

ANNEXURE II		
RETROFITTING AND RECONDITIONING OF HYDRAULIC POWER PACK, LUBRICATION SYSTEM FOR NIPPLE BENDER 100 TUBE BENDING MACHINE		
	SPECIFICATION & SCOPE OF WORK	
S.No	Description	Vendor to confirm
1	SCOPE OF WORK	
1.1	Desing,Manufacturing,supply,commissioning and prove out of HYDRAULIC POWER PACK along with Hyraulic actuators and Electrical controls as per BHEL referecnce drawing 0-M-12A-14-0651 for NIPPLE BENDER 100 TUBE BENDING MACHINE	
1.2	Required operation and function in the Hydraulic circut 0-M-12A-14-0651 1. BENDING FORWARD & REVERSE ----- 2 Cylinders 2. TUBE CLAMPING VERTICAL -----1 Cylinder 3. TUBE CLAMP HORIZONTAL -----1 Cylinder 4. FOLLOWER BLOCK PRESSING UNIT ---1 Cylinder 5. TOOL RETURN -----1 HYDRO MOTOR 6. BOOSTER forward and reverse -----1 Cylinder Other actutation in the hydraulic circut shall be ignored.	
1.3	Design Specitications for Pump flow,Motor HP/Kw, working pressure range;operating temperature range;type of fluid to be used;sequence of events; and lubrication shall be as per BHEL Ref drg: 0-M-12A-14-0651	
1.4	SUPPLY, INSTALLATION AND COMMISSIONING IS VENDOR'S SCOPE.	
2	HYDRAULIC SYSTEM - FEATURES:	
2.1.0	The hydraulic system shall be designed in accordance with ISO 4413:1998 or equivalent.	
2.1.1	Installation of complete hydraulic systems shall be according to IS 10481: 1983 or equivalent , 'Guide for applications and installation of oil hydraulic systems'.	
2.1.2	The supplier shall provide a circuit diagram in accordance with ISO 1219-2 or equivalent which reflects the system design, identifies the components and satisfies the requirements as per BHEL DRAWING NO: 0-M-12A-14-0651 All the components of the hydraulic system should conform to the hydraulic circuit diagram.	
2.1.3	The system shall be designed and constructed so that components are located where they are accessible and can be safely adjusted and serviced. Hydraulic components including piping shall be accessible and fitted so as not to interfere with adjustment or maintenance. Particular attention shall be given to the location of systems and components that need regular maintenance.	
2.2.0	Hydraulic pumps and motors	
2.2.1	The power pack shall have stand by pump and motor	
2.2.2	Hydraulic pumps and motors shall be mounted so that a) They are accessible for maintenance; b) No shaft misalignment is introduced as a result of the duty cycle, temperature variations or applied pressure loadings; c) Induced axial and radial loads are within limits specified by the pump/motor supplier; d) Drive couplings and mountings are capable of repeatedly withstanding the maximum torque generated under all operating conditions; e) The transmission or amplification of torsional vibration is limited using couplings that are adequately damped.	
2.2.3	Hydraulic pumps and motors shall be installed such that a) piping connections are configured to prevent external leakage; tapered pipe threads or connection mechanisms that require sealing compounds shall not be used; b) loss of primary or case lubrication is prevented during periods of inactivity; c) the pressure at the pump inlet port is not less than the minimum specified by the pump supplier for the operating conditions and the system fluid used.	

2.3.0	Cylinders	
2.3.1	Materials for construction (cylinder) for all the components are as follows (OR ITS EQUIVALENT ACCEPTABLE TO BHEL ENGINEERS): Bidder to specify in offer itself CYLINDER TUBE (SEAMLESS) : ST52-W/EN 8/EN 24 PISTON ROD OR RAM : EN 8/ EN 24 PISTON : EN 8 LOCK NUT : EN 24 TIE RODS : EN 24 END COVERS/FLANGES : EN 8/EN 24 FASTENERS HIGH TENSILE GRADE: 10.9/12.8 SEALS : PU/PTFE/VITON OR ITS COMBINATION in the Makes as specified here	
2.3.2	Cylinders shall be designed and/or selected with the following characteristic as per BHEL drg which shall be given once the order is placed.	
2.3.3	Resistance to buckling: Attention shall be given to stroke length, loading and cylinder mountings in order to avoid bending or buckling of the cylinder piston rod at any position.	
2.3.4	Loading and overrunning:For applications in which overrunning or other external loads are encountered, the design of the cylinder and its mountings shall take into account the maximum expected load or pressure peak.	
2.3.5	Mounting fasteners for cylinders and attachments shall be designed and installed to accommodate all predictable forces. As far as possible the fasteners should be free from shear forces. Foot mounted cylinders should have means to absorb shear loads, rather than depending on mounting fasteners. The mounting fasteners shall be adequate to absorb overturning moments.	
2.3.6	Cylinder bore and rod shall be hard chrome plated to 55HRC (MIN) AND 40 MICRONS THICK (MIN).Cylinder bore to be honed to a surface finish not less than 20 micron inch, Piston rod should be hard chrome plated to 40 micron thick(MIN) and 55 HRC min hardness.The supplier should produce test certificate for the hardness and chrome plating thickness from an authorised certitifying agency.	
2.3.7	Latest standard wear resistant sealing arrangement with bearing guied strip to work in titling condition of the cylinder shall be used.Only standard makes of seals like PARKER/MERKEL/BUSHAK AND SHAMBAN/HUNGER/HALLITE/JAMES WALKER/SIMRIT FREUDENBERG are ACCEPTABLE.	
2.4.0	Valves	
2.4.1	Valve types shall be selected to take into account correct function, leak tightness, and resistance against foreseeable mechanical and environmental influence. Surface mounted and/or cartridge valves are preferred wherever practicable.	
