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

Specification cum Compliance Certificate for CNC LATHE : 3500MM x 12000MM - (QTY : 2 Nos)

NOTE:-

TOTAL NO. OF MACHINES = 2
MACHINE NO. 1 (FOR HARIDWAR)
MACHINE NO. 2 (FOR HYDERABAD)

Vendor to note that the two machines are to be supplied to different units of BHEL in different cities and accordingly, the two machines shall be erected & commissioned separately i.e. one at the works of BHEL, Haridwar (Machine No. 1) and other at the works of BHEL, Hyderabad (Machine No. 2). All Features & Requirements specified below are for both machines and shall be applicable independently for each machine unless mentioned as "Applicable only for machine no...". Breakup prices are to be quoted by vendor for items mentioned as "Applicable only for machine no..."

1. Vendor (OEM) must submit complete information against clause no. 25.0 (Qualifying Conditions). The offer meeting this clause would only be processed. (OEM - Original Equipment Manufacturer)

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

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

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

SCOPE: SUPPLY, ERECTION & COMMISSIONING OF CNC LATHE COMPLYING WITH SPECIFICATIONS AS BELOW

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
1.0	PURPOSE & WORKPIECE MATERIAL :		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
1.1	**Purpose (Operations/Jobs involved) :** A) To rough & finish turn the Steam Turbine Shafts/Rotors (Steam Turbines of different ratings) which are components of high precision. B) To Machine different types of grooves on rotor for blade roots like T-Root, TT root & Fork Root grooves. C) To Turn the Taper portions on Rotor. D) To Face the Flange at the end of rotor. E) To machine the Internal and External threads at the end of Rotor, if required. F) To Roll,Polish & Burnish the Rotor Journals. G) When Rotor/Job is held in Chuck & at one steady, it should be able to machine or face easily throughout the length. H) To take runout measurements on bladed rotors. I) The machine shall be used for all types of turning/grooving/threading operations, grinding operations on cylindrical & radial (LH&RH) surfaces and blade tips, rolling operations on diameter/faces/fillet radii etc. on different types of shafts/rotors.	Vendor to accept	
1.2	**Work Piece Material: (Material detail, Hardness etc.) :** **Work Piece : Turbine Rotor -** Forging of high alloy steels like 28CrMoNiV59 & 26NiCrMoV145 and similar other materials which are generally used in power producing equipment having Tensile Strength upto 980 N/mm^2 & Hardness 300 BHN.	Vendor to accept	
2.0	**SPECIFICATIONS :**		
2.1	**CAPACITY & SIZE :**		
2.1.1	Max.Turning Diameter	3500mm	
2.1.2	Max.Turning Length	12000mm	
2.1.3	Max. Weight of Work-piece between centers without steady	60000kg or more	
2.1.4	Max. Weight of Work-piece:		
2.1.4.1	In head stock with one steady rest without tail stock support.	80000kg or more	
2.1.4.2	In head stock with two steady rests without tail stock support.	100000kg or more	
2.1.4.2.1	Supported on two steady rests without tail stock support and drive taken from headstock using cardan shaft, clamped in chuck and coupled to the workpiece (rotor).	100000kg or more	
2.1.4.3	Only in chuck	Vendor to inform	
2.1.5	Min. & max. bore diameter (at center of flange of rotor)	50mm - 500mm	
2.1.6	Max boring depth (Sl.No. 2.1.5) from flange face	400mm	
2.1.7	Admit between centers (ABC) / Center Distance {Machine should be capable of facing at maximum length}	12000mm or more	
2.1.8	Center Height	Vendor to inform	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.1.9	Swing over bed (SOB)	Vendor to inform	
2.1.10	Swing Over Carriage (SOC)	3600mm	
2.1.11	Distance of center of gravity from face plate, in case the workpiece is held only in chuck (Sl.No. 2.1.4.3)	Vendor to inform	
2.1.12	Face plate Diameter	Vendor to inform	
2.1.13	No. of Hard Jaws	4 nos.	
2.1.14	Max. & Min. Chucking Diameters (with single set of jaws).	Vendor to inform	
2.1.14.1	External - Min. 90mm or less, Max. 1000mm or more	Vendor to inform	
2.1.14.2	Internal	Vendor to inform	
2.1.15	Min distance between Head stock & Tail stock	Vendor to inform	
2.1.16	Min and Max facing diameters without Tool holder extension (Tool holder/carrier at its reference position)	Vendor to inform	
2.1.17	C-Axis	Not Required	
2.2	**HEAD STOCK :**		
2.2.1	Spindle Motor Rating (Min.) AC, S1 (100%) Continuous Duty	170kw or more	
2.2.2	Spindle Motor Make (Either Siemens or Fanuc), Model etc.	Vendor to inform	
2.2.3	Spindle Bearing Type & Diameters (Radial & Axial)	Vendor to inform	
2.2.4	Spindle nose details (Drawing to be submitted)	Vendor to inform	
2.2.5	Spindle speed (Infinitely variable)	Min. 2rpm or less, Max. 200rpm or more	
2.2.6	Detail of speed ranges (Selectable through program)	Vendor to inform	
2.2.7	Range of spindle speed at constant power.	Vendor to inform	
2.2.8	Max permissible torque at face plate	Vendor to inform	
2.2.9	RPM at which max. permissible torque is available	Vendor to inform	
2.2.10	Torque/Power/Speed diagram of spindle motor	Vendor to submit	
2.2.11	Head stock center, either 60^0 or 90^0 with cover plate to cover the space when headstock center is removed.	Vendor to offer	
2.2.12	Spindle bore diameter and its depth from chuck face	Vendor to inform	
2.2.13	Detail of Hard Jaws, Force Multipliers for easy movement & clamping of jaws, T-slots on chuck etc. (Face plate drawing showing slot position etc also should be submitted)	Vendor to inform	
2.2.14	Clamping force on each jaw	Vendor to inform	
2.2.15	Chuck guard of suitable length to cover the chuck for the length more than jaw's height with motorised movement through push buttons & interlock to prevent chuck rotation when guard is behind chuck face.	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.2.16	Male & Female Gauges/Templates (One Set) for checking the headstock angle should be provided.	Vendor to offer	
2.3	**MACHINE BED :**		
2.3.1	No. of Guide ways	Vendor to inform	
2.3.2	Bed width across ways	Vendor to inform	
2.3.3	Type of guide ways: Hydro-static Guideways for X and Z axes, (Details should be submitted)	Vendor to offer & submit	
2.3.4	Hardness of guideways	Vendor to inform	
2.3.5	**Metallic Telescopic Covers** of rust resistant material should be provided with wipers for X & Z axes guide ways. Joints of telescopic covers should be so sealed to avoid mixing of coolant & hydrostatic oil is to be provided. Telescopic covers should be sloping towards chip conveyor.	Vendor to offer	
2.4	**FEEDS AND DRIVE SYSTEM :**		
2.4.1	Feed range in X & Z axes (Infinitely variable)	0.1 - 6000mm/min or more	
2.4.2	Rapid traverse in X & Z axes (Infinitely variable)	0 - 6000mm/min or more	
2.4.3	Feed drives/motors X & Z axes (AC servo motors) Either Siemens or Fanuc digital type (detail of model, make, type etc. should be submitted)	Vendor to offer & submit	
2.4.4	Feed back system for X & Z axes. Heidenhain linear scales with pressurised compressed air cleaning (Details - Model Nos. should be submitted)	Vendor to offer & submit	
2.4.5	Details of System to ensure zero backlash for X & Z axis	Vendor to inform	
2.4.6	Mechanism for locking X & Z axis (Through brake directly on the feed motor)	Vendor to inform	
2.4.7	Maximum feed force in X and Z axes	Vendor to inform	
2.4.8	Maximum Torque in X and Z axes	Vendor to inform	
2.4.9	Detail of X and Z axes feed mechanism	Vendor to inform	
2.5	**STEADY RESTS :** (Refer & Consider clause 2.1.4)		
2.5.1	Range of supporting dia for Hydrostatic Steady Rests	Min. 150mm or less, Max. 1200mm or more	
2.5.2	Range of supporting dia for Open force lubricated steady rests	Min. 150mm or less, Max. 1200mm or more	
2.5.3	No. of Top Portions (minimum two nos.- to cover the specified range at SL.No. 2.5.1) and their supporting dia ranges of Hydrostatic Steady Rest. Max.weight admitted on each steady rest to be 60Tons or more. (Quantity - 2 Sets of each top portion, complete in all respects)	Vendor to inform	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.5.4	Vendor to provide Hydrostatic steady rest pads (1 no. each, total 10 nos.) for diameters as given below: 250 (- 0.029), 315 (h6), 380 (- 0.036), 400 (- 0.036), 450 (- 0.04), 597 (- 0.044), 599 (- 0.044), 605 (h6), 746 (- 0.05), 747 (- 0.05) mm. Width and design of pads should suit offered hydrostatic steady rests. In case of minor changes in diameters of required pads, vendor shall be informed prior to ordering. Price of each pad is to be quoted separately.	Vendor to offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
2.5.4a	Vendor to provide Hydrostatic steady rest pads (total 18 nos.) for diameters as given in Annexure-I Design of pads should suit offered hydrostatic steady rests. In case of minor changes in diameters of required pads, vendor shall be informed prior to ordering. Price of each pad is to be quoted separately.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
2.5.5	Vendor to provide Pad's constructional details for offered Open force lubricated steady rests. These pads should have babbit lining. Vendor to also provide Positive clamping of pad supports.	Vendor to offer	
2.5.6	No. of Top Portions (minimum two nos.- to cover the specified range at SL.No. 2.5.2) and their supporting dia ranges of open force lubricated Steady Rest. Max.weight admitted on each steady rest to be 60Tons or more. (Quantity - 2 Sets of each top portion, complete in all respects)	Vendor to offer	
2.5.7	Availability of sufficient gap on Top Portion of Steady Rest for job loading/unloading.	Vendor to confirm	
2.5.8	No. of common bases for steady rests for complete supporting range. Common base should suit to both types of offered steady rests i.e. Hydrostatic Steady Rests and Open Force Lubricated Steady Rests. (Quantity of common bases - 2 Sets complete in all respects)	Vendor to inform	
2.5.9	Mounting of Steady Rest on Base shall be through quick-clamping fastener (Details should be submitted) The steady rest unit should be compact with minimum possible total width (along Z-axis) to avoid its obstruction with nearby flanges/faces or carriage/tool post in any way while machining near steady support dia, when the component is supported on steady with other end in chuck considering attached proveout component drawings.	Vendor to offer	
2.5.10	Motorised movement on bedways with positive clamping (Details should be submitted)	Vendor to offer	
2.5.11	Clamping force of base on bedways	Vendor to inform	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.5.12	Independent, automatic, refrigerated type (with heating also, if required) recirculating (with provision to avoid mixing of oil with coolant) lubrication system , fixed on hydrostatic steady, shall be provided for lubrication between hydrostatic pads and supporting dia of job. Vendor to Provide lubrication system for open force steady rests also. Tank for lubricating oil fixed with steady shall have provision to display alarm on control panel in case of low oil level (Details should be submitted)	Vendor to offer	
2.5.13	Adjustable Chip Protection Guards on steady rests to avoid falling of small chips on hydrostatic & open force steady rest pads.	Vendor to offer	
2.5.14	Mechanism of motion of Side Pads & Center Pad of offered Hydrostatic and Open Force Lubrication Type Steady Rests.	Vendor to inform	
2.6	**TAIL STOCK :**		
2.6.1	Motorised movement on bed by Push Buttons on Tail Stock	Vendor to offer	
2.6.2	Quill stroke	Vendor to inform	
2.6.3	Quill movement to be equipped with following features :		
2.6.3.1	Presetting, display & automatic control of thrust applied	Vendor to offer	
2.6.3.2	Compensation for thermal expansion of work piece	Vendor to offer	
2.6.3.3	Motorised Drive	Vendor to offer	
2.6.4	Quill diameter	Vendor to inform	
2.6.5	Rapid Traverse rate of tail stock body on bed	Vendor to inform	
2.6.6	Traverse of quill with traverse rate	Vendor to inform	
2.6.7	Hardened Tail stock centre - For both 60 & 90degree (Drawing to be submitted) as per standard.	Vendor to offer	
2.6.8	Detail of Positive Clamping & Unclamping of tail stock on bed	Vendor to inform	
2.6.9	Max thrust on the Quill	Vendor to inform	
2.6.10	Set of Male & Female Gauges/Templates for checking the angle should be provided.	Vendor to offer	
2.7	**CARRIAGE/ CROSSSLIDE :**		
2.7.1	Z-axis travel	Vendor to inform	
2.7.2	X-axis travel Specify movement along x-axis beyond center i.e. X -negative side also.	Vendor to inform	
2.7.3	Cutting force available at the carriage	Vendor to inform	
2.7.4	Layout showing extreme positions of the all axes movements	Vendor to submit	
2.7.5	Carriage to clear chuck, tailstock and all steady rests (should be confirmed)	Vendor to confirm	
2.8	**TOOL POST :**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.8.1	**Type of Tool Post:** Fixed type tool post equipped with two blade/plate type tool carriers mounted on either side suitable for conventional & downturning with additional provision of boring bar holder for boring bars (Sl.No. 2.1.5 & 2.1.6) and mounting of rolling device, superfinishing device. Grinding attachment shall also be mountable on same tool post/carriage. Offered tooling system should ensure rigid and vibration free machining considering different overhang of tools required for proveout component. Left blade shall be primarily used for all types of turning, grooving, threading, rolling, boring etc. operations using square shank tools in radial/axial clamping, boring bars etc. Right blade shall be primarily used for deep grooving, turning and contouring operations using suitable	Vendor to offer	
2.8.1.1	Thickness of Blades : Left Blade - 120mm, Right Blade - 40mm or more to suit specified requirement of deep grooving/contouring.	Vendor to offer	
2.8.1.2	Positioning of Blades : Through two independent CNC programmable axes using M functions with positioning at steps with minimum overhang of 100mm or less and maximum overhang of 800mm or more.	Vendor to offer	
2.8.1.3	Traverse of Blades : 800mm or more - To suit specified requirements in view of proveout component.	Vendor to confirm	
2.8.1.4	Blades should have provision to accept standard block type cartridges/ cassettes/ adapters capable of clamping of square shank tools (40mmx40mm) in radial & axial directions, LH & RH clamping, with holding/grip length of 200mm or more for both upturning and down turning operations and also boring bars (dia 32, dia 40,dia 50 & dia 80). Tool holder mounting system shall be discussed and agreed with BHEL.	Vendor to offer	
2.8.1.5	Vendor to submit layout of X-axis and axes of blades showing possible recessing depth on maximum turning diameter.	Vendor to submit	
2.8.2	Type of Tool Holders for both Tool carriers, Boring Bar Holder, Mounting of Rolling device / Superfinishing device / Grinding attachment - Preliminary representative drgs./sketches to be submitted by vendor.	Vendor to submit	
2.8.3	Tool shank height for different tool holders - 40mmx40mm for square shank tools, for other type of tool holders - to suit specified requirements.	Vendor to offer	
2.8.4	Provision for coolant to reach upto tool tip in all types of tool holders clamped in all tool carriers for both upturning and down turning operations and also boring bars.	Vendor to offer	
2.8.5	Automatic operation / selection of positioning of tool carriers through CNC program/M codes. While executing CNC program, automatic updation of tool offsets should be there in case of change of projection of carrier.	Vendor to offer	
2.8.6	Additional manual operation/selection of positioning of tool carriers through push buttons or equivalent.	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.8.7	Drawing of tool post showing configuration of the tool post and all tool carriers.	Vendor to submit	
2.8.8	Limitation regarding length & weight of tool / tool holder clamped in different tool holders for troublefree operation	Vendor to inform	
2.8.9	Projection of the tool carriers (without tool holder/cassette) with which the tool carriers can clear all offered steady rests during movement along Z-axis.	Vendor to inform	
2.8.10	Following safety features to be provided for all the tool carriers. * The tool carrier should not go to its reference position unless cassette/tool/cartridge/adapter, mounted on it, is removed. * Movement of a tool carrier should be possible only when other carrier is at reference position. * Movement of tool carriers should be interlocked with chuck rotation and feed motion in X & Z-axes.	Vendor to offer	
2.9	**CONSTRUCTION:**		
2.9.1	Vendor to furnish details of material, hardness & constructional details including explanatory drawings of various components/assemblies like Headstock, Steady Rest, Steady rest pads, Chuck, Tailstock, Carriage, Tool post, Machine bed, Feed Transmission system, Feedback system etc.of the machine.	Vendor to inform	
2.9.2	Video/images on CD/ hard copy explaining the technical features / Literature with photographs, drawings explaining the technical features should be enclosed with the offer	Vendor to submit	
2.10	**OPERATOR'S PLATFORM:**		
2.10.1	Independent operator's platform should be provided on both sides of tool post with staircases and having sufficient space for left to right & vice versa movement without any obstruction and stepping down for convenient and safe operation from both sides. A 15 Amp. Plug Point (Indian type) with ON/ OFF switch is also to be provided on the Platform.	Vendor to offer	
2.10.2	Splash / Chip guards (sliding door type with glass windows) on operator platform for protection of operator, operator's panel and to avoid spillage of coolant & chips on shop floor and operator's platform.	Vendor to offer	
2.10.3	Additionally, Movable Splash / Chip guard should be provided on rear side (opposite to operator's platform) to avoid spillage of coolant & chips on shop floor.	Vendor to offer	
2.10.4	Operator's Platform should clear all steady rests, tailstock and also headstock while working near chuck.	Vendor to offer	
2.11	**OPERATION AND CONTROL SYSTEM:**		
2.11.1	**OPERATOR'S PANEL:**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.11.1.1	Swiveling and sliding type operator's panel having complete CNC and machine control system with TFT flat colour display of required configuration shall be provided on the operators platform 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 (Indian) for easy operation. All displays/indications should also be conveniently placed accordingly. Layout showing complete details should be submitted.	Vendor to offer	
2.11.1.2	An auxiliary pendant, which can be taken near to the chuck for job setting and similar other purposes.	Vendor to offer	
2.11.2	**CNC SYSTEM & FEATURES :**		
2.11.2.1	Make : Fanuc / Siemens.	Vendor to inform	
2.11.2.2	Type : PC based latest version	Vendor to confirm	
2.11.2.3	Model (Latest version, as available at the time of ordering, should be supplied).	Vendor to inform	
2.11.2.4	Details of Standard features	Vendor to inform	
2.11.2.5	Details of optional features, recommended by vendor.	Vendor to inform	
2.11.2.6	Details of other optional features	Vendor to inform	
2.11.2.7	The system should have full alphanumeric keyboard, TFT colour display(10.4"or more), additional draw-out type Querty Key Board and mouse in suitable enclosure, RS232C serial interfaces, parallel interface for printer, COM port for telediagnostics, network ready with LAN, Ethernet card supporting TCP/IP protocols with necessary software and proveout on machine, electronic hand wheels for all axes, USB port with pen drive unit for data input/output, hard disk of sufficient capacity (Largest size available at the time of order shall be supplied), graphic simulation and preinstalled system software & other required softwares etc.(Details should be submitted by Vendor)	Vendor to offer	
2.11.2.7 contd.	In case of non-availability of COM(V.24), LPT1 interface, RS232-C etc. (if not provided by CNC system manufacturer at the time of supply), suitable separate ports (USB or equivalent) shall be provided for each functionality like networking with LAN, data input/output in CNC mode with pen drive, interface for telediagnostics, interface for printer & any other. In case, only USB ports are provided, suitable hardware/connectors/converters shall be provided to ensure functionalities as per tender specifications.	Vendor to offer	
2.11.3	**MANUAL CONTROL :**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.11.3.1	Complete manual control of machine with required switches / keys should be provided on operator's panel for selection of required axis, axis direction, cutting feed spindle rpm, cutting feed on/off, display of axis position values etc, for manual turning operation without using CNC program, CNC option MANUAL TURN & MDI mode. Diagram / Sketches for switches / keys provided on operators pendant should be submitted.	Vendor to offer	
2.11.4	**HAND HELD UNIT:**		
2.11.4.1	Hand Held unit, Type B-MPI of Siemens make or equivalent alongwith sufficient length of interfacing cable is to be offered with complete details.	Vendor to offer	
2.11.5	**UPS FOR CNC SYSTEM:**		
2.11.5.1	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 offer	
2.12	**MACHINE LIGHTS:**		
2.12.1	Machine Lights for sufficient illumination of complete working area on all sides of operator's platform should be provided for clear visibility.	Vendor to offer	
2.12.2	A magnetic base portable spot light with sufficiently long cable should also be provided.	Vendor to offer	
2.12.3	Any lights required in the foundation/ pit area shall also be foreseen and supplied by the vendor.	Vendor to offer	
2.12.4	All light fittings, consumables, adapters/receptacles should have compatibility with Indian equivalents	Vendor to confirm	
2.12.5	Flashing / rotary type End of Cutting and Program Stop Light.	Vendor to offer	
2.13	**AIR CONDITIONERS:**		
2.13.1	Air Conditioners (Door mounted - One no. for each cabinet / panel) with Dehumidifiers of suitable / sufficient capacity to be provided for all Electrical / Electronic Panels / Cabinets considering specified ambient conditions. The blow of cool air from the air conditioners shall not fall directly on the electronic circuits/modules. Make & broad specifications of the same are to be submitted.	Vendor to offer	
2.13.2	In case of order, vendor shall provide following information about Air Conditioners and Chiller Unit (s) used in the machine: Type of Refrigeration/ Chiller unit, Capacity of the chiller unit, Type of compressor with complete specifications, Type of Thermostatic Expansion Valve with complete specifications, Fan size and flow in CFM (cubic feet meter) of the Condenser unit, Specifications of the Evaporator Unit (Width Plate type/ Coil type), Functional requirement of temperature of Cooling Oil to be maintained between range T1 to T2, Type of temperature indicator/ controller used in the chiller unit with complete specifications.	Vendor to confirm	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.14	**HYDRAULIC SYSTEM :** Details should be submitted by the Vendor.		
2.14.1	The system should be centralised type . Hydraulic Tank shall preferably be located at floor level. Complete hydraulic system should be designed to avoid any leakage or spillage.	Vendor to offer and confirm	
2.14.2	Make Rexroth / Vickers Sperry or equivalent from a reputed manufacturer. (Details to be submitted)	Vendor to offer and confirm	
2.14.3	Filtration System, Details should be submitted. There should be provision of filters in delivery lines of pumps from oil collection tank to main hydrostat / hydraulic systems tanks. Filter elements should be of Make : EPE / Hydac / equivalent Internationally reputed manufacturer.	Vendor to offer and confirm	
2.14.4	Failure indication	Vendor to offer	
2.14.5	Automatic shut off provision, Details should be submitted.	Vendor to offer	
2.14.6	Refrigerated type cooling (and Electric heating, only if required) 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 offer & submit	
2.14.7	Hydraulic pump capacity (flow / pressure)	Vendor to inform	
2.14.8	Each pump should have an independent motor. Tandem pumps should not be used.	Vendor to confirm & offer	
2.14.9	**First filling of all required Oils & Grease etc**. to be supplied by vendor for complete machine & its peripherals including transformer & air-compressor. Indigenous (Indian) source or Indian equivalent and specifications of oils/ greases are also to be provided by the vendor.	Vendor to offer	
2.15	**COOLANT SYSTEM :**		
2.15.1	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.	Vendor to offer	
2.15.1.1	Recirculating Type Flood Coolant System	Vendor to offer	
2.15.2	All attachments, tool holders, boring bars, cassettes, adapters etc. shall have the provision so that coolant is available directly at the tool-cutting tip.	Vendor to offer	
2.15.3	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. In case, any leakage is found, it shall be corrected by vendor.	Vendor to offer & confirm	
2.15.4	Coolant Filtration System: Recirculating type coolant system with Centrifugal Hydrocyclone System or Vacuum Rotary drum type System and Magnetic Separator.	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.15.5	Paper Filter, in case of grinding facility, with indigenously (Indian) available consumables and its independent selection/operation only during grinding.	Vendor to offer	
2.15.6	Coolant Flow Diagram showing filters, pumps, valves, tanks etc.to be submitted with the offer.	Vendor to submit	
2.15.7	Main Coolant pump & motor details etc. including pressure & flow of coolant for different operations like turning & grinding etc.	Vendor to inform	
2.15.8	Standby Coolant pump & motor should be provided to supply coolant in case of failure of main set.	Vendor to offer	
2.15.9	Coolant Tank Capacity	Vendor to inform	
2.15.10	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 inform	
2.15.11	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 offer	
2.15.12	The coolant tank should be fitted with skimmer for regular cleaning of coolant from contamination with tramp oil.	Vendor to offer	
2.15.13	Coolant tank with pump,valves,filtration system shall be located above the ground. Necessary arrangement for pumping the coolant from pit to main tank with level control shall be provided.	Vendor to offer	
2.16	**ELECTRICAL :**		
2.16.1	Voltage = 415V +10% / -10% , Frequency= 50Hz +3% / -3% , No. of phases = 3 phase with 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 including Voltage Stabilizer, Transformer & Air-Compressor etc. 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.	Vendor to accept.	
2.16.2	**Tropicalisation:** All electrical / electronic equipment shall be tropicalized to suit specified ambient & operating conditions.	Vendor to confirm	
2.16.3	All electrical & electronic control cabinets & panels should be dust and vermin proof	Vendor to confirm	
2.16.4	All electrical components in the cabinets should be mounted on DIN Rail	Vendor to confirm	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.16.5	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	
2.16.6	Motors shall conform to IEC or Indian Standards	Vendor to confirm	
2.16.7	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	
2.16.8	Vendor should ensure the proper earthing for the machine and its peripherals.	Vendor to confirm	
2.16.9	**In-cycle hour counter** with reset facility for counting spindle & carriage running time, cutting time etc. and display the counted data on CNC display	Vendor to offer	
2.17	**SAFETY ARRANGEMENTS:** Following safety features in addition to other standard safety features should be provided on the machine:		
2.17.1	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	
2.17.2	A detailed list of all alarms / indications provided on machine should be submitted by the supplier.	Vendor to confirm	
2.17.3	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	
2.17.4	All the rotating parts used on machine should be statically & dynamically balanced to avoid undue vibrations.	Vendor to confirm	
2.17.5	Emergency Switches at suitable locations as per International Norms should be provided.	Vendor to confirm	
2.17.6	Oil & water pipe lines should not run with electrical cable in the same tray / trench.	Vendor to confirm	
2.18	**ENVIRONMENTAL PERFORMANCE OF THE MACHINE :** The Machine should conform to following factors related to environment :		
2.18.1	Maximum noise level shall be 85 dB(A) at normal load condition, 1meter 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 asked for.	Vendor to confirm	
2.18.2	There shall not be any emissions from the machine except fumes of cutting fluid during machining.	Vendor to confirm	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
2.18.3	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	
2.18.4	No hazardous chemicals shall be required to be used in the machine.	Vendor to confirm	
2.18.5	If any safety / environmental protection enclosure is required it should be built in the machine by the vendor.	Vendor to confirm	
2.18.6	Paint of the machine should be oil / coolant resistant and should not peel off and mix up with coolant.	Vendor to confirm	
3.00	**CHIP CONVEYOR :**		
3.1	A chip conveyor to carry both short and curly chips efficiently and effectively to the chip bin (on tailstock side) should be provided on rear side of the machine or at appropriate location (as recommended by the vendor).	Vendor to offer	
3.1.1	Two nos. of Chip Bins of appropriate size of Indian make, with wheels, lifting hooks & handle for movement, should also be supplied.	Vendor to offer	
3.2	Type of chip conveyor	Vendor to inform	
3.3	Width of conveyor	Vendor to inform	
3.4	Elevation of chip conveyor for chip bin	Vendor to inform	
3.5	Material of chip conveyor (should be rust resistant)	Vendor to confirm	
3.6	Provision for smooth flow of chips through bedways to the conveyor and for avoiding clogging of chips should be provided. Grill/Mesh type rigid covers should be provided above the chip conveyor, to enable machine operator's access to chip conveyor from shop floor for disposal of scattered chips on shop floor, if any, through chip conveyor. Details for the same should be submitted by vendor. Easy removal & fitment shall be considered while designing layout of machine).	Vendor to offer	
3.7	In case of grinding, provision for flushing out grinding dust to avoid clogging of conveyor's holes should be provided.	Vendor to offer	
3.8	Operation of chip conveyor (forward & reverse) through push buttons on operator's panel and at Chip Conveyor	Vendor to offer	
3.9	Layout showing location of chip conveyor should be submitted.	Vendor to submit	
4.0	**SERVO VOLTAGE STABILIZER:**		
4.1	Indian make Oil / Air Cooled servo Controlled Voltage Stabilizer suitable for complete machine, its drives, controls, PLC etc with no undesirable Harmonics in the stabiliser output.	Vendor to offer	
4.2	Make (Neel or Servomax or Aplab or equivalent reputed Indian Manufacturer)	Vendor to inform	
4.3	Model & Rating	Vendor to inform	
4.5	Catalogue of the Voltage Stabiliser shall be submitted with the offer.	Vendor to submit	
5.0	**ULTRA ISOLATION TRANSFORMER :**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
5.1	Indian make Ultra Isolation Transformer suitable for complete machine , its drives, controls, PLC etc. shall be supplied	Vendor to offer	
5.2	Make (Neel or Servomax or Aplab or equivalent reputed Indian Manufacturer)	Vendor to inform	
5.3	Model and Rating	Vendor to inform	
5.5	Catalogue of the Ultra Isolation Transformer shall be submitted with the offer.	Vendor to submit	
6.0	**PNEUMATIC SYSTEM:**		
6.1	**AIR COMPRESSOR:**		
6.1.1	Independent Air Compressor (of reputed Indian make like Elgi or Ingersollrand) 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 (around 4-5 bar with moisture/oil contents) could be used as and when required. The compressor unit should be suitable for continuous duty.	Vendor to offer	
6.1.2	Make & Model of Air Compressor	Vendor to inform	
6.1.3	Make & Model of Refrigerated Air Dryer	Vendor to inform	
6.1.4	Capacity (Flow, Pressure & KW)	Vendor to inform	
6.2	**COMPRESSED AIR POINTS:**		
6.2.1	Compressed Air Point with manually ON/ OFF Valve and flexible pipe of suitable length for work piece cleaning should be suitably provided on carriage near tool post.	Vendor to offer	
7.0	**TOOLINGS :** * Quantity- one no. of each item should be offered, unless specified. * Ordering quantity for all tooling items shall be decided by BHEL at the time of ordering. * LH - Left Hand / RH - Right Hand. Radial - along X axis, Axial - along Z axis. * All tool holders & boring bars, which are not handy, to have holes for lifting by offered jib crane and suitable no. of eye-bolts are to be offered for the same. * All tool holders/boring bars should be complete with their fasteners, coolant connections and packing plates for clamping for square/rectangular shank tools (as applicable) * Detail of consumables/spares like screws, keys etc., used on offered items, shall be provided by vendor in case of order. * Vendor to accept that final drawings for offered items shall be submitted to BHEL after PO, in case of order, for BHEL's approval prior to their manufacturing & supply.	Vendor to accept & offer	
7.1	**TOOL HOLDERS FOR TOOL CARRIERS :**	Vendor to offer	
7.1.1	**Tool Holders for Tool Carrier no. 1 (LH Blade/Plate on Tool Post towards chuck side) :**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
7.1.1.1	Tool Holder for radial clamping of square shank (40mm x 40mm) tools on LH side of tool carrier.	Vendor to offer	
7.1.1.2	Tool Holder for radial clamping of square shank (40mm x 40mm) tools on RH side of tool carrier.	Vendor to offer	
7.1.1.3	Long Tool Holder for radial clamping of square shank (40mm x 40mm) tools on LH side of tool carrier. (Length approx. 400mm)	Vendor to offer	
7.1.1.4	Long Tool Holder for radial clamping of square shank (40mm x 40mm) tools on RH side of tool carrier. (Length approx. 400mm)	Vendor to offer	
7.1.1.5	Tool Holder for axial clamping of square shank (40mm x 40mm) tools on LH side of tool carrier..	Vendor to offer	
7.1.1.6	Tool Holder for axial clamping of square shank (40mm x 40mm) tools on RH side of tool carrier..	Vendor to offer	
7.1.2	**Boring Bar Holder for Tool Carrier no. 1 :**		
7.1.2.1	Boring Bar Holder with through hole for boring bar dia 60, complete with set of fasteners. Holding length for boring bar in the holder should be sufficient (approx. 4xdia i.e. 240mm) for vibration/chattering free boring operation.	Vendor to offer	
7.1.2.1.1	Reduction Sleeve, dia 60 - dia 50, for Boring Bar Holder	Vendor to offer	
7.1.2.1.2	Reduction Sleeve, dia 60 - dia 40, for Boring Bar Holder	Vendor to offer	
