.	Vendor to Confirm			
23.1	1. Name of the customer / company where similar machine is installed.	Vendor to Specify			
	2. Complete postal address of the customer.	Vendor to Specify			
	3. Month & Year of commissioning.	Vendor to Specify			

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	4.Parameters of machine(s) supplied (Pallet size,Spindle power,Load capacity &Maximum job envelop) & application for which the machine is supplied.	Vendor to Specify			
	5. Name and designation of the contact person of the customer.	Vendor to Specify			
	6. Phone, FAX no. and email address of the contact person of the customer.	Vendor to Specify			
	7.Performance certificate from the customers regarding satisfactory performance of machine supplied to them in original. (original certificate or through E-mail directly from the customer). The original may be returned after verification by BHEL, If required.	Vendor to Confirm			
	8.BHEL reserves the right to verify the information provided by vendor. In case the information provided by vendor is found to be false/incorrect at any point of time, the offer shall be rejected.	Vendor to Confirm			
	9. Detailed Product Catalogue and Information about the OEM should be submitted along with the offer.	Vendor to Confirm			
24.0	OTHER FEATURES:				
24.1	NETWORKING:				
24.1.1.1	Machine control should have necessary hardware and software for interfacing with gigabit Ethernet Local Area Network with 100 MB/sec through UTP cables for NC program and other related data transfer. This network to be connected to wide area network/Internet. The networking should have following capabilities.	Vendor to Confirm			
	a) The machine shall appear as a node in the Entire Network. (Network Neighborhood)	Vendor to Confirm			
	b) The program transfer shall be by simple copy and paste method provided sharing access is allowed between any PC and the machine across the network.	Vendor to Confirm			

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	c) The program transfer between CNC system and network should also be possible in CNC Mode.	Vendor to Confirm			
24.2	MACHINE MONITORING SYSTEM (MMS) SIGNALS				
24.2.1	Following MMS signals would be made available on a specifically earmarked terminal strip. These MMS signals should be sourced from a PLC output card separately.	Vendor to Confirm			
	a) Control ON	Vendor to Confirm			
	b) Program running	Vendor to Confirm			
	c) Spindle running	Vendor to Confirm			
	d) Axes moving	Vendor to Confirm			
	e) M30 (Program Stop)	Vendor to Confirm			
	f) Alarm Active				