2.4.2	When mounting valves the following should be considered: a) independence from their associated fluid piping or connector; b) access for removal, repair or adjustment; c) effects of gravity, impact and vibration on the valve; d) sufficient clearance for wrench and/or bolt access and electrical connections; e) provisions to ensure that valves cannot be incorrectly mounted; f) location as close as possible to their actuators; g) installation so that they cannot be damaged by an operating device;	

2.4.3	For surface-mounted valves provisions should be applied to ensure a) detection of leaking valves or valve operating devices; b) elimination of detrimental effects of back pressure; c) adequate spacing between adjacent valves for the use of protective conduit; d) manifolds or subplates with mounting surfaces in accordance with ISO 4401, ISO 5781, ISO 6263, ISO 6264, ISO 7790 and ISO 10372.	
2.4.4	Cartridge valves Manifolds with cavities in accordance with ISO 7368 and ISO 7789 should be used for cartridge valves.	
2.4.5	Line-mounted valves should be connected using ports in accordance with ISO 6149-1 or fourbolt flange connections in accordance with ISO6162orISO6164.	
2.4.6	All pressure setting shall be accurate with zero pressure drop.	
2.4.7	Proportional valve shall be provided for bending and booster cylinder.	
2.4.8	Electrical connections The control voltage for electrical control system shall be of 230v ac. the control voltages for all the solenoids of the valves shall be of 24v dc and all solenoid operated valves should have manual over-ride provision and light indicating solenoids.	
2.4.9	Electrical connections to a supply shall be in accordance with appropriate standards, e.g. IEC 204-1. For hazardous operating conditions, the appropriate degree of protection (e.g. explosion proofing, water proofing) shall be employed. Electrical connections be separable, oil-tight, plug-in connector conforming to ISO 4400 or ISO 6952.	
2.4.10	Terminal block housings to valves should Where terminal block housings are specified on the valves, they shall be constructed as follows: a) the appropriate degree of protection in accordance with IEC 529; b)adequate space for permanently located terminals and for the terminal cable, including an additional length of cable; c)captive fasteners for the electrical access cover to prevent loss, e.g. screws with retaining washers; d)suitable securing device for the electrical access cover, e.g. a chain; e)cable connections with strain relief.	
2.4.11	Solenoids Solenoids shall be selected (e.g. cyclic rate, temperature rating, etc.) so that they are capable of operating the valves reliably at the nominal voltage of 10%. Solenoids shall be protected against the entry of extraneous fluid or dirt in accordance with IEC 529.	
2.4.12	Manual overrideIf an electrically controlled valve needs to be operated for safety or other reasons when electrical control is not available, then it shall be fitted with manual override facilities. These shall be designed or selected so that they cannot be operated inadvertently, and they shall reset when the manual control is removed, unless otherwise specified.	
2.4.13	Symbol plates Symbol plates shall be attached to the valve in such a way that the positions and controls represented agree directionally with the operating device movement.	
2.4.14	Adjustments Valves that permit adjustments of one or more controlled parameters should have the following characteristics: a) provisions for securing the valve adjustment; b) provisions for locking the adjustment to prevent unauthorised change, as agreed between purchaser and supplier; c) provisions for monitoring the parameter being adjusted.	
2.4.15	Removal Irrespective of the valve connection method used, removal of the valve shall not require the removal of any associated piping or connectors. Associated piping or connectors may be loosened to provide removal clearance.	
2.5	Automatic lubrication system	
2.5.1	Hydraulic fluids the oil to be used shall be of standard iso viscosity grades ss 68 / 150 centi-stokes at 40 deg c. the grade of oil and capacity of tank should be painted on the tank near the oil filling point.	

2.5.2	Automatic lubrication system; a) All the new hoses to be assemble; b) New lubrication pump and distribution headers to be assemble; c) Proper size end fittings to be assemble; d) Hoses to be neatly routed and fixed properly; Total system to made working without any lubricant leakages and free flow of grease/oil to be ensured till all lubrication points.	
2.5.3	Available automatic Lubricator shall be interfaced and controlled through Control system.	
2.5.4	All necessary lubrication pump, hoses, distribution headers and fittings are in vendor's scope.	
2.5.5	All Pressure gauges available in machine shall be replaced with new pressure gauges	
2.5.6	Required cleaning materials like cotton waste, kerosene shall be issued by BHEL at free of cost.	
2.5.7	Shop Compressed air Pressure shall be 4 - 4.5 bar at 1" line	
2.5.8	Supplier shall indicate the any additional required components/systems which are required to make the system functional (if required) one.	
2.5.9	Makes of all bought out items shall be as follows unless otherwise specified elsewhere; All couplings with guards: SKF/FENNER/HYDAX; Hydraulic fittings: PARKER/SWAGELOC/HYLOC" ; PU tubes & one touch fittings: FESTO/ SMC /PARKER; Pressure gauge: REXROTH/WIKA/WAREE/PARKER; Any other makes recommended by the supplier shall be approved by BHEL.	
2.5.10	Hand lever operated Greeze Lubrication Pump , capacity-5 kg --- 2 nos and capacity- (8-10 kg) --- 1 nos	
2.6	Fluid reservoirs	
2.6.1	The reservoir: a) shall adequately dissipate heat from the fluid under normal working conditions when heat exchangers are not installed in the system; b) should contain all the fluid that can flow from the system under normal operation or maintenance conditions; c) shall maintain the fluid level at a safe working height and allow sufficient fluid access to supply lines during all operating cycles and operating attitudes, and allow adequate space for thermal expansion and air separation; d)should provide a slow recirculating velocity which will allow for the release of entrained air and the precipitation of heavy contaminants; e) should separate the return fluid from pump intake points by baffles or other means; if baffles are used, they shall not prevent thorough cleaning of the reservoir. If the fluid reservoir is of the pressure-sealed type then the special requirements of that type of unit shall be considered.	