7.1.3	**Tool Holders for Tool Carrier no. 2 (RH Blade/Plate on Tool Post towards tailstock side):** Suitable special rigid tool holders for deep grooving, contouring, turning etc. for sizes given below should be offered. Standard grooving inserts of widths and grooving depths same or near to specified sizes may be selected with consent from BHEL. Tool holders should be mountable on tool carrier with inserts facing downwards and also, if possible, with inserts facing upwards. Qty. - One no. of each type, complete in all respects including fasteners/insert etc. 1. Tool Holder with Grooving Insert - Grooving Width = 12 mm / Depth = 60 mm. 2. Tool Holder with Grooving Insert - Grooving Width = 15 mm / Depth = 70 mm. 3. Tool Holder with Grooving Insert - Grooving Width = 18 mm / Depth = 80 mm. 4. Tool Holder with Grooving Insert - Grooving Width = 25 mm / Depth = 120 mm. 5. LH & RH Tool Holder with Round Insert - Round Dia 25 mm / Depth = 140 mm.	Vendor to offer	
7.1.4	**Set of tools, as listed in Annexure-II.**	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
7.1.5	**One set of following items:** a. Tool Storage Cabinets (4 nos.) of reputed Indian make having covered heavy duty drawers of suitable sizes with lock facility to store offered tooling items etc. b. 1 No. of Work bench along with 2 chairs of reputed Indian make. c. 1 No. of Godrej Storwel Almirah or equivalent.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
7.2	**TOOLING FOR MACHINING OF PROVE-OUT COMPONENT (Sl.No. 20.1a):** All types of required tools, inserts, tool holders / cassettes, adapters, grinding wheels, steady pads (with their manufacturing drawings) etc. in sufficient quantity for all types of operations like turning, grooving, grinding, boring, rolling, measurement operations etc., as recommended by the vendor & agreed with BHEL for complete proveout machining as mentioned at Sl.No. 20.1a to meet required drawing accuracy & surface finish .	Vendor to offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
7.2a	**TOOLING FOR MACHINING OF PROVE-OUT COMPONENTS (Sl.No. 20.1b.1 & 20.1b.2):** All types of required tools, inserts, tool holders / cassettes, adapters, grinding wheels, steady pads (with their manufacturing drawings) etc. in sufficient quantity for all types of operations like turning, grooving, grinding, boring, rolling, measurement operations etc., as recommended by the vendor & agreed with BHEL for complete proveout machining as mentioned at Sl.No. 20.1b.1 & 20.1b.2 to meet required drawing accuracy & surface finish .	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
7.3	Additional set of 4 Jaws	Vendor to offer	
8.0	**MEASURING SYSTEMS:**		
8.2	**Laser blade Tip measuring system** for measuring both straight and taper blade tip diameters .	Vendor to offer	
8.3	**Automatic Tool Offset Measuring System** with measuring cycles, calibration system etc suitable for all types of tools recommended for prove-out components. Vendor to furnish detailed description of the system along with offer.	Vendor to offer	
8.4	**Runout Optimization System** to perform runout measurement at different stages/diameters/discs of a turbine rotor by probes/sensors, analysis, display & printout of data, computation of correction parameters to reduce eccentricity of whole rotor.	Vendor to offer	
9.0	**DIAGNOSTIC SYSTEM**		
9.1	**TELE-DIAGNOSTIC SERVICE :**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
9.1.1	Tele-diagnostic service should be provided through International telephone lines along with required Hardware / Software package for the supplied CNC system for remote diagnosis and correction of the problems in both CNC System and PLC of the machine. This should be provided free of charge for the guarantee period. Terms and conditions for the service after guarantee period should be informed by vendor. Subsequently, it should be possible to use other platforms, such as Internet or ISDN, subject to their availability in future. The system shall have facility for storing and generating monthly report of alarms,occuring on the machine during the period.	Vendor to offer & inform	
9.2	**FAULT DIAGNOSTIC SYSTEM:**		
9.2.1	Supplier's own diagnostic system with required hardware and software should be supplied and installed on the CNC system. This should include customised auto-diagnostic system with supporting hardware and software which shows detailed cause and remedy for the fault on the display with full video diagnostic help for faults related to mechanical and electrical maintenance. PG/PC laptop unit supplied along with machine for debugging and diagnostic purpose of PLC system.	Vendor to offer & submit	
9.3	Help guide should be provided to use both diagnostic systems	Vendor to offer	
10.0	**LEVELING & ANCHORING SYSTEM**		
10.1	Complete anchoring system including foundation bolts, anchoring materials, fixators, leveling shoes etc should be supplied.	Vendor to offer	
11.0	**TOOLS FOR ERECTION, OPERATION & MAINTENANCE :**		
11.1	Special tools and equipment required for erection of the machine shall be brought by the vendor. 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 offer	
11.2	Test mandrel for checking spindle run-out & alignment of headstock/tailstock etc. should be supplied.	Vendor to offer	
12.0	**ACCESSORIES :**		
12.1	**ROLLING DEVICE :**		
12.1.1	Rolling Device with required tools, rollers & accessories etc. for rolling of Journal diameters, adjacent LH/RH fillet radii with/without taper entry, faces of turbine rotors.	Vendor to offer	
12.1.2	The cylindricity & runout on dia after rolling operation should be within 0.01mm & 0.02mm respectively.	Vendor to confirm & offer	
12.1.3	Details like drawing of rolling tool, catalogue etc. are to be submitted.	Vendor to submit	
12.1.4	Smallest & Largest fillet radii which can be rolled using offered tool.	Vendor to inform	
12.1.5	Smallest & Largest entry angle of fillet radii which can be rolled using offered tool.	Vendor to inform	
12.1.6	Drawings showing mounting details of Rolling Device on tool post	Vendor to submit	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
12.1.7	Specifications & source of offered Rolling Tool & Rollers shall be informed by vendor for future procurement of same by BHEL.	Vendor to inform	
12.1.8	In case of special coolant requirements for rolling operation, vendor should offer suitable system. Details to be submitted.	Vendor to inform & offer	
12.2	**GRINDING UNIT :**		
12.2.1	The Grinding Unit, having a swiveling base, should be suitably mounted on the Tool Post/Carriage to enable troublefree grinding on journal diameters, Journal & flange faces, blade tips (angular gridning) as per drawing accuracy & surface finish. All operations using grinding unit should be programmable for grinding on different surfaces. The grinding Unit should be supplied with its all required accessories for its' mounting/clamping on tool post, coolant supply/connections using same offered flood coolant through Vacuum Rotary Drum Type Filter + Magnetic Separator + Paper Filter and tools for mounting of grinding wheel on the unit etc.. Details with relevant drawings/sketches/catalogue including list of offered accessories to be submitted.	Vendor to offer	
12.2.2	Grinding unit for grinding Journals of rotors as well as tips of mounted blades (angular gridning) on turbine rotors. The unit shall be mounted on angular rotating base for grinding the inclined tips of turbine rotor blades. Location of unit shall be suitable for grinding journals at a distance of from chuck face as shown in proveout component or similar.	Vendor to offer	
12.2.4	Provision of Wheel Dressing Device, suitably located for CNC program controlled dressing of wheels for accurate alignment of the wheel with working axis considering all types of specified grinding applications. Location of device is to be informed.	Vendor to offer	
12.2.5	Programmable Grinding Cycles & respective Wheel Dressing Cycles for all types of specified grinding operations should be provided.	Vendor to offer	
12.2.6	Additionally, provision for manual grinding i.e. without CNC program should also be there for grinding on diameters & faces and if possible, for angular tip grinding also.	Vendor to offer	
12.2.7	Details of grinding spindle motor like make, rating, type, torque etc.	Vendor to inform	
12.2.8	Max. and Min. dia of Grinding Wheels for all types of specified grinding applications.	Vendor to inform	
12.2.9	Width of Grinding Wheel	Vendor to inform	
12.2.10	Min. & Max. Dia. For Cylindrical Grinding	Vendor to inform	
12.2.11	Min. & Max. Dia. For Facial Grinding	Vendor to inform	
12.2.12	Limitations, if any for grinding on journal LH/RH faces.	Vendor to inform	
12.2.13	Swiveling positions of base of Grinding Unit/Spindle and range for angular tip grinding.	Vendor to inform	
12.2.14	Drawings showing mounting details of grinding unit	Vendor to submit	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
12.2.15	Specifications & source of offered grinding wheels shall be informed by vendor for future procurement of same by BHEL.	Vendor to inform	
12.2.16	Sufficient protection to bearing and guide ways from ground dust / slurry to be provided.	Vendor to confirm	
12.3	**SUPER FINISHING ATTACHMENT :** Super Finishing Attachment for finishing of Thrust Collars and Journals of Rotors to achieve surface finish of Ra 0.4 microns or better.	Vendor to offer	
12.4	**CARDAN SHAFT :**		
12.4.1	Suitable Cardan Shaft (Double Jointer Shaft) for driving large size rotor shaft (like proveout component) supported on two hydrostatic steady rests to perform troublefree rough and finish turning/grooving operations on the shaft at required rpm.	Vendor to offer & submit	
12.4.2	The cardan shaft should have provision of torque transmission through universal joint with sufficient safety factor, tubular design of fixed length, flange yoke with face key connection, maximum operating angle 15 deg, no length compensation etc. Details to be submitted.	Vendor to offer	
12.4.3	Length, flange diameters and coupling/fixing details etc.	Vendor to inform	
12.4.4	Provision to avoid axial shifting/movement (along Z-axis) while driving through cardan shaft for machining of rotors is to be offered. Details to be submitted.	Vendor to offer	
12.4.5	Torque transmitted by the Cardan Shaft	Vendor to inform	
12.4.6	Set of Intermediate Flanges (2 nos. - one each for chuck side & rotor side) to suit offered Cardan Shaft & flanges of proveout component (Sl.No. 20.1a for BHEL Haridwar) with their manufacturing drawings considering clamping of rotor through Cardan Shaft for machining.	Vendor to offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
12.4.6a	Set of Intermediate Flanges (2 nos. - one each for chuck side & rotor side) to suit offered Cardan Shaft & flanges of proveout component (Sl.No. 20.1b.2 for BHEL Hydrabad) with their manufacturing drawings considering clamping of rotor through Cardan Shaft for machining.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
12.4.7	Set of Fasteners, Spanners, Torque Wrench etc. required to clamp Cardan Shaft, its Intermediate Flanges etc. with rotor and chuck.	Vendor to offer	
12.4.8	Drg./Catalogue of Cardan Shaft to be submitted.	Vendor to offer	
13.0	**SPARES:**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
13.1	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:		
13.1.1	**Mechanical & Hydraulic Spares :** Following Spares are to be offered.	Vendor to offer	
13.1.1.1	All types of Pumps used on machine i.e. Hydraulic, Hydrostatic, Lubrication, coolant and oil cooling system (1 no. each type)	Vendor to offer	
13.1.1.2	All types of Pressure control valves, Pressure reducing valves, Flow control valves & Direction control valves used in Hydraulic, Lubrication, Pneumatic & Coolant circuit. (1 no. of each type)	Vendor to offer	
13.1.1.3	All types of pressure switches, pressure transducers, flow switches and float switches used in Hydraulic, Lubrication, Pneumatic & Coolant circuit. (1 no. of each type)	Vendor to offer	
13.1.1.4	All types of Filter Cartridges of regenerative type (5 nos. of each type)	Vendor to offer	
13.1.1.5	All types of Filter Cartridges of disposal type (10 nos. each type)	Vendor to offer	
13.1.1.7	One set of belts (including timing belt) used in the machine.	Vendor to offer	
13.1.1.8	One set of seal kits used in different hydraulic & pneumatic cylinders in the machine.	Vendor to offer	
13.1.1.9	All types of Wipers & O-rings (5 nos. of each type) used in the machine.	Vendor to offer	
13.1.2	**Electrical /Electronic / CNC Spares :** Following Spares are to be offered.	Vendor to offer	
13.1.2.1	Relays (2 Nos each type)	Vendor to offer	
13.1.2.2	Contactors (2 Nos each type)	Vendor to offer	
13.1.2.3	Semiconductor Fuses of each Type and Rating (1 No each type)	Vendor to offer	
13.1.2.4	Proximity Switches & Limit Switches (2 Nos each type)	Vendor to offer	
13.1.2.5	Push Buttons (10 Nos each type)	Vendor to offer	
13.1.2.6	Indicating Lamps (10 Nos each type)	Vendor to offer	
13.1.2.7	Circuit Breakers (2 No each type)	Vendor to offer	
13.1.2.8	Encoder for spindle (1 No)	Vendor to offer	
13.1.2.9	Encoders & Scanning Heads for Linear Scales (1 No each type)	Vendor to offer	
13.1.2.10	PCU module (Hard disk loaded with Ghost of the machine after final commissioning)	Vendor to offer	
13.1.2.11	NCU module	Vendor to offer	
13.1.2.12	I/O Cards for PLC (1 No each type)	Vendor to offer	
13.1.2.13	Power Module & Control Cards for Main Drive as well as Feed Drives (1 Nos each type)	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
13.2	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 these in advance, if required.	Vendor to confirm	
13.3	Recommended Set of Spares (Package of Mechanical & Electrical/Electronic Spares) for all attachments including Voltage Stabiliser (Sl.No. 4.0), Air Compressor and Refrigerator type Dryer etc. (Sl.No. 6.1), Laser Blade Tip Measurement System (Sl.No. 8.2), Automatic Tool Offset Measuring System (Sl.No. 8.3), Runout Optimisation System (Sl.No. 8.4), Rolling Unit (Sl.No. 12.1), Grinding Unit (Sl.No. 12.2), Superfinishing Unit (Sl.No. 12.3) are to be offered with details. (List showing name & quantity of items is to be submitted.)	Vendor to offer	
13.4	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	
14.0	**DOCUMENTATION :** Five sets of following documents (Hard copies) & soft copies (wherever specified) in English language should be supplied along with the machine	Vendor to offer	
14.1	Operating manuals of Machine & CNC system	Vendor to offer	
14.2	Programming Manuals of Machine & CNC system	Vendor to offer	
14.3	Detailed Maintenance manual of machine with all drawings of machine assemblies/sub-assemblies/parts including Electrical / Pneumatic/ Coolant / Hydraulic circuit diagrams. All Hydraulic circuit drawings shall be fixed on the machine on anodised sheet. All Assembly/ Sub Assembly Drawings shall be supplied with the part list also.	Vendor to offer	
14.4	Maintenance, Interface & commissioning manuals for CNC system, spindle & feed drives.	Vendor to offer	
14.5	Manufacturing drawings for all supplied tool holders, coolant connections, tailstock center, adapters, sleeves, fixtures etc.	Vendor to offer	
14.6	Catalogues, O&M Manuals of all bought out items including drawings, wherever applicable.	Vendor to offer	
14.7	Detailed specification of all rubber items and hydraulic/lube fittings	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
14.8	Operating Manuals, Maintenance Manuals & Catalogues for supplied Voltage Stabiliser (Sl.No. 4.0), Air Compressor and Refrigerator type Dryer etc. (Sl.No. 6.1), Laser Blade Tip Measurement System (Sl.No. 8.2), Automatic Tool Offset Measuring System (Sl.No. 8.3), Runout Optimisation System (Sl.No. 8.4), Rolling Unit (Sl.No. 12.1), Grinding Unit (Sl.No. 12.2), Superfinishing Unit (Sl.No. 12.3) and all supplied Accessories.	Vendor to offer	
14.9	PLC program print-outs with comments in English.	Vendor to offer	
14.10	PLC program on CD, NC data & PLC data on floppy.	Vendor to offer	
14.11	Complete back-up of hard disk on GHOST CD and clear written Instructions (3 copies) to take back-up and reloading of a new hard disk. Spare hard disk with complete back-up loaded on it	Vendor to offer	
14.12	Complete Master List of parts used in the machine shall be submitted by the vendor.	Vendor to offer	
14.13	One additional set of all the above documentation on CD ROM, wherever possible. This should include complete backup (on CD) of all cycles/subroutines (provided by both vendor and supplier of CNC System) and any other special programs pertaining to different applications/machining processes/accessories/measuring systems etc. including CNC programs for proveout machining.	Vendor to offer	
15.0	**TRAINING & PRE-DISPATCH INSPECTION :**		
15.1	BHEL Persons should be trained at supplier's Works for the period of two weeks each (10 working days) in the area of (a) CNC Part Programming / Technology, Use of all CNC Features, Programming for Measuring Systems & supplied accessories etc. (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. Pre-dispatch inspection (ref. Sl.No. 21.1) of the machine shall also be carried out by the team during their stay at vendor's works for the training. Vendor may specify days required for pre-dispatch inspection. BHEL reserves the right to choose no. of persons, field & period of training, out of above, while deputing their engineers for training.	Vendor to offer	
15.2	Air-fare, boarding & lodging for the trainees shall be borne by BHEL.	Vendor to note	
15.3	Competent, English speaking experts shall be arranged by the vendor during training for satisfactory & effective training of BHEL personnel.	Vendor to confirm	
15.4	Vendor to quote for training on per man per day basis	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
15.5	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	
16.0	**FOUNDATION :**		
16.1	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. Soil condition data will be furnished by BHEL along with the approval. Complete Foundation Design including details viz. static / dynamic load details etc. to suit soil condition at BHEL Haridwar (Sl.No. 16.1a) and Final Layout drawings to suit location/available area at respective site shall be submitted by the supplier within three months after getting BHEL's approval. The layout should consist of all reqirements pertaining to complete machine including space requirement for Voltage Stabilizer, Isolation Transformer, Air compressor, Chip Bin & any other accessories. **BHEL, Haridwar shall construct** complete foundation for the machine under supervision of supplier and at supplier's responsibility. 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.	Vendor to offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
16.1a	The Soil condition data at site for the machine (BHEL, Hardwar) is as below: (Based on the tests : BH1, D4, PLT1) a) The Dynamic Properties are as below: (i) Cu = 1.667 kg/cubic cm (ii) CΦ = 9.70 kg/cubic cm (iii) CΨ = 4.20 kg/cubic cm b) Bearing Capacity at 3M depth = 7.2 Tons/SquareM and at 5M depth = 10.6 Tons/SquareM c) At depth 3M and below c = 0.0, Friction Angle Φ = 31, Bulk Density = 1.7 Tons/Cubic	Vendor to note "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
16.2	Vendor shall submit the preliminary General Arrangement Drawing & Layout Drawing for getting BHEL's approval within two months from the date of Letter of Intent (LOI) / P.O. Complete Foundation details viz. static / dynamic load details etc. and Final Layout drawings shall be submitted by the supplier within two months after getting BHEL's approval. The layout should consist of all reqirements pertaining to complete machine including space requirement for Voltage Stabilizer, Isolation Transformer, Air compressor, Chip Bin & all other accessories/ attachments/ offered items. **BHEL - Hyderabad shall design & construct** complete foundation for the machine as per Final Layout & other details provided by vendor. The vendor shall also indicate detailed specifications of grouting compound and grouting procedure etc. if any specifically desired for foundation bolts of the machine.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
17.0	**ERECTION & COMMISSIONING :** The two machines shall be erected & commissioned separately in different cities i.e. one at the works of BHEL, Haridwar (Machine No. 1) and other at the works of BHEL, Hyderabad (Machine No. 2).	Vendor to note	
17.1	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 offer	
17.2	Erection & Commissioning of Voltage stabilizer, Isolation Transformer & Air Compressor shall also be responsibility of the vendor.	Vendor to offer	
17.3	Successful proving of BHEL component by the supplier shall be considered as part of commissioning. All tests, as mentioned at Sl.No. 21 (Machine Acceptance) shall form part of the commissioning activity.	Vendor to offer	
17.4	All tools required for performing machine geometry test shall be supplied by vendor.	Vendor to offer	
17.5	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 offer	
17.6	Commissioning spares, required for commissioning of the machine within stipulated time, shall be brought by the supplier on returnable basis.	Vendor to offer	
17.7	All Cover Plates required for the machine and its peripherals including pits, if any, shall be supplied and installed by the vendor. The plates may be sourced from India.	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
17.8	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 offer	
17.9	Schedule of Erection and Commissioning shall be submitted with the offer.	Vendor to submit	
17.10	Charges, duration, terms & conditions for E&C should be furnished in detail separately by vendor along with offer.	Vendor to submit	
18.0	**ACCURACY TESTS:**		
18.1	**GEOMETRICAL ACCURACIES :**		
18.1.1	Geometrical Accuracy Tests shall be in accordance with ISO 1708 standard or equivalent applicable standard. Detailed Test Charts for the same, clearly showing the accuracies to be achieved on the machine, shall also be submitted with the offer.	Vendor to confirm & submit	
18.1.2	Head Stock Spindle run out: (Radial & Axial)	**≤** 0.015 mm	
18.1.3	All other accuracies to confirm to ISO 1708 (Latest Revision) or Suppliers Test chart whichever is finer.	Vendor to offer	
18.1.4	Tail stock Quill taper run-out	Vendor to inform	
18.1.5	Cylindricity of turning (To suit proveout component)	Vendor to inform	
18.1.6	True roundness of turning (To suit proveout component)	Vendor to inform	
18.1.7	Facial run-outs (To suit proveout component)	Vendor to inform	
18.1.8	All the above accuracies should be demonstrated to BHEL engineers during pre-acceptance at Suppliers works and during Erection & Commissioning at BHEL Works.	Vendor to confirm	
18.2	**MACHINE POSITIONING ACCURACIES & REPEATABILITY:** Should be measured as per VDI/ DGQ3441/ ISO 230-2 (Latest Revision) using LASER INTERFERO METER.	Vendor to confirm	
18.2.1	Positioning accuracy in X axis (Pa) per 1000 mm	**≤** 0.015 mm	
18.2.2	Positioning accuracy in Z axis (Pa) per 1000 mm	**≤** 0.015 mm	
18.2.3	Repeatability in X axis (Ps)	0.01mm or less	
18.2.4	Repeatability in Z axis (Ps)	0.01mm or less	
18.2.5	Positioning accuracy over entire traverse in X axis (Pa)	Vendor to inform	
18.2.6	Positioning accuracy over entire traverse in Z axis (Pa)	Vendor to inform	
18.2.7	Total positioning error along X & Z axes per 1000 mm (P)	Vendor to inform	
18.2.8	Total positioning error along X & Z axes over entire traverse (P)	Vendor to inform	
18.2.9	All the above accuracies should be demonstrated to BHEL engineers during pre-acceptance at Suppliers works and during Erection & Commissioning at BHEL Works	Vendor to confirm	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
19.0	**OPERATING CONDITIONS & THERMAL STABILITY**		
19.1	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 (AC): Voltage = 415V +10% / -10% , Frequency= 50Hz +3% / -3% , No. of phases = 3 phase with neutral. Ambient Operating Conditions: Temperature = 5 to 45 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)	Vendor to offer & confirm	
19.2	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 machine is suitable for above and details of provisions on the machine for the same are to be furnished by Vendor)	Vendor to accept & confirm	
19.3	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. (Vendor to confirm that machine is suitable for above and details of provisions on the machine for the same should be furnished by Vendor)	Vendor to accept & confirm	
19.4	The machine, including attachments and accessories, should be suitable for 24 hrs. continuous operation to its full capacity for 24 hour a day and 7 days a week throughout. Vendor to ensure and confirm the same.	Vendor to accept & confirm	
20.0	**PROVEOUT OF BHEL COMPONENTS :**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
20.1a	**PROVEOUT OF BHEL COMPONENT (1 NO.) AT BHEL HARIDWAR:** Drawings of proveout component are enclosed. Vendor to submit preliminary process, time study & tool list recommended by them along with the offer. Final Job setting plan, Machining process plan & Requirement of Tools etc. for machining of proveout component shall be discussed and mutually agreed with vendor (Final proveout component drawing no. may change, however, the machining features of the changed components shall be in line with the original component drawing). 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 of the proveout components shall be provided by BHEL. Vendor shall submit final job setting plan, machining process plan, tool layout & list with complete description, time study etc. for the proveout machining within two months of placement of order. Vendor shall submit CNC programs prior to start of erection of Machine at BHEL works.	Vendor to offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
20.1a.1	The proveout component shall be one turbine rotor (L.P.Rotor of Steam Turbine) as per following drawing nos. or similar. The drawings are enclosed. * Forging of Shaft - drg.no. 11030146999 * Shaft - drg.no. 01030146000 * Groove Plan - drg.no. 91030446051 * T-Groove - drg.no. 41010746012 * T-Groove - drg.no. 41010746014 * T-Groove - drg.no. 41020446014 * T-Groove - drg.no. 41030446011 * T-Groove - drg.no. 41030446012 Note: Groove Plan - drg.no. 91030446051 shows both casing and rotor parts. Only rotor part is to be considered. Above drawings should be treated as BHEL property. Strict confidentiality is to be maintained and under no circumstances these drawings or copy of these must be transferred to third party without permission of BHEL. These drawings must not be used directly or indirectly in any way detrimental to the interest of the BHEL.	Vendor to accept & confirm "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
20.1a.2	The proveout machining shall include following operations:		
20.1a.2.1	All turning and grooving operations for machining of Shaft including Groove Plan.	Vendor to accept & offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
20.1a.2.2	Grinding operations on journal diameters, faces and flange faces.	Vendor to accept & offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
20.1a.2.3	Rolling operations on journal dia with fillet radii/contours & faces. Rolling operation shall be demonstrated first on allowance available for machining to establish the process and required surface finish.	Vendor to accept & offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
20.1a.3	All operations shall be performed using CNC Programs supplied by vendor. The CNC Programs should consist of generalised parametric subroutines for repetitive type of operations like different operations of T-grooves etc. so that these subroutines could be adopted for other similar rotors by using different parameter's values and calling same subroutines in other main-program. During proveout, all tools shall be set by using supplied Tool Offset Measuring System.	Vendor to accept & offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
20.1b	**PROVEOUT OF BHEL COMPONENTS (2 NOS.) AT BHEL HYDERABAD:** Drawings of proveout components are enclosed. Vendor to submit preliminary process, time study & tool list recommended by them along with the offer. Final Job setting plan, Machining process plan & Requirement of Tools etc. for machining of proveout component shall be discussed and mutually agreed with vendor (Final proveout component drawing no. may change, however, the machining features of the changed components shall be in line with the original component drawing). 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 of the proveout components shall be provided by BHEL. Vendor shall submit final job setting plan, machining process plan, tool layout & list with complete description, time study etc. for the proveout machining within two months of placement of order. Vendor shall submit CNC programs prior to start of erection of Machine at BHEL works.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
20.1b.1	**PROVEOUT COMPONENT NO. 1:** The proveout component shall be one Steam Turbine Rotor as per drawing nos. mentioned in Annexure-III. Raw Material : High Alloy Steel 26NiCrMoV145. Above drawings should be treated as BHEL property. Strict confidentiality is to be maintained and under no circumstances these drawings or copy of these must be transferred to third party without permission of BHEL. These drawings must not be used directly or indirectly in any way detrimental to the interest of the BHEL.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
20.1b.1.1	The proveout machining shall include operations as mentioned in Annexure-III.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
20.1b.1.2	All operations shall be performed using CNC Programs supplied by vendor. The CNC Programs should consist of generalised parametric subroutines for repetitive type of operations like different operations of TT-grooves etc. so that these subroutines could be adopted for other similar rotors by using different parameter's values and calling same subroutines in other main-program. During proveout, all tools shall be set by using supplied Tool Offset Measuring System.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
20.1b.2	**PROVEOUT COMPONENT NO. 2:** The proveout component shall be one Frame-6 Gas Turbine Unit Rotor as per drawing nos. Assembly Drawing : 13530161001-XX Drive End Detail Drg: 13530461003-XX. Raw Material : Alloy steel. Above drawings should be treated as BHEL property. Strict confidentiality is to be maintained and under no circumstances these drawings or copy of these must be transferred to third party without permission of BHEL. These drawings must not be used directly or indirectly in any way detrimental to the interest of the BHEL.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	
20.1b.2	The proveout machining shall include following operations: The Assembled GT rotor shall be mounted on two hydrostatic steady rests & pads of suitable diameter and driven by Cardan shaft with necessary arrangement for arresting axial movement of the rotor while rotating/cutting. The rotor shall be rotated at slow RPM to take the axial & radial runouts & trim cuts on the rotor.	Vendor to offer "Applicable only for MACHINE NO. 2 (FOR HYDERABAD)"	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
20.2	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 accept	
20.3	Vendor shall be responsible, financially or otherwise, for any deviation/ rejection in proveout component to the extent of cost of Casting/Forging, 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..For such deviation / rejection, commercial condition as informed separately shall be applicable.	Vendor to accept & confirm	
21.0	**MACHINE ACCEPTANCE: (Tests/Activities to be Performed by Vendor)**		
21.1	**Tests/Activities to be carried out at supplier's works on the machine before dispatch :** Report of the same shall be submitted to BHEL.	Vendor to accept & offer	
21.1.1	Geometrical accuracies as per test chart (ref. Sl.No. 18.1)	Vendor to accept	
21.1.2	Positioning accuracies as per VDI-DGQ/3441 (ref. Sl.No. 18.2)	Vendor to accept	
21.1.3	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 accept	
21.1.4	Demonstration of all features of the machine, control system & accessories	Vendor to accept	
21.1.5	Machining of test piece as per AFNOR/ISO. Vendor to supply test piece and tooling for it's machining.	Vendor to accept & submit	
21.2	**Tests/Activities to be carried out at BHEL works while commissioning the machine :**		
21.2.1	Geometrical accuracies as per test chart (ref. Sl.No. 18.1)	Vendor to accept	
21.2.2	Positioning accuracies as per VDI-DGQ/3441 (ref. Sl.No. 18.2)	Vendor to accept	
21.2.3	Full load test to demonstrate the maximum power & cutting capacity of the machine.	Vendor to accept	
21.2.4	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 accept	
21.2.5	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 accept	
21.2.6	Demonstration by actual use of all supplied attachments and accessories to their full capacity.	Vendor to accept	
21.2.7	Machining test piece as per AFNOR/ISO. Vendor to arrange Test pieces and tooling for it's machining.	Vendor to accept	
21.2.8	Job Proveout machining as per Sl.No. 20.0.	Vendor to accept	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
21.2.9	Two weeks supervision of independent operation of machine by BHEL after job proveout	Vendor to accept	
21.2.10	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 accept	
22.0	**PACKING:**		
22.1	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 dispatched in containers, all small loose items shall be suitably packed in boxes	Vendor to accept & offer	
23.0	**GUARANTEE :**		
23.1	24 months from the date of acceptance of the machine.	Vendor to offer	
24.0	**GENERAL :**		
24.1	Machine Model No.	Vendor to inform	
24.2	Total connected load (KVA):	Vendor to inform	
24.3	Floor area required (Length, Width, Height) for complete machine & accessories	Vendor to inform	
24.4	Painting of Machine / Electrical Panels : RAL 6011 Apple Green (Polyurethane Paint)	Vendor to offer	
24.5	Total weight of the machine	Vendor to inform	
24.6	Weight of heaviest part of machine	Vendor to inform	
24.7	Weight of the heaviest assembly / sub-assembly of the Machine	Vendor to inform	
24.8	Dimensions of largest part/ sub-assembly/ assembly of the machine	Vendor to inform	
24.9	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, Swing Over Carriage, Center Distance, Load Carrying Capacity, Main Drive Rating, CNC System etc	Vendor to submit	
24.10	Detailed catalogues , sketch/ photographs of the m/c and accessories/ attachments should be submitted with the offer.	Vendor to confirm	
24.11	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	
25.0	**QUALIFYING CONDITIONS :**		

