An ISO 9001 Company

Bharat Heavy Electricals Limited

(High Pressure Boiler Plant**)**
Tiruchirappalli – 620014, TAMIL NADU, INDIA
MATERIALS MANAGEMENT / CAPITAL EQUIPMENT

ENQUIRY	Phone: +91 431 257 70 49 Fax : +91 431 252 07 19 Email : csguna@bheltry.co.in Web : www.bhel.com

	Enquiry Number:	**Enquiry Date:**	**Due date for submission of quotation:**
	2620900042	**16.02.2009**	**18.03.2009**
You are requested to quote the Enquiry number date and due date in all your correspondences. This is only a request for quotation and not an order			

Item	**Description**	**Quantity**	**Delivery (Item required at BHEL on)**
10	Electronic Co-ordinate Determination System as per the technical specification & commercial conditions applicable (to be downloaded from web site (www.bhel.com or http://tenders.gov.in)	01 No.	25.11.2009

BHEL commercial terms & conditions with Price Bid and Bank Guarantee formats can be downloaded from BHEL web site http://www.bhel.com or from the Government tender website http://tenders.gov.in (public sector units > Bharat Heavy Electricals Limited page) under Enquiry reference "2620900042".

Tenders should reach us before 14:00 hours on the due date Tenders will be opened at 14:30 hours on the due date Tenders would be opened in presence of the tenderers who have submitted their offers and who may like to be present	Yours faithfully, For **BHARAT HEAVY ELECTRICALS LIMITED** Sr.Manager / MM / Capital Equipment

PART A

QUALIFYING CRITERIA FOR THE SUPPLY OF ELECTRONIC CO-ORDINATE DETERMINATION SYSTEM (ECDS)

SECTION – I COMPANY PROFILE

The BIDDER / VENDOR has to compulsorily meet the following requirements to get qualified for submitting an offer for ECDS.

S. No.	REQUIREMENTS	VENDOR's COMMENTS
1.0	The Bidder / Vendor shall have a minimum of FIVE Years of Continuous Experience in the Design, Manufacture & Supply of such equipments. Kindly indicate the actual experience.	
2.0	The Bidder / Vendor shall have supplied at least one number of similar equipment in the last 5 years. Kindly confirm and indicate the number of equipments (similar to the quoted model) sold in 2003/08 in the world..	
3.0	The bidding FIRM should have 'in-house' or 'self-owned' facility for fabrication, inspection and testing of ECDS at the rated capacity.	
4.0	Reference List of Customers and Performance Certificates from Customers (minimum 2 Customers) with full contact details of Contact person.	
5.0	The Bidder / Vendor should have sound financial position and should furnish the Finance Statements (Summary of P & L Statement and Balance Sheet) for the immediate past three years.	
6.0	In case of short listing by the Purchaser, the Bidder / Vendor has to co-ordinate for the visit of Assessing Team, to the Works of the Bidder / Vendor with a notice period of 10 Days.	

SECTION – II

The Bidder / Vendor has to necessarily provide the following details, for making an assessment of the firm's capability and competency.

The Bidder is expected to give complete details against each clause in the table given below and wherever necessary an additional sheet may be attached giving clear reference number to cover the required details.

S. No.	PARTICULARS	VENDOR's RESPONSE
1.0	Number of Years of Experience of the Bidder/ Vendor in the field of manufacturing and supplying 'ECDS'	
2.0	Number of Similar Equipments supplied, erected & commissioned till date. Brief features of the supplied systems. (two to three statements per supply).	
3.0	Year of launch of the Model quoted against this Enquiry.	
4.0	Number of 'ECDS' supplied, erected & commissioned till date in the quoted Model	
5.0	Details of Design Set-Up	
6.0	Details on International standards followed in Design of the Equipment (including analysis, methodology and verification of equipment). Calibration standards and their traceability to inter-national standards. Details regarding periodic recalibration and sources / tie-ups for such recalibrations including the proposed cost of recalibration and lead time for recalibration.	
7.0	Details on manufacturing facilities – machining, forming, welding and heat treatment, material control and assembly with regard to ECDS equipment and systems manufacture, non destructive testing and final functional verification of the units. Stages of Internal Inspection and Inspection by External Agencies [other than Customer Inspection]	
8.0	Details of Electrical/Electronic Control Panel, CNC Systems, computer side parts and assembly - Manufacturing and Testing details.	
9.0	Any Additional Data to supplement the manufacturing capability of the Bidder.	

SECTION – III

The Bidder / Vendor has to comply with the following, for accepting the Technical Offer for scrutiny by the Purchaser:

S.No.	REQUIREMENTS	VENDOR's COMPLIANCE
1.0	The Bidder / Vendor shall submit the offer in TWO PARTS - Technical & Commercial and Price Bid. The Technical Offer shall be in line with the BHEL Technical Specifications and the Guidelines or Annexures mentioned, wherever applicable.	
2.0	The Technical Offer shall contain a comparative statement of Technical Specifications given by BHEL and the Offer Details submitted by the Bidder, against each clause of the specifications.	
3.0	A just 'CONFIRMED' or 'COMPLIES' or 'YES' or 'NO-DEVIATION' or similar words in the technical comparative statement may lead to disqualification of the Technical Offer.	
4.0	The Technical Offer shall be supported by Product Catalogue, drawings, manuals and Data Sheets in ORIGINAL and complete technical details of 'Bought-Out-Items' with copies of Product Catalogue and Selection Criteria. This should include operational and maintenance spares also.	
5.0	The Commercial Offer (given with the Technical Offer) shall contain the Scope of Supply and the Un-Priced Part of the Price-Bid, for confirmation	
6.0	The reference List of Customers shall be accompanied with the details (Phone Number/E-Mail ID) of the Contact Person for cross reference .	