2.6.2	Construction Reservoirs should be separate and removable from the machine structure.	
2.6.3	Spillage Provisions shall be made to prevent spilled fluid from returning directly to the reservoir.	
2.6.4	The supporting structure should a)Raise the base of the reservoir to a height not less than 150 mm above the site floor level to facilitate handling, draining and to improve heat dissipation; b)Have supports of sufficient area to allow for adjustment by shims, wedges, etc., during assembly and installation	
2.6.5	Vibration and noise Care shall be taken to prevent excessive structure borne vibration and airborne noise, particularly when components are mounted in or directly to the reservoir.	
2.6.6	The reservoir top:a) shall be positively fastened to the reservoir body;b) shall, if removable, be designed to prevent the ingress of contaminants;c) should be designed and constructed to avoid the formation of areas that will collect and trap external solid and fluid contaminant and waste.	

2.6.7	Configuration The reservoir configuration shall satisfy the following requirements: a)suction lines shall be sized so that the pump intake characteristics are in accordance with manufacturer recommendations; b)suction lines shall be located so that adequate fluid supply is maintained at the minimum operating fluid level and that air ingestion and the formation of vortices in the fluid are eliminated; c)return lines to the reservoir should discharge below the minimum operating fluid level; d)return lines to the reservoir shall discharge at the lowest practical velocity and promote the desired fluid circulation pattern within the reservoir. e)The reservoir circulation shall not promote the entrainment of air; any pipe access into the reservoir shall be effectively sealed; f) should be designed to minimise resuspension of settled contaminants in the system fluid; g) should use a "blind" (no through-hole) method of fastening for attaching the reservoir top to the body, for attaching access covers and any agreed components.	
2.6.8	The power pack should be tropicalised for indian conditions - for an ambient temperature of 40 deg c. suitable oil cooling arrangement to be provided - preferably with oil chiller & heat exchanger, considering 3-shift operation of the machine and to maintain the oil temperature within 50 deg c.	
2.6.9	Maintenance provisions shall fulfill the requirements specified below:a) access covers shall be provided that can be removed and replaced by one person. The covers shall provide access to all internal areas for cleaning and inspection;b) suction strainers, return diffusers and other replaceable internal reservoir components shall be easily accessible for removal or cleaning;c) the reservoir shall be provided with a device to permit draining;d) the reservoir should be shaped to allow complete drainage.	
2.6.10	The reservoir shall be designed to provide adequate structural integrity under the following conditions: a) filled to maximum capacity with the system fluid; b) subjected to positive and negative pressures caused by the withdrawal or return of fluid at rates required by the system under all foreseeable conditions.	
2.6.11	suitable vibro-mounts, compensators (flexible bellows), delivery hose between pump and valve block, polypropylene pipe & hose clamps, etc are to be provided to minimize the vibration induced and transmitted to the hydraulic joints.hydraulic tank shall have proper clamping arrangement for fixing the tank in the ground with required anchoring bolts.	
2.6.12	Surface treatment shall be such that: a) all interior surfaces are thoroughly cleaned and all moisture, dirt, chips, flux, scale, slag, fibrous materials and any other contaminants removed; b) any interior finishes are compatible with the fluid used in the system and the environmental atmosphere and shall be applied as recommended by the supplier of the finish. When such finishes are not used, ferrous interior surfaces should be coated with a rust inhibitor compatible with the fluid; c)exterior finishes are compatible with the fluid ,	
2.6.13	The reservoir should be constructed in such a manner that handling by a fork lift or slings and crane can be carried out without causing permanent distortion. The lifting points should be identified.	
2.6.14	Fluid level indicatorsa) shall be permanently marked with system "high" and "low" levels;b) should have additional marks as appropriate to specific systems;c) shall be fitted at each filling point so that they are clearly visible when filling.	
2.6.15	Filling points should be fitted with sealed and captive covers to prevent the ingress of contaminants when closed.	
2.6.16	Air breathers on atmospheric reservoirs should be provided which to a cleanliness level compatible with the system requirements, environmental conditions in which the system is to be installed.	
2.7	Filtration and fluid conditioning	
2.7.1	Filtration shall be provided to limit the inservice particulate contamination level to values appropriate for the components selected and the intended application. The contamination level shall be expressed in accordance with ISO 4406. The use of a separately pumped filtration system should be given due consideration.	
2.7.2	Filters shall be located in pressure, return and/or auxiliary circulation lines as necessary to achieve the cleanliness levels required by the system.	
2.7.3	All filter assemblies shall be equipped with a device that indicates when the filter requires servicing. This device shall be readily visible to the operator or maintenance personnel.	
2.7.4	Filter assemblies whose elements cannot withstand full system differential pressure without damage shall be equipped with bypass valves.	

2.7.5	When filters are located in flow lines subject to pressure and flow pulsations likely to affect the filtration efficiency, the flow fatigue characteristics of the filter element shall be taken into account. In severe cases, damping devices should be installed.	
2.7.6	Filters shall be installed where they are readily accessible, and adequate space shall be allowed for replacing filter elements.	
2.7.7	The filter element identification number and quantity required shall be permanently marked on the filter housing.	
2.7.8	When feasible, means shall be provided for replacing filter elements without shutting down the system.	
2.7.9	Suction strainers or filtersUnless agreed between purchaser and supplier, filtration on pump suction lines shall not be used. Inlet screens or strainers are acceptable. If used, suction filtration devices shall be equipped with an integral bypass valve to limit the maximum pressure drop at rated system flow to a value that ensures that the requirements of 6.1.7 c) are satisfied. An electrical device is recommended to indicate unacceptable pump inlet pressure or to enable automatic system shut down.	