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
25.1	Only those vendors, who have supplied and commissioned at least one CNC LATHE of same (SOC i.e. 3600mm, Load Carrying Capacity i.e. 80tons, with Hydrostatic Guideways, At least half of the Admit Between Centers specified which comes to be 6000mm) or higher sizes 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 its 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 (referred) machines have been supplied. This is required from all the vendors for qualification of their offer.	Vendor to accept & confirm	
25.2	Name of the customer / company where referred machine is installed.	Vendor to inform	
25.3	Complete postal address of the customer.	Vendor to inform	
25.4	Month & Year of commissioning	Vendor to inform	
25.5	Parameters of machine(s) supplied (Swing Over Carriage, Center Distance, Load Carrying Capacity) and application for which the machine is supplied.	Vendor to inform	
25.6	Name and designation of the contact person of the customer.	Vendor to inform	
25.7	Phone, FAX no. and email address of the contact person of the customer.	Vendor to inform	
25.8	Performance certificate from the customers regarding satisfactory performance of machine supplied to them (Original Certificate or Through E-mail directly from the customer). The original performance certificate may be returned after verification by BHEL, if required.	Vendor to submit	
25.9	BHEL reserves the right to verify the information provided by vendor. In case the information provided by vendor is found to be false/ incorrect, the offer shall be rejected.	Vendor to accept & confirm	
26.0	**OTHER FEATURES:**		
26.1	**NETWORKING:**		
26.1.1	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 offer	
26.1.1.1	The machine shall appear as a node in the Entire Network. (Network Neighborhood)	Vendor to confirm	
26.1.1.2	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	
26.1.1.3	The program transfer between CNC system and network should also be possible in CNC Mode.	Vendor to confirm	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
26.2	**MACHINE MONITORING SYSTEM (MMS) SIGNALS**		
26.2.1	Following MMS signals would be made available on a specifically earmarked terminal strip. These MMS signals would be sourced from CNC system / PLC output separately.	Vendor to offer	
26.2.1.1	Control ON	Vendor to confirm	
26.2.1.2	Cycle ON	Vendor to confirm	
26.2.1.3	Spindle Running	Vendor to confirm	
26.2.1.4	Feed Active (Any of the axes moving)	Vendor to confirm	
26.2.1.5	M30 (Program Stop)	Vendor to confirm	
27.0	**OPTIONAL ITEMS :**		
27.1	**BALANCING OF GRINDING WHEEL:** Provision of Balancing of Grinding Wheel which shall be mounted on Grinding Unit (Sl.No. 12.2) should be provided for carrying out Grinding Operation effectively. Details to be submitted.	Vendor to offer	
27.3	**STORAGE & HANDLING FACILITY FOR ACCESSORIES/ATTACHMENTS:** Suitably located, effective and safe storage stations are to be provided for adequate storage of the accessories like Grinding Unit, Rolling Device, Cardan Shaft & Steady Rests etc., when they are not in use. To be shown on preliminary layout by vendor.	Vendor to offer	
27.4	**HYDRAULIC CHUCK:** Complete system to have hydraulically operated movement & locking of all Jaws of the offered chuck instead of mechanical force multipliers (Sl.No. 2.2.13). Technical Details of hydraulic system & its components are to be informed by vendor with relevant drgs. Additionally, Vendor may offer also any other type of system for power operated movement/locking of jaws as an option. Vendor to quote only additional cost for equipping offered Chuck with 4 Jaws (Sl.No.2.1.13) with hydraulic movement instead of mechanical force multipliers, as above.	Vendor to offer	
27.5	**AUTOMATIC JOB MEASURING SYSTEM:**		
27.5.1	Automatic wireless job measuring system comprising of Renishaw make wireless system. The system shall be capable of measuring all the details of the complete rotor after machining The supplier shall furnish the details of the measuring system along with the quotation. Itemized break up of the system shall be furnished.	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
27.5.2	The supplier shall quote probes, stylus, software and measuring cycles for the system. The system shall perform automatic measurement of the following in a Single Program by using the Measuring Cycles. (1) Series of blade groove details (that include groove position, groove widths, groove depths, neck thickness and inside T-width) for all sizes of blade grooves on rotor .(2) Series of Outside Diameters (3) Series of Step Positions and Step Widths There shall be a provision for offline measurement programming.	Vendor to offer	
27.5.3	There shall be a provision that, in case of an unwarranted trigger, the machine shall stop automatically to avoid probe damage.	Vendor to offer	
27.5.4	The System shall facilitate formatted display of the nominal, tolerance, actual and deviation results in a Screen. The system shall print the results in a user defined format. The printer required for the same shall be quoted. Sufficient number of ports and driver software to transmit the formatted measurement data independently over LAN and to the supplied printer shall be available.	Vendor to offer	
27.5.5	Suitable accessories to calibrate the Probe for Diameter and Step / Groove/ suspension measurements shall be quoted. There shall be provision to position the calibration accessories at a convenient place in the machine. Details of the calibration set up shall be furnished along with the quotation. Appropriate automatic Calibration cycles shall be quoted.	Vendor to offer	
27.5.6	Supplier shall furnish the details of the accuracy and repeatability of measurement (of diameters, steps, groove widths, suspensions etc.) on the job by the probe.	Vendor to offer	
27.5.7	Supplier shall quote the spares of the measuring system for 5 (five) years of trouble free operation. This shall include a minimum of 10 (ten) stylus and one probe head apart from other spares of this system recommended by the supplier	Vendor to offer	
27.5.8	Supplier shall train BHEL Engineers in using the measuring system (with actual demonstration on the job) and writing measurement programs. The training on measuring system to be provided at OEM works during Pre-dispatch Inspection (at Supplier's works) and during commissioning (at BHEL works).	Vendor to offer	
27.5.9	Supplier shall prove out the measuring system by measuring all the machined dimensions of the prove out components and printing a formatted measurement report for the same. Suitable measuring program for the prove-out components shall be prepared by the supplier. The source code of this sample program shall be explained to BHEL Engineers during training.	Vendor to offer	