2.8	Piping	
2.8.1	Fluid velocity through piping, piping connections and manifolds should not exceed (design information) a) for suction lines: 1,2 m/s b) for pressure lines: 5 m/s; c) for return lines: 4 m/s.	
2.8.2	Use of fittings and connections The number of separable connections in the piping system should be kept to a minimum (e.g. by use of bent pipes instead of elbow fittings).	
2.8.3	Design of layout a)Piping should be designed to discourage its use as a step or ladder. External loads should not be imposed upon piping. b)Piping shall not be used to support components where they would impose undue loads on the piping. Undue loads may arise from component mass, shock, vibration and surge pressure. c)Every connection to piping should be accessible for tightening without disturbing adjacent piping or equipment, particularly where piping terminates in a cluster of fittings.	
2.8.4	Piping locationa)Piping should be identified or located in such a manner that it is not possible to make an incorrect connection that might cause a hazard or malfunction.b)Piping, both rigid and flexible, shall be mounted to minimise installation stresses and be located to protect against foreseeable damage and not restrict access for adjustment, repairs, replacement of components or work in progress.	
2.8.5	Tube and hose connectors Tube and hose connectors that employ elastomeric seals are preferred. All metal tube connectors shall be in accordance with ISO 8434, part 1, 2, 3 or 4 and ISO 6162 or ISO 6164, when applicable. All hose fittings shall be in accordance with ISO 12151, part 1, 2, 3, 4 or 5.	
2.8.6	The hydraulic power pack shall be provided with minimum number of pipes / pipe joints and as far as possible usage of manifolds / stacked valves construction is preferred.	
2.8.7	All the pipe / hose fittings shall be of standard weld nipple with o-ring seating type (din 3865) heavy series fittings only and no ferrule joints are to be proposed in the hydraulic system. all threaded connections shall be of inches sizes.	
2.8.8	Pressure rating of connectors Connectors shall have a rated pressure not portion of the system in which they are used.	
2.8.9	Steel tubes should conform to the specifications stated in ISO 10763.	
2.8.10	Piping, including cored and drilled holes, shall be free of detrimental foreign matter such as scale, burrs, swarf, etc., that may restrict flow or be dislodged and cause malfunction of and/or \damage to any component including seals and packings.	
2.8.11	The pipelines to be painted with standard colours as per the colour coding accepted internationally for hydraulic systems. the power pack shall be painted in apple green colour. to be mentioned by the offerer.	
2.8.12	Before Commissioning All piping of the hydraulic circuit must be thoroughly cleaned from both inside and outside; and The reservoir should be cleaned from inside.	
2.8.13	To facilitate maintenance, means shall be provided or components so fitted that their removal from the system for maintenancea) shall not lead to excessive loss of fluid;b) should not require draining of the reservoirc) should not necessitate extensive disassembly of adjacent parts.	

2.9	Hose assemblies	
2.9.1	Hose assemblies shall a) be constructed from hoses which have not been previously used in operation as part of another hose assembly and which fulfill all performance and marking requirements given in appropriate standards b) be marked with dates of manufacture (e.g. quarter and year) for both hoses and hose assemblies; e) be provided with a recommendation on service life by the system supplier not be used at pressures which exceed the manufacturer's recommended rated pressure;	
2.9.2	Installation of hose assemblies shall	
2.9.3	a) have a minimum length necessary to avoid sharp flexing and straining of the hose during the component operation. Hoses should not be bent at a radius smaller than the recommended minimum bending radius; b) minimize torsional deflection of the hose during the installation and use, e.g. as a result of a rotating connector jamming; c) be located or protected to minimize abrasive rubbing of the hose cover; d) be supported, if the weight of the hose assembly could cause undue strain.	
2.10	Control systems	
2.10.1	Unintended movement Control systems shall be designed to prevent unintended movement and improper sequencing of actuators.	
2.10.2	System protection Unexpected start-up --The system shall be designed to facilitate positive isolation from energy sources and also to facilitate dissipation of the pressurised fluid in the system in order to prevent unexpected startup. In hydraulic systems this can be done, for example, by mechanical locking of isolation valves to the shut-off position, and dissipation of pressure from hydraulic systems;- isolation of the electrical supply (see IEC 204-1).	
2.10.3	Control or power supply failure a) Hydraulic components controlled electrically, pneumatically and/or hydraulically shall be selected and applied so that failure of the control power supply does not cause a hazard. b) Whatever the type of control supply or power used (e.g. electrical, hydraulic, etc.), the following actions or occurrences (unexpected or intentional) shall not create a hazard: - switching the supply on or off; - supply reduction; - supply cut-off or re-establishment. When control power supply is restored (unexpectedly or intentionally), hazardous situations shall not occur.	
2.10.4	External loads Means shall be provided to prevent unacceptable pressure build-up where high external loads are reflected on actuators.	
2.11	Fluid loss	
2.11.1	Means shall be provided to prevent the system fluid from draining back into the reservoir when the system is switched off if such drainage could cause a hazard. When a fluid spill would constitute a fire hazard, the system should be designed to shut down automatically if piping or another component ruptures.	
2.11.2	Adjustable control mechanisms shall hold their settings within specified limits until reset	
2.11.3	Pressure and flow control valves shall be selected so that changes in working pressure, working temperature and load do not cause malfunction or a hazard.	
2.11.4	Pressure and flow control devices or their enclosures shall be fitted with tamper-resistant devices where an unauthorized alteration to pressure or flow can cause a hazard or malfunction. Means shall be supplied for locking the setting of adjustable components or of locking their enclosures, if changes or adjustment can cause a hazard or malfunction.	
2.11.5	The direction of movement of manually operated levers shall not be confusing; for example, moving a lever up shall not lower the controlled device.	
2.11.6	Any actuator required to maintain its position or to adopt a specific position for safety in the event of a control system failure shall be controlled by a valve that is either spring biased or detent located to a safe position.	
2.11.7	Where actuators are controlled by servo or proportional valves and malfunction of the control system may result in the actuators causing a hazard then means shall be provided to maintain or recover control of these actuators.	

2.11.8	A full flow filter without bypass and with a readily visible element condition indicator should be installed in the supply line and close to a servo or proportional valve if a valve malfunction caused by contaminant could create a hazard. The collapse strength of the filter element shall exceed the system maximum working pressure. Blockage of fluid flow by non-bypass filters shall not create a hazard.	
2.12	Other design considerations	
2.12.1	The selection of the hydraulic Pumps, valves, cylinders and other accessories shall be based on the flow and pressure applicable to that part of the circuit.	
2.12.2	The latest version of pumps (axial piston pumps preferred), valves, accessories, etc., should be used with rexroth /Vickers make only.	
2.12.3	Monitoring of system parameters Where changes in system operating parameters could constitute a hazard, clear indication of the system operating parameters shall be provided.	
2.12.4	Test points It is recommended that an adequate number of test points be used on all systems, regardless of size and complexity. Test points installed in hydraulic systems to verify pressure shall a) be accessible; b) be permanently attached; c) have a safety cap that is permanently attached to minimise the ingress of contamination; d) be designed to ensure safe and rapid engagement of the test point at maximum working pressure.	
2.12.5	Pressure measuring minimess check points (preferably with ¼" bsp stud end) to be provided, wherever required for quick pressure measuring and pressure setting while trouble shooting. one set of handheld minimess pressure gauge (glycerin filled) of suitable range with minimess hose (1 to 1.5m length) also has to be supplied along with the power pack. fixed pressure gauges provided in the system should be of glycerin filled type and should have suitable gauge isolators	
2.12.6	Safety Interlocks Where a system has more than one interrelated automatically and/or manually controlled device and where failure of any of these devices could cause a hazard, protective interlocks or other safety means shall be provided. Where practicable, these interlocks should interrupt all operations, provided that such interruption does not of itself cause a hazard or damage.	
2.12.7	Sequence control Sequencing by position sensing shall be used wherever practicable and shall always be used when a sequencing malfunction of a pressure or time lapse ctrctd, on its own, could cause a hazard.	
2.12.8	Location of position sensing devices If the locations of position sensing devices become changed after a motion sequence or cycle time has been established, the devices shall either be returned to their original positions or else the motion sequence or cycle timing shall be re-adjusted.	
2.12.9	Location of controls Protection Controls shall be designed or installed in such away that adequate protection is provided against a) malfunction and predictable damage; b) high temperature; c) corrosive atmosphere.	
2.12.9.1	Controls shall be easily accessible for adjustment and maintenance. They shall be a minimum of 0,6 m or a maximum of 1,8 m above the working floor unless size, function or piping method requires alternative location.	
2.12.10	Manual controls The location and mounting of manual controls shall a) place the control within reach of the operator's normal working position; b) not require the operator to reach past rotating or moving devices to operate the control; c) not interfere with the operator's required working movements.	
2.12.11	Emergency controlsHydraulic systems shall be designed so that operation of an emergency stop or emergency return control does not result in a hazard. When a hazard (for example a fire hazard) exists, a hydraulic system emergency stop shall be provided. At least one emergency stop button shall be remotely located.	

2.12.12	Features of emergency controls When emergency stop and emergency return controls are applied with hydraulic systems, they shall a) be readily identifiable; b) be provided at each operator's working position and be readily accessible under all conditions of working. Additional controls may be necessary to fulfill this requirement; c) operate immediately; be independent of, and unaffected by, the adjustments of other controls or flow restrictions; e) not require operation of more than one manual control for all emergency functions.	
2.12.13	System restart Restarting a system after an emergency stop or emergency return shall not cause a hazard or damage.	
2.12.14	Diagnostics and monitoring Provisions for diagnostic testing and condition monitoring should be made to facilitate predictive maintenance and trouble-shooting. Pressure measurement Permanently installed pressure gauges shall be protected by a pressure limiter or gauge isolator. The upper limit of the pressure gauge range should exceed the maximum working pressure by not less than 25 percent. Pressure damping devices should not be an integrated part of pressure transducers.	
2.12.15	Fluid sampling A means of obtaining a representative fluid sample in accordance with ISO 4021 should be provided to allow for checking fluid cleanliness condition. If a sample valve is provided from a high pressure line, a label warning of a high pressure jet hazard shall be installed and the sample valve shall be shielded.	
2.12.16	Temperature sensing A temperature sensing device should be installed in the reservoir	
2.13	Identification	
2.13.1	The following particulars shall be provided by the supplier permanent and readily visible form on all components: a) the manufacturer's or supplier's name and brief address; b) the manufacturer's or supplier's product identification; c) the rated pressure; on the electrical circuit diagram. and shown, if practicable, in a d) symbols according to ISO 1219-1, with all ports correctly identified. Where lack of available space would result in lettering too small to be legible, information may be provided on supplementary materials such as instruction/maintenance sheets, catalogue sheets or accessory tags. Each component shall be given a unique item number and/or letter. This unique item number shall be used to identify the component on all diagrams, lists and layouts. It should be clearly and permanently marked on the installation adjacent to, but not on, the component. The order of stacking modules shall be clearly indicated adjacent to, but not on, the stack.	