SL. NO.	DESCRIPTION FOR BHEL REQUIREMENT		Vendor's offer with Technical details & Remarks
27.6	**INCREASED WEIGHT CAPACITY:** Provisions to make complete machine capable of machining of rotors of weight up to 120000Kg, clamped in headstock (at one end) and supported on hydrostatic steady rest at other end without use of tailstock support, inplace of specified requirement of 80000Kg at Sl.No. 2.1.4.1. Vendor to quote only additional cost.	Vendor to offer "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
27.7	**CHUCK WITH 8 JAWS:** Chuck with 8 nos. of Hard Jaws in stead of 4 nos. as specified at Sl.No. 2.1.13 keeping face plate diameter same as offered against Sl.No. 2.1.12. All the eight jaws should be equipped with Force Multipliers as per Sl.No. 2.2.13. Chucking diameter & weight/length of work piece, above which the use of 8 jaws is recommended by vendor, is to be informed by vendor. Max. & Min. Chucking Diameters for external & internal clamping using all the eight jaws are to be informed by vendor. Vendor to quote only additional costs separately for Chuck with 8 Jaws equipped with mechanical force multipliers, as above, and Chuck with 8 Jaws equipped with hydraulic movement of jaws as elaborated at Sl.No. 27.4	Vendor to offer & submit "Applicable only for MACHINE NO. 1 (FOR HARIDWAR)"	
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ANNEXURE-I		
DETAILS OF HYDRO-STATIC STEADY REST PADS		
S.N0	**ROTOR JOURNAL (DIA X WIDTH mm)**	**QTY**
	GAS TURBINE ROTORS	
1	φ 203.17(-0.03) X 190	1 No
2	φ 203.17(-0.35) X 240	1 No
3	φ 154.20(-0.05) X 160	1 No
4	φ 203.20(-0.03) X 190	1 No
5	φ 241.27(-0.03) X 230	1 No
6	φ 288.29(-0.03) X 270	1 No
7	φ 288.29(-0.03) X 270	1 No
8	φ 698.50(-0.05) X120	2 Nos
9	φ 400.00(-0.04) X 260	1 No
10	φ 426.70(-0.04) X 150	1 No
11	φ 467.56(-0.04) X 380	1 No
12	φ 396.22(-0.04) X 250	1 No
13	φ 551.36(-0.05) X 350	1 No
	STEAM TURBINE ROTORS	
14	φ 250.00(-0.03) X 160	1 No
15	φ 359.46(-0.03) X 280	1 No
16	φ 400.00(-0.03) X 320	1 No
17	φ497.00(-0.04) X 320	1 No

ANNEXURE-II

LIST OF TOOLS FOR CNC LATHE SOC 3.5 MTS

SL. NO	TOOL HOLDER DESCRIPTION	PURPOSE	HOLDERS QTY	INSERTS QTY	REMARKS
1	PCLNR 3225 P12	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
2	PCLNL 3225 P12	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
3	PCLNR 4040 S19	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
4	PCLNL 4040 S19	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
5	PCBNR 4040 S19	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
6	PCBNL 4040 S19	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
7	R 171.35 - 5032 -15	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
8	L 171.35 - 5032 - 15	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
9	PDJNR 4040 V15 (LENGTH = 400)	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
10	PDJNL 4040 V15(LENGTH = 400)	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
11	PDNN 4040 S15	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
12	PDNN 4040 V15(LENGTH = 400)	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
13	SVJBR 3225 P16	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
14	SVJBL 3225 P16	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
15	SVVBN 3225 P16	TURNING	2	50	M/S SANDVIK OR EQUIVALENT
16	PRGCR 2525 M10	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
17	PRGCL 2525 M10	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
18	N176.39 2020 M10	NEUTRAL	2	50	M/S SANDVIK OR EQUIVALENT
19	R X123G04 - 2525 B-045	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
20	L X123G04 - 2525 B-045	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
21	R X123J05 - 3225 B-045	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
22	L X123J05 - 3225 B-045	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
23	R X123J16 - 3225 B-070	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
24	L X123J16 - 3225 B-070	RELIEF	2	50	M/S SANDVIK OR EQUIVALENT
25	R G123K08-2525 CM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
26	L G123K08-2525 CM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
27	R G123L20-2525B-075 BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
28	L G123L20-2525B-075 BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
29	R G123L20-2525B-140 BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
30	L G123L20-2525B-140 BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
31	R F123K25-2525B-168BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
32	L F123K25-2525B-168BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
33	R F123K25-2525B-220BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT

SL. NO	TOOL HOLDER DESCRIPTION	PURPOSE	HOLDERS QTY	INSERTS QTY	REMARKS
34	L F123K25-2525B-220BM	FACE GRV	2	50	M/S SANDVIK OR EQUIVALENT
35	R F123G20 3225 B	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
36	L F123G20 3225 B	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
37	R F123H25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
38	L F123H25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
39	R F123J25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
40	L F123J25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
41	R F123K25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
42	L F123K25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
43	R F123L25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
44	L F123L25 3225 BM	EXT GRV/Shank Type	2	50	M/S SANDVIK OR EQUIVALENT
45	HOLDER 151.2 - 2020 - 21 BLADE 151.2 - 25 - 40	EXT GRV/Blade Type	2	50	M/S SANDVIK OR EQUIVALENT
46	HOLDER 151.2 - 3232 - 25 BLADE 151.2 - 25 - 50	EXT GRV/Blade Type	2	50	M/S SANDVIK OR EQUIVALENT
47	HOLDER 151.2 - 3232 - 25 BLADE 151.2 - 25 - 60	EXT GRV/Blade Type	2	50	M/S SANDVIK OR EQUIVALENT
48	HOLDER 151.2 - 4040 - 45 BLADE 151.2 - 45 - 80	EXT GRV/Blade Type	2	50	M/S SANDVIK OR EQUIVALENT
49	S50W - PCLNR 12	BORING	2	50	M/S SANDVIK OR EQUIVALENT
50	S50W - PCLNL 12	BORING	2	50	M/S SANDVIK OR EQUIVALENT
51	S50W - PDUNR 15	BORING	2	50	M/S SANDVIK OR EQUIVALENT
52	S50W - PDUNL 15	BORING	2	50	M/S SANDVIK OR EQUIVALENT
53	S12M - SCLCR 06	BORING	2	50	M/S SANDVIK OR EQUIVALENT
54	S12M - SCLCL 06	BORING	2	50	M/S SANDVIK OR EQUIVALENT
55	R 166.4FG-3225-16	Threading	2	50	M/S SANDVIK OR EQUIVALENT
56	L 166.4FG-3225-16	Threading	2	50	M/S SANDVIK OR EQUIVALENT
57	R 166.4FG-4040-22	Threading	2	50	M/S SANDVIK OR EQUIVALENT
58	L 166.4FG-3225-22	Threading	2	50	M/S SANDVIK OR EQUIVALENT
59	Rollers for Journals Rolling to 0.4Ra	Rolling	2	NOT APPL	ANY REPUTED MAKE
60	Diamond burnishing tools for Burnishing of Journals	Burnishing	2	NOT APPL	ANY REPUTED MAKE

NOTE: ALL INSERT GRADES SHALL BE SUITABLE FOR MACHINING OF STEAM/GAS TURBINE ROTORS AS PER MATERIAL SPECIFICATION INDICATED AT PART-B

ANNEXURE-III

TYPICAL JOB PROVE-OUT DRAWINGS FOR CNC LATHE - 3.5M

Forging drg	:	11030162901-00/06.
Rotor Drg (1 sht)	:	01030162003-00/01.
Blading Plan drg	:	91030462011-00/01.
Groove plan drg	:	91030462012-00/00.
LP Blade groove drg. (Pos.no-6)	:	41030062012-00/02.
LP Blade groove drg. (Pos.no-7)	:	41030062013-00/02.
LP Blade groove drg. (Pos.no-8)	:	41030062014-00/02.

SEQUENCE OF MACHINING OPERATIONS TO BE CARRIED OUT:

Finish machining of Blading plan portion including groove machining.(i.e. Step dia's as per blading plan & groove as per groove plan drg & journals machining with 2mm allowance on journal dia's as per rotor drg).

NOTE:

A Typical rotor component to be machined is mentioned, however this job prove out (on any one rotor) will be done on any other nearly similar Rotor available at the time of Erection & commissioning. Modifications to carryout the same including CNC Programming, Tooling, Machining time etc.. Shall be part of contract.

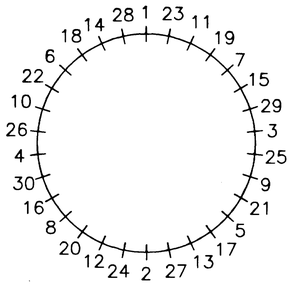
THIRD ANGLE PROJECTION

(ALL DIMENSIONS ARE IN mm)

DRG. NO 1-353-01-61001 SH. 01 OF 01

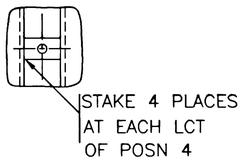
GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

COMPUTER FILE NAME 1530160I.DWG | REF. DRG. NO. 14204844 REV '-' | SIGN. AND DATE | INVENTORY NO

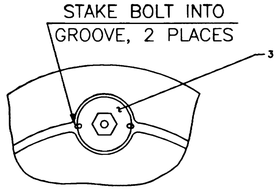


BOLT TIGHTING SEQUENCE

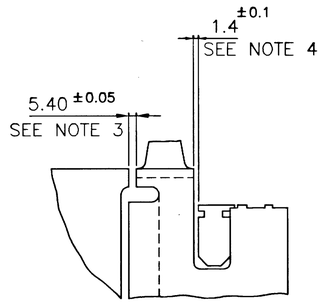
VIEW 'C-2' (F-8)



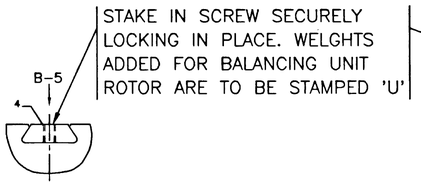
VIEW 'B-4'(C-4)



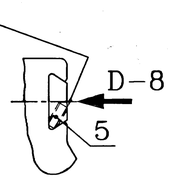
VIEW 'B-6'(F-8)



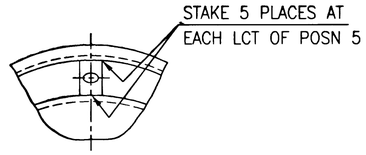
VIEW 'B-8'(E-6)



VIEW 'C-4'(E-7,E-2)



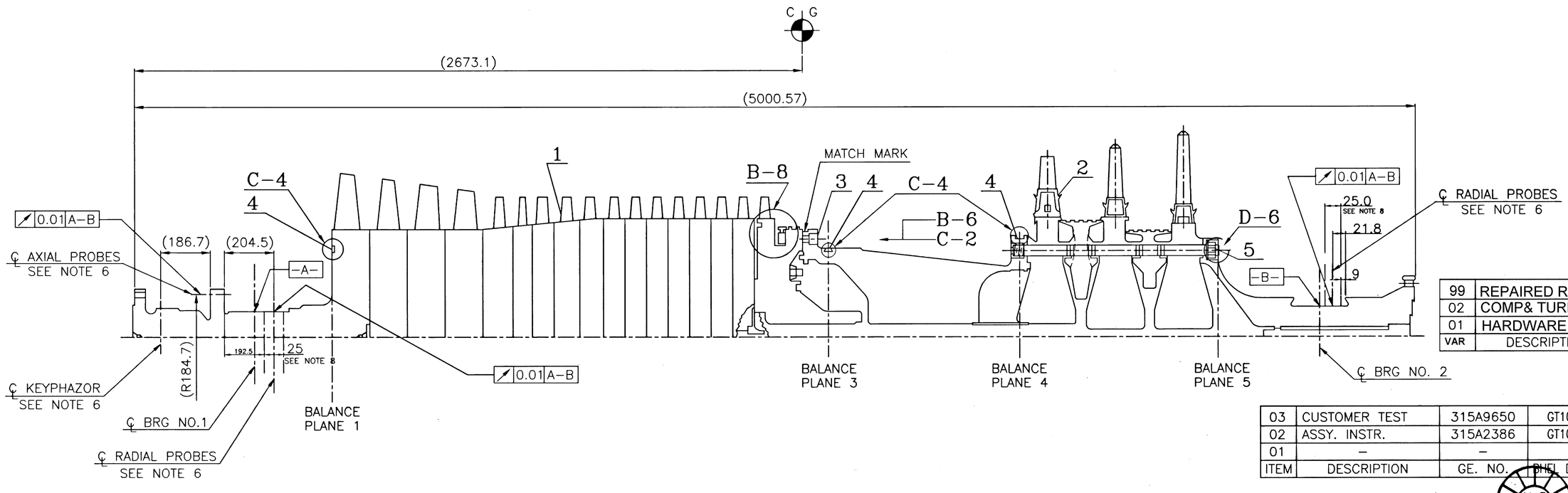
VIEW 'D-6'(F-10)



VIEW 'D-8'(C-6)

NOTES:-

1. FOR ASSY. PROCEDURE SEE ITEM 2 EXCEPT USE GT-5585.
2. HEAT ONLY IS TO BE USED TO ASSEMBLE ROTORS.
3. VERIFY GAP AT FOUR EQUALLY SPACED LOCATIONS AFTER TORQUING OF ROTOR BOLTS AND TEMPERATURE NORMALIZATION.
4. RECORD GAP FOR EACH NUT ON GT-5337 AFTER TORQUING OF ROTOR BOLTS AND TEMPERATURE NORMALIZATION.
5. BALANCE WEIGHTS, POSN 4 AND 5, ARE NOT INTERCHANGEABLE.
6. DEGAUSS PROBE TARGET AREAS TO A LEVEL NO GREATER THAN 5 GAUSS.
7. FOR CUSTOMER TEST SEE ITEM 3.
8. COMBINED ELECTRICAL AND MECHANICAL RUNOUT OF ROTOR IS TO BE MEASURED AT VIBRATION PROBE LACATION (FRONT & REAR) AND MAINTAINED WITHIN 10 μm (AS PER API 616) OVER A WIDTH SHOWN.



99	REPAIRED ROTOR		
02	COMP& TURB ASSY		
01	HARDWARE ONLY		
VAR	DESCRIPTION		

03	CUSTOMER TEST	315A9650	GT10115
02	ASSY. INSTR.	315A2386	GT10261
01	–	–	–
ITEM	DESCRIPTION	GE. NO.	BHEL DOG. NO.

TYPE OF PRODUCT OR
NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LIMITED
HYDERABAD

	NAME	SIGN	DATE	NO.OF VAR.
DRN.	UNIC		4.01.91	
CHD.	K.M.MOHAN		10.1.91	NA
APPD.	K.R.M.RAO		25.7.91	

REV.	DATE	ALTERED	ZONE
04	30/7/04	VARIANT TABLE ADDED DCA NO. GT1596 30/7/04	
03	23.6.97	DRAWING REDRAWN. (DCA NO. GT0860)	
02	22.5.96	DIMENSION 25 AT VIBRATION PROBE LOCATIONS (FRONT & REAR) IS ADDED AS PER CL 3.5 OF SPEC No.GT10115 (DCA No.GT0694 dated:22.5.96	F-2, E-9
01	12.4.96	ZONE C-10 NOTE 8 ADDED. DCA NO.GT0673 dated:12.4.96.	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
GTD	GR. F/M/F	NTS	11364		NA	NA
CODE 423						

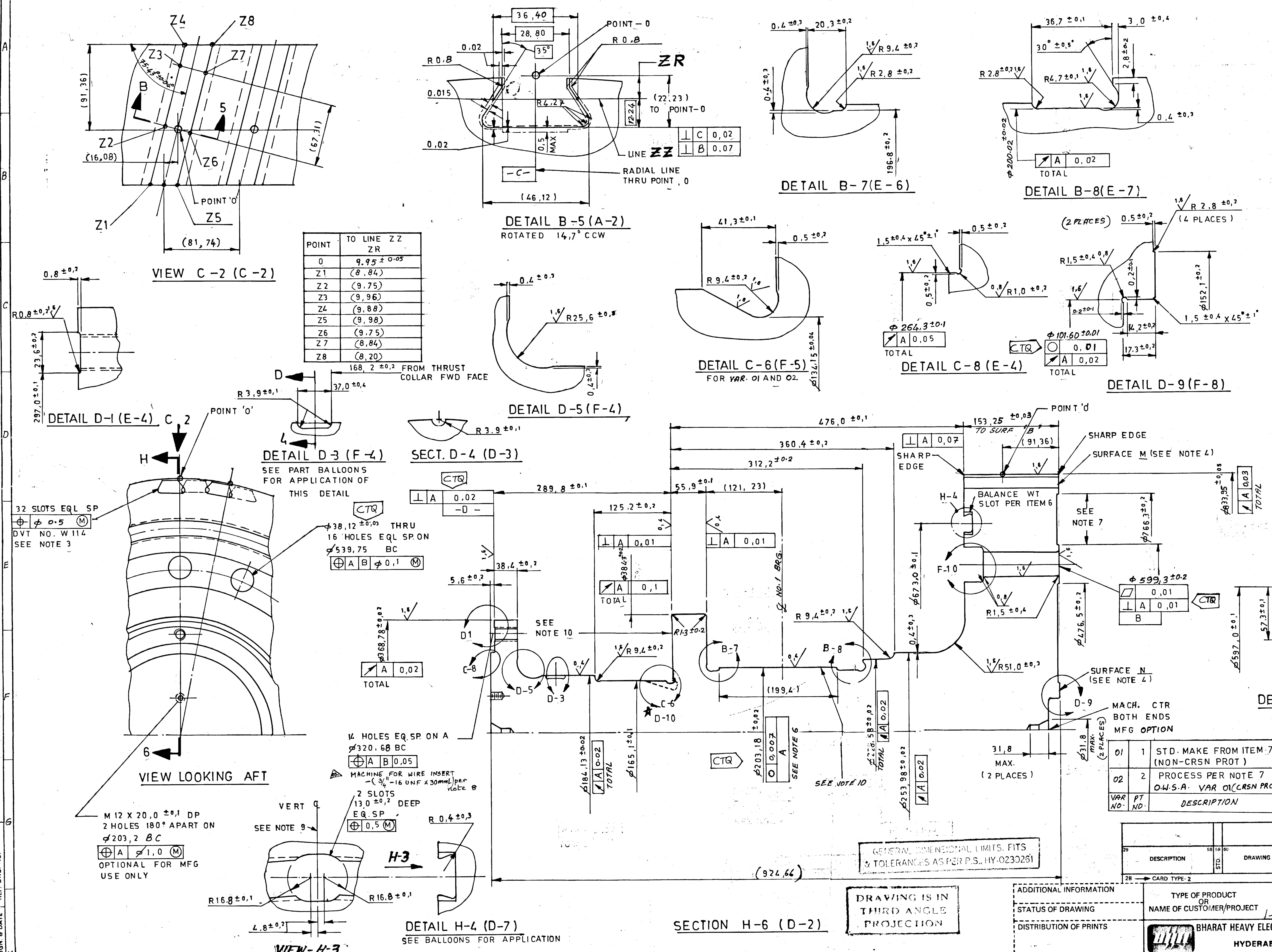
TITLE: ROTOR ASSY, CPRSR AND TURB

CARD CODE | DRAWING NO. 1-353-01-61001 | REV. 04 | SHT. No 01 | NO. OF SHT. 01

THIRD ANGLE PROJECTION

(ALL DIMENSIONS ...)

DRG. NO. 1-35304-61003 SH 1 OF 1



DRAWING IS IN THIRD ANGLE PROJECTION

POINT	TO LINE ZZ ZR
0	9.95 ± 0.05
Z1	(8.84)
Z2	(9.75)
Z3	(9.96)
Z4	(9.88)
Z5	(9.98)
Z6	(9.75)
Z7	(8.84)
Z8	(8.20)

NOTES:

1. PROCESS PER ITEM 2
2. RUNOUTS RECORDED PER ITEM 3
3. ANY CIRCUMFERENTIAL RELATION BETWEEN BOLT HOLES AND DVT. SLOTS IS PERMISSIBLE
4. SURFACE 'M' MUST NOT DEVIATE FROM SURFACE 'B' BY MORE THAN ±0,05 SURFACE 'N' MUST NOT DEVIATE FROM SURFACE 'B' BY MORE THAN ±0,1
5. ~~—~~
6. MAXIMUM PERMISSIBLE TAPER ON JOURNAL DIA. IS 0.2 MM PER METRE OF JOURNAL LENGTH.
7. PROCESS ALL SURFACES BETWEEN ARROWS (SEE ZONES D-7 AND D-8) PER ITEM 5
8. MACHINE FOR WIRE INSERT ONLY PER ITEM 8 PT 24
9. ANGULAR LOCATION OF ENTRANCE OPENING PERMISSIBLE, BUT OPENINGS MUST BE EQUALLY SPACED.
10. DEGAUSS THIS PROBE TARGET AREA TO LEVEL NO GREATER THAN 5 GAUSS. (SEE PART BALLOONS FOR APPLICATION OF THIS REQUIREMENT).

VAR	PT	DESCRIPTION
03	3	DETAIL D-10 & H-4 OTHERWISE SAME AS PT 1 (NON-CRSN PROT)
04	4	DETAIL D-10, H-4 & PROCESS PER NOTE 7 OTHERWISE SAME AS PT 1 (CRSN PROT)

(05) APPLY DETAIL D-10 & H-4 & NOTE 10. PROCESS PER NOTE 7 (CRSNPROT) OTHERWISE SAME AS PT 1

(06) APPLY DETAIL D-3 (KEY PHAZOR SLOT) OWSA P4

VAR NO.	PT NO.	DESCRIPTION
01	1	STD. MAKE FROM ITEM 7 (NON-CRSN PROT)
02	2	PROCESS PER NOTE 7 O.W.S.A. VAR 01 (CRSN PROT)

LIST OF COMPLEMENTARY DOCS.			
8	INSERT WIRE	138C8220	
7	FORGING.	201B3196P1	
6	DVT. MACH.	114A5498	
5	PROCESS	P6C-AG25	GT10116
4	PROCESS	P29A-AG215	GT10108
3	RUNOUTS	GT-5165	
2	SKTG/STPG.	239A5288	GT 10321
1	~~APPL. PRAC~~	~~118D5700~~	—
S.NO.	ITEM	GE REF.	BHEL NO.