2.13.2	The hydraulic circuit drawing stensled on a metallic plate shall be fitted on the power pack on the visible side.	
2.13.3	PORTS All port connections should be in accordance with- ISO 6149 for threaded ports and stud ends, or- ISO 6162 or ISO 6164 for four-screw flange port connections. All ports, power take-off, test and bleed points and drain outlets (e.g. reservoir drains) shall be clearly and distinctly identified. The identification shall correspond to the data on the circuit diagram. When components have standard port identifications applied by the component supplier, these ~ shall be supplemented by identifications corresponding to the circuit diagram	
2.13.4	Valve control mechanisms Electrical control mechanisms (solenoids and their attaching plugs or cables) shall be identified on the electrical and hydraulic circuit diagrams with the same identification. Non-electrical control mechanisms and their functions shall be clearly and permanently identified with the same identification used on the circuit diagram.	
2.13.5	Internal devices Cartridge valves and other functional devices (orifice plugs, passages, shuttle valves, check valves, etc.) located within a manifold, mounting plate, pad or fitting shall be identified adjacent to their access openings. Where access openings are located under a component or components, identification shall, if practicable, be provided adjacent to the component and marked "CONCEALED".	
2.13.6	A function plate should be provided for each control station and located where it can be easily read. The function plate information shall be relevant and easily understood, providing positive identification of system function controlled.	

3	DESIGN, MANUFACTURE, SUPPLY ,INTERFACING, ERECTION AND COMMISSIONING OF PLC PANEL WITH OUR EXISTING MACHINE: ELECTRICAL SYSTEM - FEATURES	
3.1.0	Existing control system	
3.1.1	Existing CNC Tube Bending Machine is designed for three axis motion controlled by CNC-Siemens 840D System through CNC programme.	
3.1.2	Existing Siemens 840D PCU specification is SINUMERIK 840D BS003, VERSION-A and SIEMENS DISPLAY specification is SINUMERIC BENDIENTAFELFRONT-OP 010, 10.4" TFT (640 X 480)-VERSION; G A5E00759460 . Specification of I/O module used in machine is SIEMENS, I/O MODULE-SINUMERIK 810D .	
3.1.3	Three axis motion is Y-axis : Tube Feed , B-axis : Tube Rotation & C-axis : Bending .Collet axis centering, in line with CLR of bend die is also be through CNC programme.	
3.1.4	Existing system has following parameters which is programmable by the operator. 1. Bending angle, Bending Speed 2. Rotation angle, Rotation Speed 3. Distance between bends, Carriage travel speed 4. Boosting segmentally 5. Collet axis centering in line with CLR of bend die 6. Stretch and Spring Back 7. Bend configuration input through YBC co-ordinates, both shall be mutually convertible	
3.1.5	Machine is operated in three modes viz., Manual, semi-Automatic and Automatic	
3.1.6	Boosting facility is available to control thinning. The extent of boosting is set through CNC program by the operator.	
3.1.7	CNC System Remote Operator Control panel is Self Standing - PC Based touch screen type control panel .	
3.2.0	SCOPE OF WORK AND SUPPLY-	
3.2.1	PLC PANEL WITH CPU controller with required nos of DI/DO and AI/AO of High speed encoder module associated relay modules and additional 24 spare configurable are required for future expension.	
3.2.2	I/Os, programming software Licensed version and cable.	
3.2.3	Panel shall be of free standing with standard size and IP 54 protection with suitable A/C.	
3.2.4	Minimum 10 Inch colour touch panel to be flush mounted on the control desk with Ethernet interface / communication cable and programming data cable along with software to be supplied.	
3.2.5	Electrical control circuit shall be designed and manufactured incorporating the safety interlocks and logics as required by the hydraulic functions. It may be noted that rotation axis and carriage axis is no longer being used in the machine. Electrical control can be designed based on that.	
3.2.6	The electrical system shall have 1. one electrical control panel for PLC, Hydraulic power pack control elements and field element with suitable AC & 2. one operator panel located near the operator at a distance of around 3 meters from Machine. Operator panel shall have louvers and cooling fan. All the contactors, OLR and relays shall be of siemens, L&T, telemecanic or any other reputed make accepted to BHEL	
3.2.7	The electrical control panel for the power pack shall have a main mccb for mains control, mains & control on and hydraulic on indicating lamps. necessary switchgear, protection elements, contactors, mcbs, control relays, necessary control transformer, 24v dc supply and other control elements shall be provided in the power panel with necessary interconnection and wiring. this control panel shall have IP54 protection. Hydraulic power pack should have temperature sensor and level indicator. If any abnormal in the hydraulic power pack, it should be indicated in HMI	
3.2.8	Required operating switches, Emergency push button, indicating lamps are to be provided.	
3.2.9	Machine should able to operate in auto / semi auto and manual mode.	
3.2.10	Energy efficient motors are required in all areas ,minimum EFF1/IE2& IP55 Protection.	
3.2.11	Neutral line to be provided from transformer as bhel will give only 3- phase incoming to the hydraulic control panel.	
3.2.12	415V + 10% / -10%, 50HZ +/-3 Hz, 3 Phase AC (3 wire system without neutral) power supply will be provided by BHEL at a single point near the machine, as per layout recommended by Vendor.	
3.2.13	Tropicalization: All electrical / electronic equipment shall be tropicalized.	

3.2.14	All electrical & electronic control cabinets & panels should be dust and vermin proof.	
3.2.15	All electrical components in the cabinets should be mounted on DIN Rail	
3.2.16	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.	
3.2.17	Motors & other electrical components shall conform to IEC or Indian Standards	
3.2.18	All necessary cables along with cable trays (if required) for laying of cables should be included in the offer.	
3.2.19	Vendor should ensure the proper earthing for the machine and its peripherals.	
3.2.20	All Electric enclosures shall have IP 54 protection	
3.2.21	Suitable transformers are to be used for 24V/ 230V / 110V supply. Only 3ph 415V supply will be provide in panel.	
3.2.22	All limit switches are to be replaced with new limit switches. Field Limit switches LLA, LLB and LLFM type of reputed make. Proximity switches can be used where ever required.	