DESCRIPTION | STD | DRAWING NO. | IT NO. | VAR. | MATL. CODE | MATL. SPCN. | A/C | UNIT | UNIT WT. 794.0 | QTY. | GS | ZONE

28 → CARD TYPE-2 | 28 → CARD TYPE-1

ADDITIONAL INFORMATION

STATUS OF DRAWING

DISTRIBUTION OF PRINTS

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: FR-6 GT. 1-353-04-61003

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN	DATE
DRN.	V.Vijaya		30/1/91
CHD	K. SATISH		1/1/91
APPD	P.S. CHARY		

REV	DATE	ALTERED / CHECKED	ZONE	DESCRIPTION
01	17/9/91	K. Satish / G.V. Adithyan	F6	17/9/91. ★ Both representations C-6 & D-10 have been incorporated.
02	26/02/93	/ E.V. Adithyan	G3	Helicoil data added
03	1-2-2001			CTQ'S ADDED DCA NO GT 1275 dt 1-2-2001

DEPT CODE: GTD 423 | GRADE OF TOL DIM: CMF | SCALE: N.T.S. | WEIGHT (Kg): 800 | REF. TO ASSY DWG: 132 D3729 Rev L

TITLE: SHAFT, STUB, FWD. CPRSR

CARD CODE | DRAWING NO. 1 35304 61003 - 03 | SHEET NO. 1

REF. DRG. NO. 132 D 3729

INVENTORY NO. | SIGN & DATE

THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY.

TD-149, REV. NO. 2

INVENTORY NO	SIGN. AND DATE	REF. DRG. NO.	COMPUTER FILE NAME
			A0301003.DWG

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261

FIRST ANGLE PROJECTION

DRG. NO. 0-103-01-62003 SH. 1 OF 1

(ALL DIMENSIONS ARE IN mm)

CAUTION:

LAST STAGE L.P FIRTREE BLADES SHOULD NOT BE USED FOR ROTOR ROTATION.

REV.	DATE	ALTERED	CHD/APPD	ZONE	
01	03.1.03	DSR	DSR	H13 K13	DET.Z: 12xM8 HOLES ADDED T.Rs T.R. 14 ADDED.
00	29.11.00	DSR	DSR		NEW DRAWING

NALCO-VII & -VIII	9-10304-62012-00	9-10304-62011-00	00
PROJECT	GROOVE PLAN DRG.	BLADING PLAN DRG.	VAR

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.
HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.				-NA-
CHD.				
APPD.				

DEPT. I.T.D. / DEPT. CODE 415	UNTOL. DIMS. GR.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
	~~C/M/F~~	NTS	24480	-N.A.-	-N.A.-	-N.A.-

TITLE
L.P.ROTOR (N30-2x3.2)

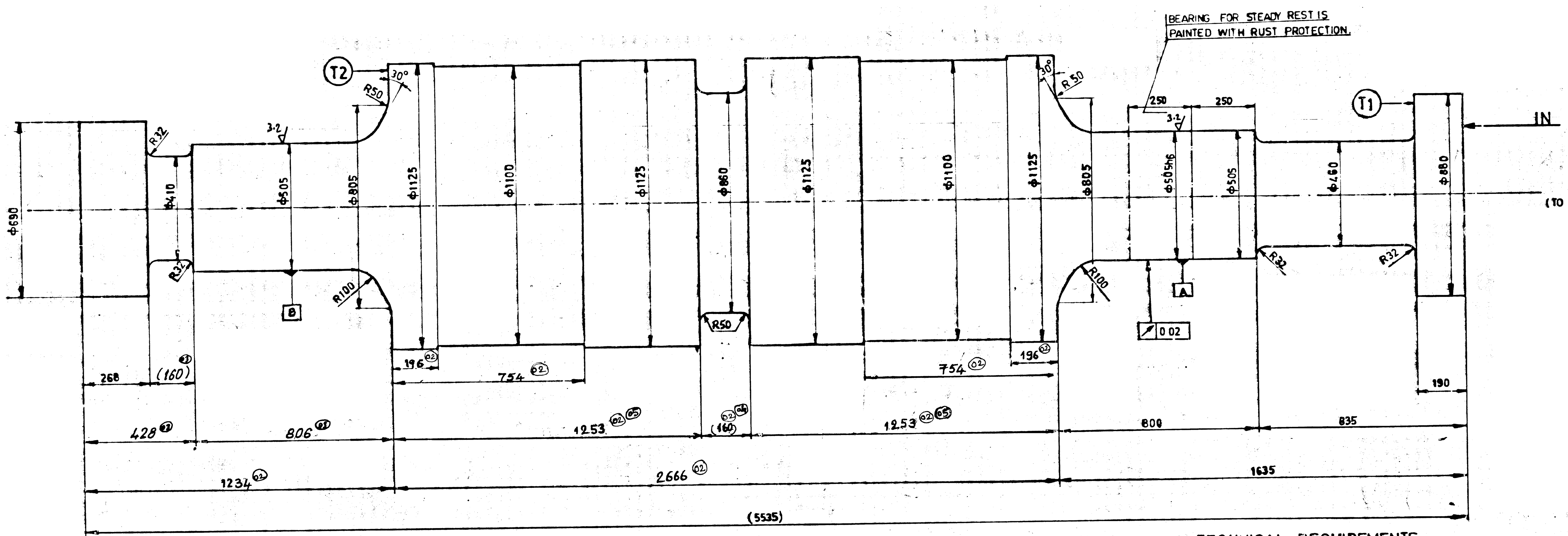
CARD CODE N.A.

DRAWING NO. 0-103-01-62003 REV. 01

SHT. No 1 NO. OF SHT. 1

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN MM)

DRG. NO. 1-103-01-62901 SH. 1 OF 2



TECHNICAL REQUIREMENTS

1. THE FORGING SHALL BE SUPPLIED EXACTLY IN CONFORMITY WITH THE PURCHASING SPECIFICATION NO. HY 19485.
2. THE FORGING SHALL BE SUPPLIED IN ROUGH MACHINED CONDITION. THE PERMISSIBLE TOLERANCES ON OUT SIDE DIMENSION: +2mm.
3. UNSPECIFIED RADII SHALL BE TAKEN AS R10.
4. BRACKETED DIMENSIONS ARE FOR REFERENCE ONLY.
5. AT THE PLACES MARKED T1 AND T2 SUPPLIER SHALL LOCATE THE TANGENTIAL TEST SAMPLES FOR MECHANICAL TESTING AND GET IT APPROVED FROM BHEL. PART OF THE TEST SAMPLE SHALL BE LEFT INTEGRAL WITH THE SHAFT FOR RETESTING PURPOSES AT BHEL.
6. PERMISSIBLE RADIAL RUN OUT OF SHAFT IS 1mm WITH RESPECT TO STEADY REST BEARING [A] [B].
7. THE IDENTIFICATION NUMBER MUST BE STAMPED AT THE PLACE MARKED IN AND SURROUNDED WITH PAINT. IDENTIFICATION ACCORDING TO ST. 00004.
8. THE AXIAL TREPAN BORE AFTER TESTING SHALL BE PLUGGED BY DETACHABLE PLUG. THE PRESERVATIVE USED FOR PROTECTING THE BORE AGAINST CORROSION MUST BE ABLE TO BE REMOVED BY COLD DEGREASING AGENT.
9. AXIAL TREPAN CORE TESTING SHALL BE AS PER VARIANT-02 OF SHEET 2 OF THIS DRAWING.

FOR TESTING OF AXIAL CORE REFER SHEET NO. 2

ST 9518 50000 / HY 19485

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: N30-2×3.2

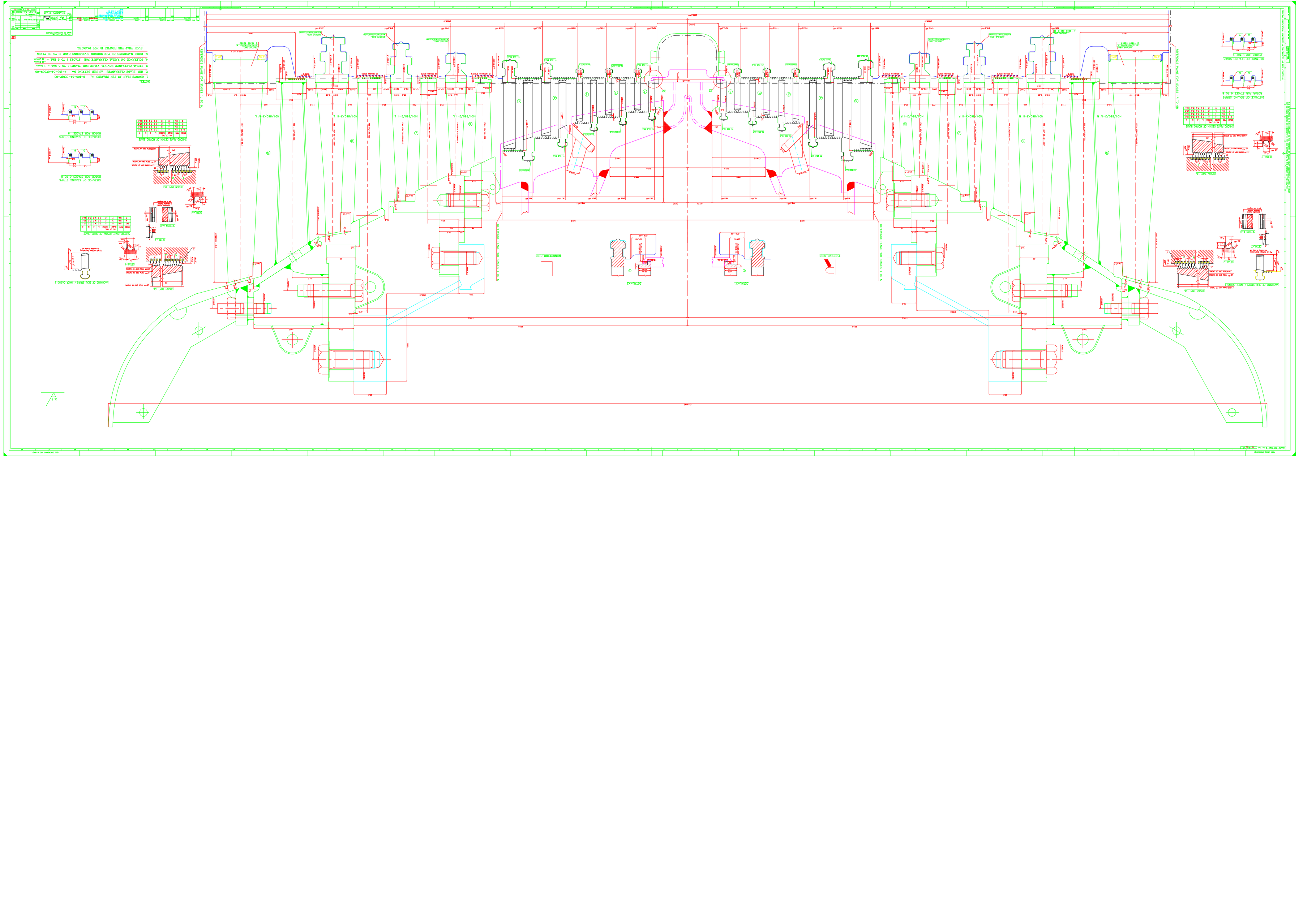
BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

SCALE: NTS — WEIGHT (kg): 25400

TITLE: FORGING FOR L.P. TURBINE SHAFT (ROUGH MACHINED)

DRAWING NO. 1-103-01-62901 — REV. 06

SHEET NO. 1 — NO. OF SHEETS 2



FIRST ANGLE PROJECTION

21029-90-0001-0 ON 1MB 18" A1 ISS

ALL DIMENSIONS ARE IN mm

INSERTION GROOVES DETAILS

FOR STAGES 8R SEC. G-G

FOR STAGES 7R SEC. F-F

FOR STAGES 6R SEC. E-E

SEC C-D

INSERTION GROOVE

DETAILS FOR STAGES 1 TO 5

DIRECTION OF STEAM FLOW

STAGE	B	D	C	F	SR	AR
1	19.90	10.5	4.76	11.7	0.15	41.20
2	19.90	10.5	4.76	11.7	0.15	41.20
3	19.90	10.5	4.76	11.7	0.15	41.20
4	31.70	20.5	6.40	20.5	0.80	44.20
5	38.70	25.5	9.70	24.5	0.77	49.20

TYPE OF GROOVES FOR SEALING STRIPS

ROTOR

FOR STAGES 6 TO 9

18 HOLES

R0.6

GUIDE BLADE GROOVE (RIGHT)

3.2/ (12.5/)

DIRECTION OF STEAM FLOW

R0.4 AS PER BLADING PLAN

MOVING BLADE GROOVE (RIGHT)

W/ (W/)

DIRECTION OF STEAM FLOW

R0.4 AS PER BLADING PLAN

STAGE	MOVING BLADE PROFILE	BF	BHLN	BHRN	LHL	LHR	LHT	RA	RB	RT	FIR	FIL	AF
1 R	T4-20-55.5	25.0	12.5	25.6	12.0	23.0	13.5	6.6	4.0	3.0	1.6	1.2	3.0
2 R	T4-20-55.5	25.0	12.5	25.6	12.0	23.0	13.5	6.6	4.0	3.0	1.6	1.2	3.0
3 R	T4-20-55.5	25.0	12.5	25.6	12.0	23.0	13.5	6.6	4.0	3.0	1.6	1.2	3.0
4 R	T4-32-53.5	32.0	20.0	34.0	19.0	34.0	20.5	1.0	7.0	4.0	2.5	2.0	5.0
5 R	T4-40-53.5	40.0	25.0	41.0	23.0	44.0	24.5	1.2	8.0	4.0	3.0	2.5	6.0

R

TURBINE SIDE

TYPE OF GROOVES FOR SEALING STRIPS

ROTOR

FOR STAGES 2 TO 5

CASING

FOR STAGES 1 TO 5

CASING REFERENCE PLANE FOR STAGES 1R TO 5R

CASING REFERENCE PLANE FOR STAGES 1L TO 5L

ROTOR REFERENCE PLANE FOR STAGES 1R TO 9R

ROTOR REFERENCE PLANE FOR STAGES 1L TO 9L

GENERAL DIMENSIONAL TOLERANCES ± TOLERANCES AS PER ISO2768-1

GROOVE DRG. R-10300-K6006-00 & R-10300-K6003-00

GROOVE DRG. R-10300-K6014-00

GROOVE DRG. R-10300-K6013-00

GROOVE DRG. R-10300-K6012-00

L

GENERATOR SIDE

GUIDE BLADE GROOVE (LEFT)

3.2/ (12.5/)

DIRECTION OF STEAM FLOW

R0.4 AS PER BLADING PLAN

MOVING BLADE GROOVE (LEFT)

W/ (W/)

DIRECTION OF STEAM FLOW

R0.4 AS PER BLADING PLAN

STAGE	MOVING BLADE PROFILE	BF	BHLN	BHRN	LHL	LHR	LHT	RA	RB	RT	FIR	FIL	AF
1 L	T4-20-55.5	25.0	12.5	25.6	12.0	23.0	13.5	6.6	4.0	3.0	1.6	1.2	3.0
2 L	T4-20-55.5	25.0	12.5	25.6	12.0	23.0	13.5	6.6	4.0	3.0	1.6	1.2	3.0
3 L	T4-20-55.5	25.0	12.5	25.6	12.0	23.0	13.5	6.6	4.0	3.0	1.6	1.2	3.0
4 L	T4-32-53.5	32.0	20.0	34.0	19.0	34.0	20.5	1.0	7.0	4.0	2.5	2.0	5.0
5 L	T4-40-53.5	40.0	25.0	41.0	23.0	44.0	24.5	1.2	8.0	4.0	3.0	2.5	6.0

INSERTION GROOVES DETAILS

FOR STAGES 6L SEC. E-E

FOR STAGES 7L SEC. F-F

FOR STAGES 8L SEC. G-G

INSERTION GROOVE

DETAILS FOR STAGES 1 TO 5

SEC C-D

DIRECTION OF STEAM FLOW

STAGE	B	D	C	F	SR	AR
1	19.90	10.5	4.76	11.7	0.15	41.20
2	19.90	10.5	4.76	11.7	0.15	41.20
3	19.90	10.5	4.76	11.7	0.15	41.20
4	31.70	20.5	6.40	20.5	0.80	44.20
5	38.70	25.5	9.70	24.5	0.77	49.20

TYPE OF GROOVES FOR SEALING STRIPS

ROTOR

FOR STAGES 6 TO 9

18 HOLES

R0.6

GROOVE DRG. R-10300-K6001-00 & R-10300-K6003-00

GROOVE DRG. R-10300-K6014-00

GROOVE DRG. R-10300-K6013-00

GROOVE DRG. R-10300-K6012-00

NOTES:

LOCATION OF INSERTION GROOVE SEE FV10813 STAGES 1 TO 9 ##+45°

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ISS	DATE	BY	CHK	APP	DESCRIPTION
0	30/09/2013	A.SAHU			FIRST ISSUE

USE OF PRODUCT OR NAME OF CUSTOMER/PROJECT

TITLE: GROOVE PLAN

SIZE: A1 | SCALE: 1:10 | WEIGHT: 0.00 KG

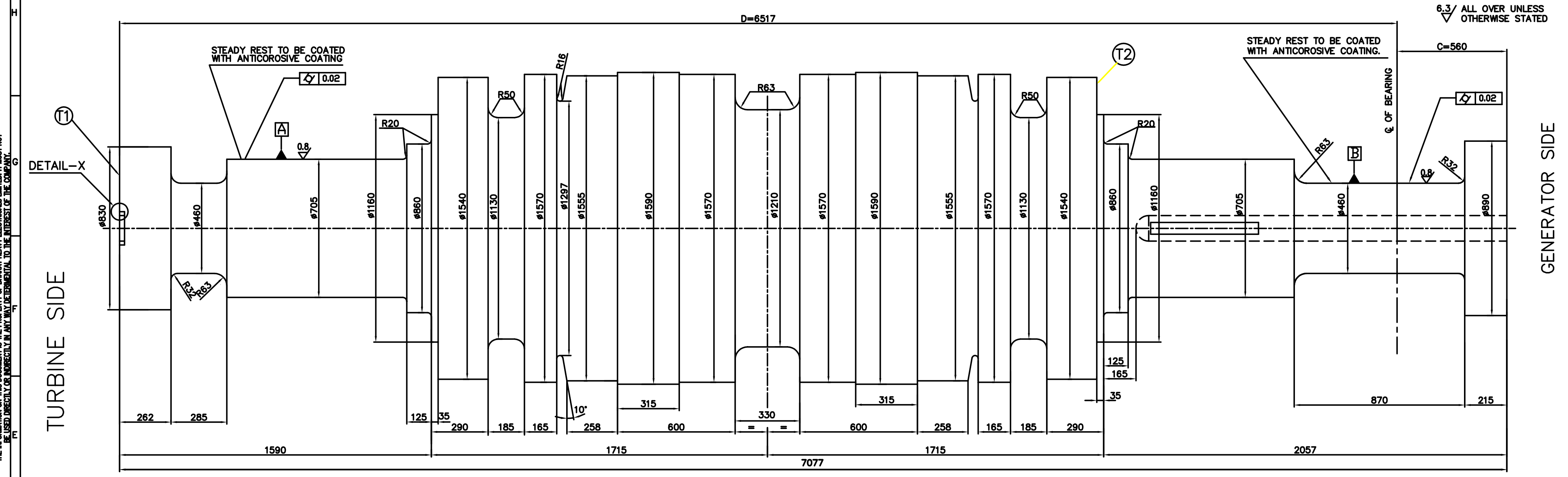
DRG NO: R-1103-04-60010-00

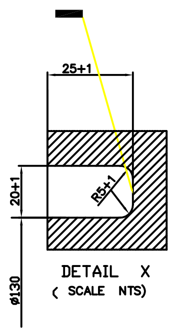
प्रथम कोण प्रक्षेपण/FIRST ANGLE PROJECTION

सभी विमाएं मिलिमीटर में हैं।/ALL DIMENSIONS ARE IN mm.