3.2.23	2 nos Encoder (bending and booster) are to be replaced with rack and pinon mechanism with suitable length of cable. Encoder make - Autonics / heidenhain / stegmann or any other reputed make acceptable to BHEL.	
3.2.24	All control elements shall be of 24V and Pnematic / hydraulic coils are to be 24V with LED indication.	
3.2.25	Supply, laying and end termination (with ferrule numbering) of required size of power and control cable with copper conductor in flexible metallic hose (pvc overlapped) for the motor, hydraulic valves, control elements shall be done by the supplier.	
3.2.26	Control panel of a standard RITTAL OR HOFFMAN make shall accommodate the proposed PLC control system and their accessories.The vendor should study the panel dimension in the existing location.Panel for housing the controller Hardwares, mains ON/OFF switch of suitable capacity, power contactors for Hydraulic motors, control Transformer 415V/220V of suitable rating fused TBs for all inputs and outputs, panel light, door limit switch, 5Amps socket, all power and I/O terminations terminated at a height of 300mm from the gland plate for field wiring.	
3.2.27	All the control elements, switchgears, contactors, indicating elements, terminal blocks,I/Os, and control and power wirings shall be accommodated in the new panels.	
3.2.28	The supplier should supply suitable energy meter with suitable ratings of Current transformers and required accessories to connect in the incoming supply of the equipment.	
3.2.29	3Ph power and shielded control cables for connecting the field elements, motors to PLC panel and to the control desk	
3.2.30	Erection of the above items , laying of all cables,testing, programming and commissioning are the scope of vendor.	
3.2.31	PLC software and backups are to be given in CD / DVD. Software should be installed in BHEL laptop and demonstrated for usage.	
3.2.32	Chiller unit should be interfaced with PLC system for on / off , emergency and alarm indications. All interlock feature in the machine are to be retained. Safe operation of machine are to be ensured.	
3.3.0	Electrical MAKE DETAILS:	
3.3.1	PLC and TOUCH PANEL MAKE:SIEMENS/ABB/MITSUBISHI/YASKAWA/SCHNIEDER only	
3.3.2	CONTACTORS :TELEMECHANIQUE/L&T/ SIEMENS .	
3.3.3	Encoder make - Autonics / heidenhain / stegmann or any reputed make acceptable to BHEL.	
3.3.4	Field Limit switches LLA, LLB and LLFM type of reputed make acceptable to BHEL.	
3.3.5	Control panel and operator panel RITTAL OR HOFFMAN make.	
3.3.6	Motors make - Siemens, Mitsubishi, Bharat bijlee or any reputed make acceptable to BHEL.	
3.3.7	Control panel AC unit - Werner finley or reputed make acceptable to BHEL. .	
4	GENERAL POINTS	
4.1	Electrostatic oil cleaner & oil chiller unit with required connecting hoses(not less than 20 meters) with end fittings to be added as a part of scope of supply. the details shall be submitted with offer.	
4.2	Input power supply of 415v, 3 ph, 3 wire, 50 hz with isolator will be provided by bhel.	
4.3	The control panel should be of self standing type.	
4.4	The electric motor with 1440 rpm shall be conforming to s1 - continuous duty with ip-55 protection.	
4.5	All electrical components in control panel / operating panel should be of reputed makes of siemens / l&t / telemechanic only.	
4.6	All proximity sensors should be of reputed makes like technic / omron/ifm or any reputed make acceptable to BHEL	

4.7	The operating panel should have sufficient aesthetic appearance and ergonomic to normal operation.	
4.8	All electrical terminations to be provided with suitably sized cable glands.	
4.9	The power pack and all connected materials are to be selected in accordance with is 10481-2002 /iso 4413-1998.	
4.1	Supplier shall visit the site and see the existing facility for complete understanding of our system requirements before submission of offer.	
4.11	It is the responsibility of vendor to erect and commission the above system with sufficient manpower, tools & tackles and required fasteners, fittings.	
4.12	BHEL shall provide all the civil work if required. necessary power, water, compressed air, welding set & cutting set with consumables like electrodes and gases and any machining required at site will be provided by bhel free of cost.	
4.13	Supplier shall quote for materials supply and erection work separately.	
4.14	The refrigerator type oil chiller shall be of advanced cooling system pvt. ltd / werner finley make only.	
4.15	The vendor to submit the suitably designed hydraulic & electrical circuit with BOM for technical evaluation.	
5	DOCUMENTS	
5.1	In case of ordering, the following drawings to be submitted for bhel's approval:-	
5.1.1	Hydraulic circuit with BOM.	
5.1.2	Cross sectional drawing with major and mounting dimensions of all hydraulic cylinders with BOM.	
5.1.3	Electrical schematic and control circuit diagram with complete bill of materials including makes of each components in it.	
5.1.4	Layout of hydraulic and electrical system	
5.1.5	Layout of operator panel with switch details.	
5.1.6	Electrostatic oil cleaner shall be of 100 lph capacity and to be added as a part of scope of supply. the details shall be submitted with offer.	
5.1.7	The hose make shall be parker/aeroquip/gates only acceptable.	
5.1.8	Limit switches shall be of omron/siemens/cutler hammer only acceptable	
5.1.9	Bhel will dismantle the existing system during erection and commissioning.	
5.1.10	For designing and selection of components vendor shall visit the site and get acquaintance for submitting a competitive offer with hydraulic circuit.	
5.1.11	Hydraulic circuit with bill of materials giving complete purchase specifications and make of each item.	
5.1.12	Details of sealing arrangement and proposed seal make and part no.	
5.2	Documents to be provided along with offer for technical evaluation:	
5.2.1	The following documents to be provided along with offer for technical evaluation. in the absence of all the required documents, the offer will not be considered.	