प्रपत्र डीजी 45 (बी)/FORM 45 (B)

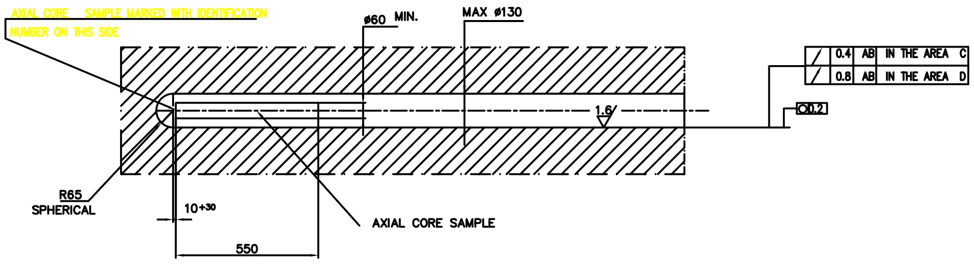
11030146999





TECHNICAL REQUIREMENTS

1. FORGING SHALL BE SUPPLIED AS PER SPEC. NO. HW 19373
2. FORGING SHALL BE SUPPLIED IN ROUGH MACHINED CONDITION .
   PERMISSIBLE TOLERANCE
   ON OUT SIDE DIMENSION +2
   ON INSIDE DIMENSION -2
3. UNSPECIFIED RADII SHALL BE TAKEN AS R10
4. BRACKETED DIMENSIONS ARE FOR REFERENCE ONLY.
5. AT THE PLACE MARKED (T1) AND (T2) SUPPLIER SHALL LOCATE TANGENTIAL TEST SAMPLE FOR MECH. TESTING AND GET IT APPROVED FROM BHEL. PART OF THE TEST SAMPLE APPX 40 mm SHALL BE LEFT INTEGRAL WITH THE SHAFT FOR RETESTING PURPOSE AT BHEL.
6. AFTER SATISFACTORY TEST OF (T1) (T2), RESIDUAL STRESSES AND ULTRASONIC, BHEL WILL INSTRUCT THE SUPPLIER TO TREPAN AXIAL CORE. TESTING OF AXIAL CORE IS TO BE DONE AS PER HW0850395. BALANCE OF CORE DULY MARKED WITH IDENTIFICATION NUMBER SHALL BE SENT TO BHEL ALONG WITH FORGING.
7. PERMISSIBLE RADIAL RUN OUT OF SHAFT IS 1 mm WITH RESPECT TO STEADY REST BEARING.
8. THE IDENTIFICATION NUMBER MUST BE STAMPED AT THE PLACE MARKED ▬▬— SURROUNDED WITH PAINT IDENTIFICATION ACCORDING TO ST 00004.
9. AXIAL BORE AFTER TESTING SHALL BE PLUGGED BY SUPPLIER AS PER DRAWING NO. 11030501500.



VAR.00	REMARKS	ITEM NO.	DESCRIPTION	STD	DESCRIPTION	VAR.	MATERIAL CODE / MATERIAL SPECN.	C/A	UNIT	UNIT WEIGHT	GS	ZONE
							W95310301097 / HW19373			60832		

असत्य विमाओं का वर्ग / GRADE OF UNTOLERANCED DIMENSION	सी.बी.ओ.एम./C.B.O.M. 01030146000	अभिकल्प का स्तर / STATUS OF DRG. U	उत्पाद का प्रकार या ग्राहक/परियोजना का नाम / TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE
मशीनिंग - एए0230208 एम / MACHINING - AA0230208 m	STE / AKJ / Sd/- / 20.9.05		भारत हेवी इलेक्ट्रिकल्स लिमिटेड, रानीपुर, हरिद्वार / BHARAT HEAVY ELECTRICALS LIMITED, RANIPUR, HARDWAR
वेल्डिंग - एए0621104 की श्रेणी बी / WELDING-CLASS 'B' OF AA0621104	NCT / PKA / Sd/- / 24.9.05		DRG. ASHOK Sd/- 5/8/05
गैस कटिंग - एए0621101 की सारणी 3 / GAS CUTTING-TABLE 3 OF AA0621101	TTX / YPA / Sd/- / 29.905		CHD JPM Sd/- 20.8.05; APPD JPM Sd/- 29.09.05

REV.	DATE	ALTERED BY / CHD	REV.	DATE	ALTERED BY / CHD
			03		ASHOK-SD- / JPM-SD/-

SUPERSEDES THE OLD DRG UNDER THE SAME NO. AS PER C/A NO. MTE-05-F0078

विभाग/DEPTT. MTE
कूट/CODE 4300
अनुपात/SCALE 1:20
भार कि.ग्रा./WEIGHT (KG) 60832.00
असेम्बली अभिकल्प का संदर्भ/REFER TO ASSLY. DRG.
नग क्रमांक/ITEM NO.
नगों की संख्या/NO. OF ITEMS

शीर्षक/TITLE FORGING FOR LP SHAFT

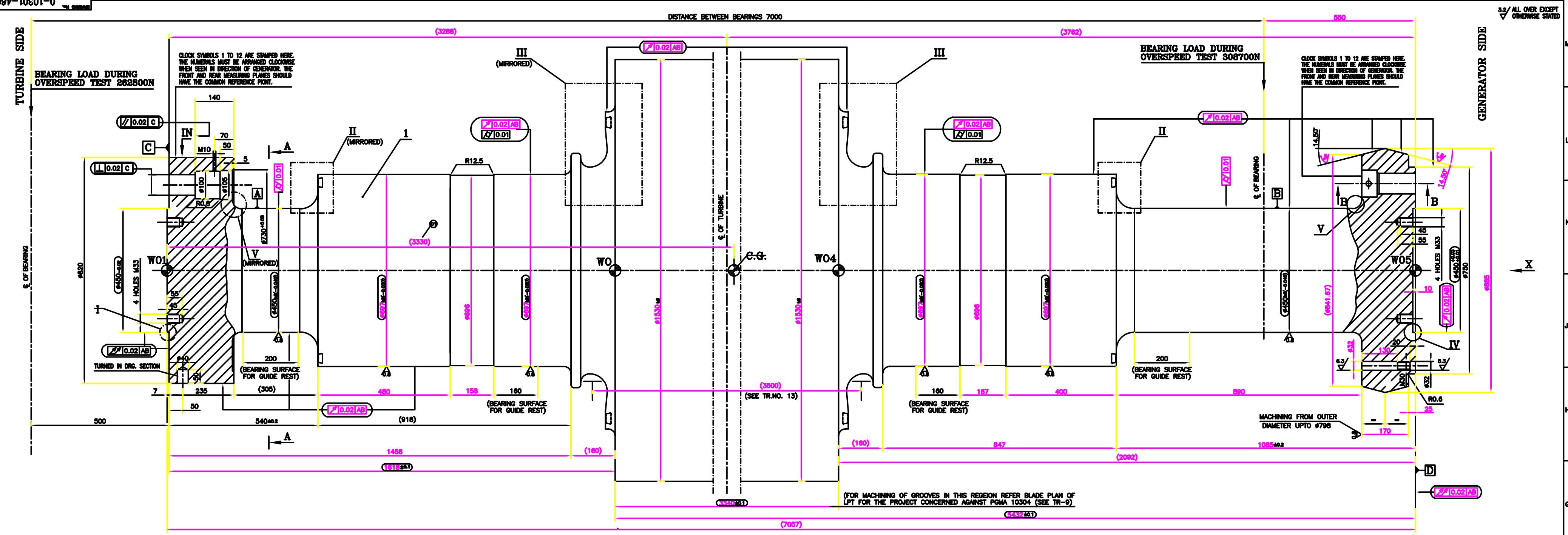
कार्ड कूट/CARD CODE

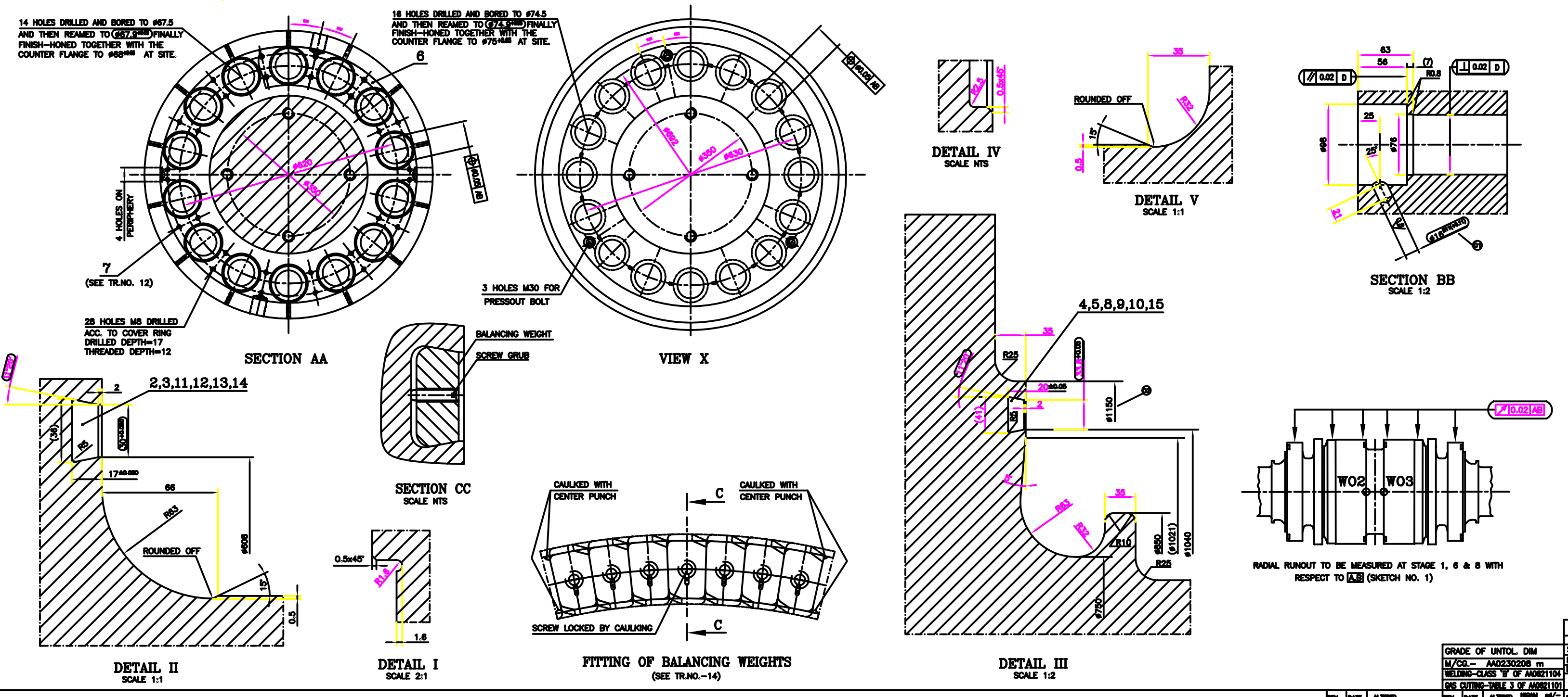
अभिकल्प संख्या/DRAWING NO. 7 11030146999 22 23 24

पृष्ठ संख्या/Sheets No. 01 पृष्ठों की संख्या/No. of Sheets 01

A1 साइज़/A1 SIZE

FE02007/11030146999





TECHNICAL REQUIREMENTS :–

1. IT SHOULD BE ENSURED DURING MARKING THAT THE COORDINATE SYSTEM OF AXIS ON TURBINE END MATCHES WITH THE COORDINATE SYSTEM OF AXIS ON THE GENERATOR END.
2. GROOVES FOR BALANCING WEIGHTS AS PER DETAIL–II ARE NOT TO BE USED DURING BALANCING OF ROTOR IN THE PLANT. THESE ARE TO BE USED ONLY FOR ADDITIONAL BALANCING OF ROTOR, IF REQUIRED, AT SITE.
3. THE EXACT QUANTITY OF ITEM NO. 004 & 005 TO BE USED IS DETERMINED DURING BALANCING OF ROTOR IN THE PLANT.
4. 40 PIECE EACH OF THE ITEM NO. 002 & 003 ARE TO BE SUPPLIED LOOSE TO SITE FOR ADDITIONAL BALANCING OF ROTOR, IF REQUIRED, AT SITE.
5. FOR FORGING DRAWING OF THE SHAFT REFER DRG. NO. 1–10301–46999.
6. WEIGHT OF BLADED ROTOR = 58277 Kg.
7. DIMENSIONS WITHIN (–––) ARE FOR REFERENCE ONLY.
8. HOLES FOR COUPLING BOLTS (SECTION–AA & VIEW–X) ARE TO BE DRILLED AND REAMED WITH THE HELP OF JIG AND THE SAME JIG MUST BE USED FOR DRILLING AND REAMING OF COUPLING HOLES ON THE FLANGE OF THE MATING ROTOR ALSO.
9. THE VALID DRAWING IS TO BE TAKEN FROM THE MID OF THE PROJECT AGAINST CONCERNED PGMA 10304.
10. (a) RUNOUT VALUES OF LP ROTOR, BEFORE AND AFTER BALANCING & OVERSPEEDING TEST MUST BE RECORDED AS PER Q.A. DOCUMENT NO. 0–10301–46000 LS.
    (b) BALANCING AND OVERSPEEDING TO BE DONE AS PER PRODUCT STANDARD NO ST37008.
11. IF THE ROTOR FORGING IS HAVING THE AXIAL TREPANED CORE HOLE, IT SHALL BE PLUGGED AS PER DRAWING MENTIONED AGAINST PGMA 10305.
12. THE SCREWS ITEM NO. 007 (SECTION–AA) SHOULD BE CAULKED AT TWO DIAGONALLY OPPOSITE LOCATION BY CENTRE PUNCH, AFTER ASSEMBLY OF COVER ITEM NO. 006 (SECTION–AA) AT SITE.
13. THESE POINTS ARE ROTOR SLINGING POINTS. USE RUBBER /LEATHER SHEET (1000x200x10TK) ALONGWITH THE SLINGS DURING LIFTING OF ROTOR TO AVOID ANY DAMAGE OF MACHINED SURFACES.
14. THE END BALANCING WEIGHTS OF ANY SECTOR ON EITHER SIDE SHOULD BE STELLITE –6 (ITEM NO. 014 & 015).
15. IDENTIFICATION ACCORDING TO HW0400397 AT THE PLACE MARKED WITH IN
16. PLACES MARKED WITH SYMBOL ↗ ARE THE SURFACES FOR CHECKING RADIAL RUNOUT.
17. DIMENSIONS WITHIN ⬭ AND ALL GEOMETRICAL TOLERENCES ARE CRITICAL TO QUALITY (CTQ).
18. CONSERVATION OF BLADED ROTOR AS PER ST33004.
18. CAUTION :–
    "NO PAINT TO BE APPLIED ON THE BLADED ROTOR".

DATA FOR OVERSPEED TEST :–

a) OVERSPEED FREQUENCY = 3750 RPM (62.5 Hz).
b) DURATION OF OVERSPEED = 2 MINUTES.
c) CRITICAL SPEED OF THE ROTOR = 1433 RPM (23.889 Hz).
d) OPERATIONAL SPEED = 3000 RPM (50 Hz).
e) EXPLODING ENERGY OF THE ROTOR IS MORE THAN 7500 TONNE–METER.
f) DIRECTION OF ROTATION OF ROTOR WHEN SEEN IN DIRECTION OF THE GENERATOR : ANTICLOCKWISE.
g) CAUTION :–
   THE ASSEMBLY OF ROTOR SHOULD BE COMPLETE IN ALL RESPECT BEFORE BALANCING AND OVERSPEEDING TEST.

GRADE OF UNTOL. DIM			
M/CG.– AA0230208 m	STT	GOVIND SINGH sd/–	17.4.03
WELDING–CLASS 'B' OF AA0621104	NCT	PK ARORA sd/–	16.4.03
GAS CUTTING–TABLE 3 OF AA0621101	MTE	DB SHARMA sd/–	24.4.03

GMS No./ C.B.O.M 01030146000 — STATUS OF DRG "U"

REV	DATE	ALTERED / CHECKED	
02		ALTERED NIGAM sd/– ; CHECKED DKRAY sd/–	IN DETAIL–III, DIMø1150 ADDED. AS PER C/A NO. STE–04–F0243
01	24.05.04	ALTERED NIGAM sd/– ; CHECKED DKRAY sd/–	DISTANCE OF C.G. DIM (3330) WAS (3786). (ZONE K12) IN SECTION BB, ø18 WAS ø18. AS PER C/A NO. STE–04–F0146

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT: STEAM TURBINE

BHARAT HEAVY ELECTRICALS LTD. RAMPUR, HARDWAR

	NAME	SIGN	DATE
DRN	DKRAY	sd/–	15.03.03
CHD	DKRAY	sd/–	25.03.03
APPD	AKJAIN	sd/–	24.04.03

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE / CODE 4011	1:5	52475.000	–––––––––	––	––

TITLE : LP SHAFT

CARD CODE 7 — DRAWING NO. 0–10301–46000 — SHEET No. 01 — No. OF SHEETS 01

A0 SIZE

0–10301–46000

FINISH MACHINING CONTOUR OF ROTOR

R

L

FINISH MACHINING CONTOUR OF CASING

R

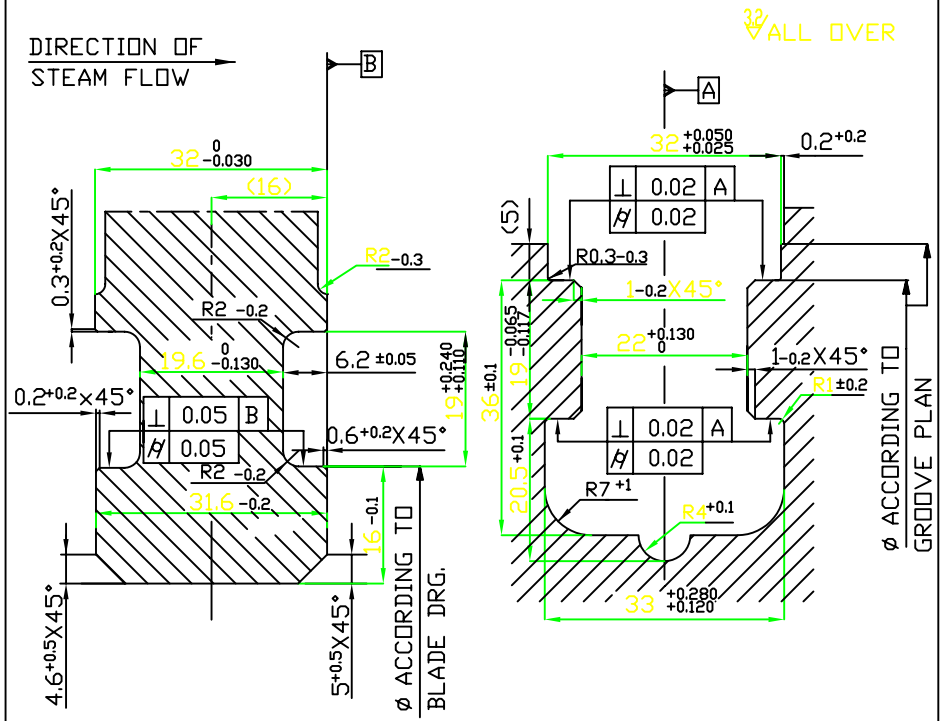
L

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 39(B)

REV	DATE	ALTERED / CHECKED	REV	DATE	ALTERED / CHECKED	~~GMS No./~~ C.B.O.M. NO.	STATUS OF DRG
ZONE			ZONE			91010746000	U

AGREED DEPT	NAME	SIGN	DATE
STT	Y.P. ANAND	Sd/-	5.12.02
NCT	P.K.ARORA	Sd/-	1.12.02

GRADE OF UNTOL.DIM M/CG. ~~C~~/M/~~F~~ –AA0230208 | WELDING ~~A~~/B/~~C~~/D AA0621104 | GAS CUTTING–T3 AA0621101



BLADE ROOT BLADE GROOVE

	NAME	SIGN	DATE
DRN	HANS LAL	Sd/-	3.09.02
CHD	P.K.BANSAL	Sd/-	3.09.02
APPD	T.K.GHOSH	Sd/-	28.02.03

BHARAT HEAVY ELECTRICALS LTD.
RANIPUR, HARDWAR

NO. OF VAR

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
DEPT STE / CODE 4011	NTS	——	91010746000	——	——

TITLE : ROOT AND GROOVE FOR MOVING BLADE

CARD CODE

DRAWING NO. 74–10107–46012 22 23 24

SHEET No. 01 No. OF SHEETS 01

Inventory No.

Sign & Date

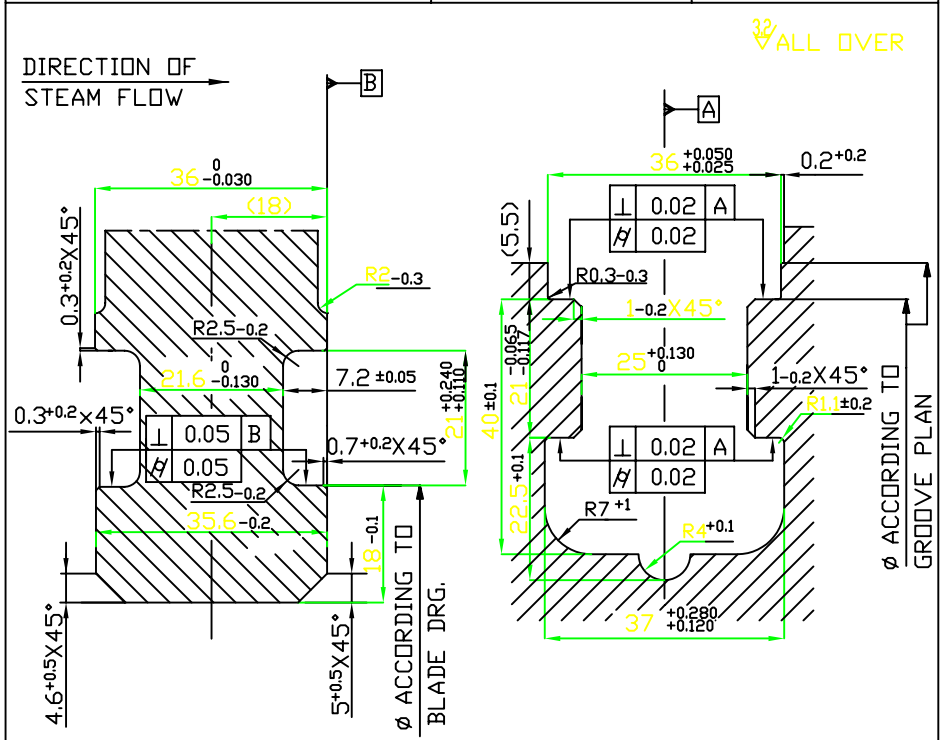
6661540 Ref.Drawing No>

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 39(B)

REV	DATE	ALTERED / CHECKED	REV	DATE	ALTERED / CHECKED	~~GMS No./~~ C.B.O.M. NO.	STATUS OF DRG
ZONE			ZONE			91010746000	U

AGREED DEPT	NAME	SIGN	DATE
STT	Y.P. ANAND	Sd/-	5.12.02
NCT	P.K.ARORA	Sd/-	1.12.02

GRADE OF UNTOL.DIM M/CG. ~~C/M/F~~ –AA0230208 | WELDING ~~A/B/C/D~~ AA0621104 | GAS CUTTING–T3 AA0621101



BLADE ROOT BLADE GROOVE

6661550 Ref.Drawing No>

Sign & Date

	NAME	SIGN	DATE
DRN	HANS LAL	Sd/-	3.09.02
CHD	P.K.BANSAL	Sd/-	3.09.02
APPD	T.K.GHOSH	Sd/-	28.02.03

BHARAT HEAVY ELECTRICALS LTD.
RANIPUR, HARDWAR

NO. OF VAR

Inventory No.

DEPT STE	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
CODE 4011	NTS	——	91010746000	——	——

TITLE : ROOT AND GROOVE FOR MOVING BLADE

CARD CODE

DRAWING NO. 7 4–10107–46014 22 23 24

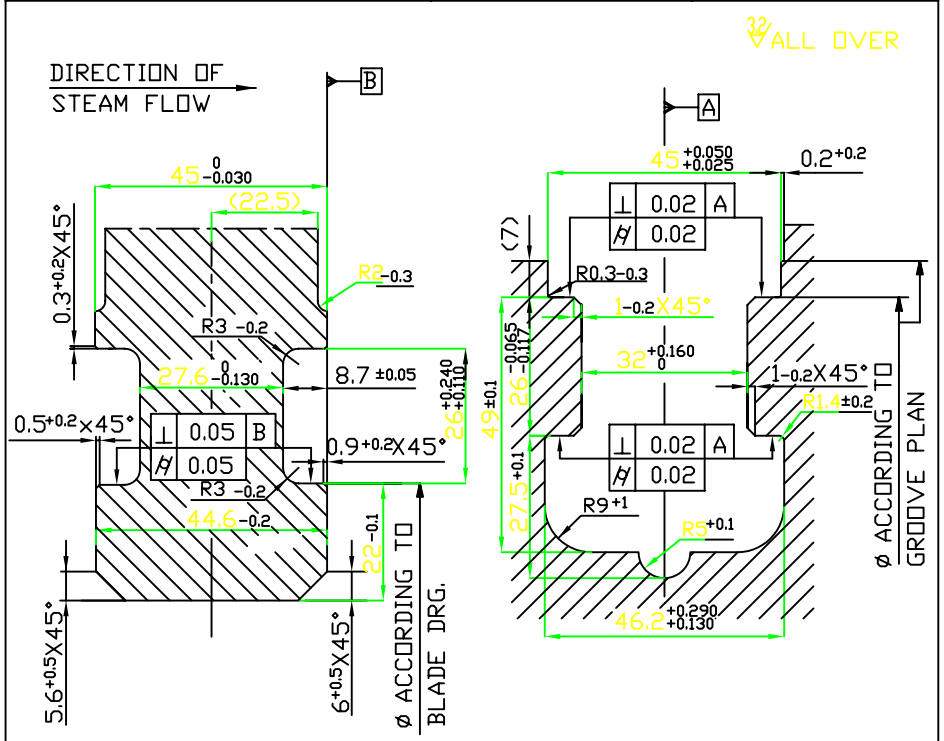
SHEET No. 01 No. OF SHEETS 01

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 39(B)

REV	DATE	ALTERED / CHECKED	REV	DATE	ALTERED / CHECKED	~~GMS No./~~ C.B.O.M. NO.	STATUS OF DRG
ZONE			ZONE			91020446000	U

AGREED DEPT	NAME	SIGN	DATE
STT	Y.P.A.	Sd/-	16.12.02
NCT	P.K.A.	Sd/-	14.12.02

GRADE OF UNTOL.DIM M/CG. C/M/F –AA0230208 | WELDING A/B/C/D AA0621104 | GAS CUTTING–T3 AA0621101



BLADE ROOT BLADE GROOVE

	NAME	SIGN	DATE
DRN	HANS LAL	Sd/-	3.8.02
CHD	S.K.GARG	Sd/-	3.8.02
APPD	T.K.GHOSH	Sd/-	12.3.03

BHARAT HEAVY ELECTRICALS LTD.
RANIPUR, HARDWAR

NO. OF VAR

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE CODE 4011	NTS	——	91020446000	——	——

TITLE : ROOT AND GROOVE FOR MOVING BLADE

CARD CODE

DRAWING NO. 4-10204-46014 22 23 24

SHEET No. 01 No. OF SHEETS 01

Sign & Date

Inventory No.

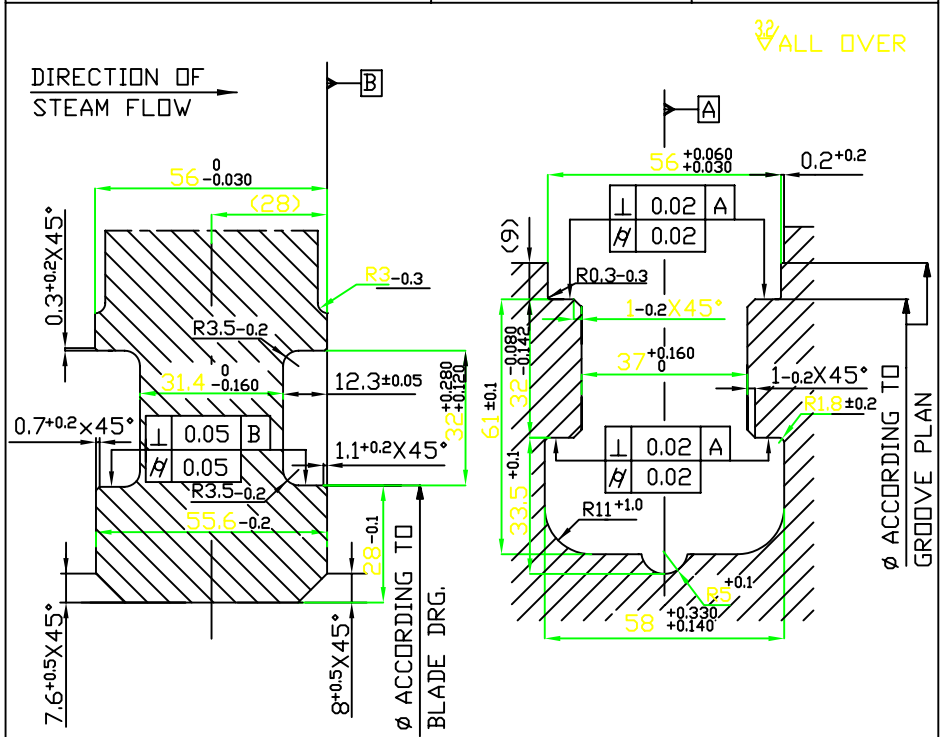
6661570 Ref.Drawing No>

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 39(B)

REV	DATE	ALTERED / CHECKED	REV	DATE	ALTERED / CHECKED	~~GMS No./~~ C.B.O.M. NO.	STATUS OF DRG
ZONE			ZONE			91030446000	U

AGREED DEPT	NAME	SIGN	DATE
NCT	V.KISHORE	Sd/-	1.5.03

GRADE OF UNTOL.DIM M/CG. ~~C/M/F~~ –AA0230208 | WELDING ~~A/B/C/D~~ AA0621104 | GAS CUTTING–T3 AA0621101



BLADE ROOT BLADE GROOVE

	NAME	SIGN	DATE
DRN	HANS LAL	Sd/-	31.03.03
CHD	P.K.BANSAL	Sd/-	03.04.03
APPD	T.K.GHOSH	Sd/-	03.07.03

BHARAT HEAVY ELECTRICALS LTD.
RANIPUR, HARDWAR

NO. OF VAR

DEPT	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM No.	NO. OF ITEMS
STE	NTS	——	91030446000	——	——
CODE 4011					

TITLE : ROOT AND GROOVE FOR MOVING BLADE

CARD CODE

DRAWING NO. 74–10304–4601122 23 24

SHEET No. 01 No. OF SHEETS 01

Ref.Drawing No> 6661591

Sign & Date

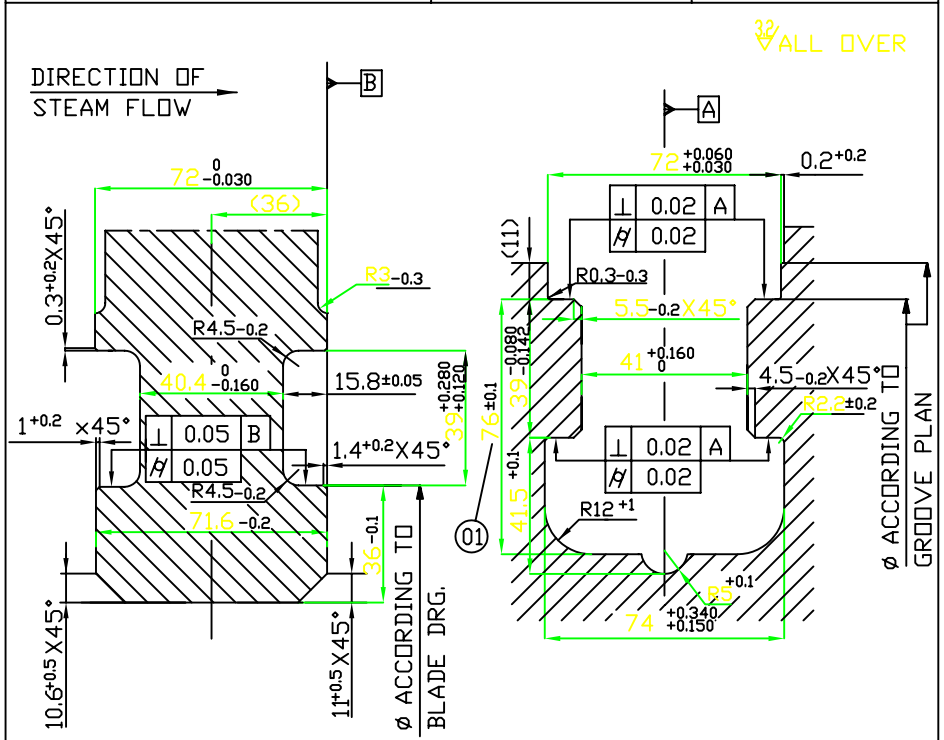
Inventory No.

FIRST ANGLE PROJECTION (ALL DIMENSIONS ARE IN mm) FORM DG 39(B)

REV	DATE	ALTERED	REV	DATE	ALTERED HANS LAL sd/-	~~GMS No./~~ C.B.O.M. NO.	STATUS OF DRG
		CHECKED	01	14.10.04	CHECKED P.K.BANSAL sd/-	91030446000	U

ZONE		ZONE	-IN BLADE GROOVE DIMENSION 76 WAS 61. (STE-04-F0279)	AGREED DEPT	NAME	SIGN	DATE
				NCT	V.KISHORE	Sd/-	1.5.03

GRADE OF UNTOL.DIM M/CG. C/M/F -AA0230208 | WELDING A/B/C/D AA0621104 | GAS CUTTING-T3 AA0621101



BLADE ROOT BLADE GROOVE

Sign & Date		BHARAT HEAVY ELECTRICALS LTD. RANIPUR, HARDWAR		NAME	SIGN	DATE	NO. OF VAR
			DRN	HANS LAL	Sd/-	3.9.02	
			CHD	P.K.BANSAL	Sd/-	3.9.02	
			APPD	T.K.GHOSH	Sd/-	3.7.03	

Inventory No.	DEPT STE CODE 4011	SCALE NTS	WEIGHT (KG) ——	REF. TO ASSY. DRG. 91030446000	ITEM No. ——	NO. OF ITEMS ——

TITLE : ROOT AND GROOVE FOR MOVING BLADE

CARD CODE

DRAWING NO. 74-10304-46012 22 23 24

SHEET No. 01 | No. OF SHEETS 01

6661275 Ref.Drawing No>