5.2.2	Hydraulic circuit	
5.2.3	Technical catalogues/details of pump,valves,chiller and cylinders (with major dimensions) in hardcopy along with the offer.	
5.2.4	Any unspecified items which are required for function of hydraulic power pack must be included in the scope of supply and the details has to be specified by the offerer.	
5.2.5	Standard: NFPA/JIC/ISO standards only acceptable and standard to be mentioned by the offerer while quoting for manufacturing of hydraulic cylinders & all accessories.	
5.2.6	Make of bought out items.	
5.3	Documents to be provided for approval before manufacturing:	
5.3.1	In case of ordering, the supplier should provide the following documents for our approval before manufacturing.	
5.3.2	Hydraulic circuit with bill of materials giving complete purchase specifications and make of each item.	
5.3.3	Cross sectional assembly drawing of cylinder with complete dimensions and sealing arrangements.	
5.3.4	Cross sectional assembly drawing of cylinder with its complete dimensions, material of construction and standard wear resistant sealing arrangements are to be provided along with offer by the offerer.	
5.3.5	Clectrical schematic and control circuit diagram with complete bill of materials including makes of each components in it.	
5.3.6	Clectrical wiring diagram with ferrule numbers.	
5.3.7	Complete scope of supply along with makes for each item.	
5.4	Documents to be supplied along with material supply	
5.4.1	Three sets of the following documents are to be provided along with power pack (both hard copy and soft copy-cd):	

5.4.2	Hydraulic circuit in accordance with iso 1219-2 (preferably with standard coloring) with bill of materials giving purchase specifications for each item. a) general arrangement drawing; b) piping and connector layout; c) time and/or sequence and function descriptions; d) floor plan; e) installation drawings and instructions; f) other drawings, as necessary; g) maintenance and operating data and manuals ; h) performance test results;	
5.4.3	Function diagram for the entire operations of the system giving solenoid sequences, interlocks and pressure & flow parameters for each operation.	
5.4.4	List of rubber items like o-rings, piston / rod seals, wipers, etc. with complete purchase specification.	
5.4.5	Pump lay out and piping lay out giving sizes of each pipe line.	
5.4.6	Cross sectional assembly drawing for all the cylinders giving major dimensions, seal details, mounting details, pressure ratings, etc.	
5.4.7	Detailed technical catalogues in original for all components in the system.	
5.4.8	Electrical schematic/ control circuit diagram with bill of materials giving complete purchase specification of all bought out components.	
5.4.9	Electrical wiring diagram with ferrule numbers.	
5.5	Control panel lay-out.	
5.5.1	One number of anodized hydraulic circuit plate has to be fixed in the power pack at convenient place & a 3-d form of hydraulic layout drawing to be supplied to bhel	
6	OTHER WORKS	
6.1	Cleaning and painting	
6.1.1	During external cleaning and painting of equipment, sensitive materials shall be protected from incompatible liquids. During painting, all nameplates, data marking and areas that should not be painted (e.g. piston rods, indicator lights, etc.) shall be covered, and the covers shall be removed afterwards.	
6.1.2	Preparation for transportation	
6.1.3	Identification of piping Whenever systems must be dismantled for transportation, the piping and connections shall be clearly identified. The identification shall correspond to the data on any appropriate drawings.	
6.1.4	Packaging All equipment shall be packaged in a manner that protects it from damage, distortion, contamination and corrosion and preserves its identification during transportation.	
6.1.5	Sealing of openings Only sealing caps that prevent reassembly until they are removed shall be used. Exposed openings in hydraulic systems/components shall be sealed, and male threads shall be protected, during transportation. The protection shall be removed immediately prior to reassembly.	
6.2	Testing and inspection	
6.2.1	Tests to prove the correct operation of the system and all safety devices;	
6.2.3	Pressure test to test each part of the system at the maximum pressure that may be sustained under all conditions for intended use.	
6.2.4	Fluid leakage--No measurable unintended leakage shall be permitted other than slight wetting insufficient to form a drop.	
6.2.5	The power pack will be tested at supplier's works for the operating parameters.	
6.2.6	The cylinder assembly will be tested to a pressure of 350 kg/cm ² at supplier's works for a holding time of minimum 15 minutes at both ends and intermediate position for leak free sealing.	

6.2.7	Test certificates for hydraulic pressure testing, material, hardness and thickness of chrome plating to be submitted during pre-dispatch inspection	
6.2.8	The supplier should provide all the facilities for testing at suppliers work and prove the performance of the power pack and cylinders.	
7	WARRANTY	
7.1	Warranty for products against defective materials and workmanship for a period of 12 months from the date of commissioning or 18 months from the date of despatch whichever is earlier, except normal wear and tear of components like rubber components.	
8	SCOPE OF SUPPLY	
8.1	Power pack and its accessories including hydraulic cylinders, valves, oil chiller unit, electro static oil cleaning unit, oil contamination indicator with hoses & minimess coupling and electrical control panel. qty: one set	
8.2	Spares:	
8.2.1	Complete seal kit for the above hydraulic cylinders- qty: 2 sets.	
8.2.2	Hydraulic hoses - qty: 1 set	
8.2.3	Hydraulic valves - qty: 1 set (1 set consists of one number in each type except proportional valve).	
9	DELIVERY	
9.1	The bidder shall quote the best possible delivery. However the delivery period shall not exceed 16 weeks from the date of Purchase Order.	
10	PERFORMANCE GUARANTEE AND PROVE OUT:	
10.1	The Performance of the Total Equipment and/or the Components / Sub-Assemblies /Bought-Out-Items shall be guaranteed for a minimum period of twelve months from the date of performance acceptance at BHEL Works.After retrofit the output of the machine should be increased from the existing condition.	