TECHNICAL SPECIFICATION FOR ELECTRONIC CO-ORDINATE DETERMINATION SYSTEM (ECDS)

PART B

Three dimensional co-ordinate measuring machine of non contact type using integrated digital camera system with attachments (laser devices / optical sensors or other means for target lighting) suitable for alignment and measurement of components in shop floor. The equipment has to be portable in order to facilitate field measurements in different shops / sites.

1.0 BRIEF DESCRIPTION :

Measurement of positional accuracy, Alignment of components during assembly, marking of axes, generation of plane are some of the Quality Control activities done in the shop floor. This activity is carried out using special measuring Instruments / gadgets. Apart from this, 3 dimensional coordinates measurement also needs to be done. To carry out these measurements, it is envisaged to use three dimensional co-ordinate measuring machine of non contact type using photogrammetry of digital cameras with attachments (laser devices / optical sensors or other means for target lighting) suitable for alignment and measurement of dimensions of components in shop floor and the equipment has to be portable in order to facilitate field measurements in different shops / sites.

This method using camera view is most suited for critical and large quantum measurements. There is lesser dependence on operator's skill for such measurements. The envisaged system should have facility for e-storing of measured data also. The computer and the data processor should have simple menu driven features for the quick and easy operation of the equipment (with minimum set up time) for the measurement of linear and angular dimensions as per 3 dimensional Cartesian co-ordinate system. Also, all types of geometric measurements (on single feature or related features covering all 3 planes) have to be carried out on jobs with this equipment and the expected job size is up to 25 metres x 25 metres x 25 metres (in the three dimensions).

Sl No	BHEL Requirement	Description of expectations from the Offer
2.0	Areas of Application in BHEL/Trichy & equipment requirements	• For conducting automated 3 dimensional measurements of light, medium and heavy engineering jobs – from small to large structures, assemblies, jigs and fixtures. The system should be able to measure objects made out of solid, flexible and elastic materials. Typical products envisaged are pressure vessels, heat exchangers, drums, headers, multi plane piping systems, columns, modules, construction work, site assembly,

		structural fabrication, panels, coils, valves, oil field equipments,3D toolings of complicated and critical nature – small to large size, host of heavy engg. Components, sub assemblies and assemblies, etc wherein all the toleranced dimensions as per drawing have to be measured (the measurement starts from components stage to finishing through the process of full machining / processing of job). Besides measurement, critical marking activities are also envisaged with this machine. Axes marking on jobs for indicating references (as per drawing) may have to be done preferably by scribing or hard punching in an accurate manner using suitable gadgets. Proper illumination of marking areas has to be provided by using suitable handy accessories. This includes measurement at hidden areas / areas not in direct view of the equipment also. During further stages of job manufacture, these marked axes have to be monitored for any changes using our ECDS (with respect to originally marked condition). The expected job size is up to 25 metres x 25 metres x 25 metres (in the three dimensions).
	Types of measurement	• All types of linear, angular and geometric measurements have to be performed in rectangular Cartesian coordinates. After establishing a reference (using suitable calibrated bars or multiple references of known positions of targets or viewing by multiple cameras known points are getting captured and made known to the equipment about a datum by triangulation process or other wise), the equipment has to measure X, Y, Z co-ordinates of the points about a datum of the equipment. Provision is required for processing this data (using computer and its user friendly software and menu driven programs) on various points with respect to equipment datum to modify with respect to a reference on the job (job datum) and therefore, any toleranced dimension of the job has to be measured using this equipment without using any touch probes. The system shall be able to make measurements in near real time and provide instantaneous 3D co-ordinates in fully automated mode. The supplied system should have been used in space / air craft / heavy engineering. Industries for 3D measurements and alignments of various types. The supplied CMM should provide very good

		flexibility, quick mobility and immediate set up and faster operation which will help for minimum production stops to get in-process feed backs in critical areas.
	Applications of the equipment	• Precision and accurate 3D measurement, critical alignment, automated inspection, on line comparison to CAD and reverse engineering are some of the general applications for the new equipment. The CAD comparison data shall be graphically displayed on the screen and high light any out of tolerance conditions. As a QA measure, this equipment has to be used for first piece inspection or in random inspection or in 100% inspection from the initial raw material stage through in-process stages up to finished part stage. Both static and dynamic inspection (when job is under machining) may have to be tried for this new equipment as a process control measure. The instrument shall be capable of point wise / line wise / area wise scanning suitably to cover wide range of engineering jobs.
	Measurement set up – features.	• Universal type of features to cover all the points / most of the points in the single equipment positioning is required using suitable special attachments. Alternately, if the equipment is disturbed between measurements, software should have inbuilt provision to establish common reference for both the measurements and it should be a simple task without any cumbersome calculations. Job should not require any special or specific setting / horizontal or vertical type of placement or leveling for carrying out ECDS Measurement. The set up time of the equipment should be reasonably short – within an hour – and in the same setting maximum possible coverage of job points is required using suitable accessories. In short, similar to a contact type / probe type CMM which covers a small volume in calibration labs / metrological centres, this equipment should cover large volumes mentioned above in fields – shop floors and sites and it has to perform measurements in non contact manner. Cumbersome calculations on the part of operator is to be avoided and this has to be done by the computer system in almost real time manner based on ‘menu’ driven selections chosen by the operator

		and results should be immediately displayed.
	Equipment calibration.	• It should also be capable of replacing automatic measurements carried out on CNC machines using special measurement probes (laser devices / LED probes or other types). Along with 3 dimensional measurements, the equipment has to cater to reference planes marking and verification, reference axes marking and verification and alignment of components and assemblies and verification of alignment on the established line of site (presently, these activities are performed by optical alignment telescopes, levels and theodolites). Along with the equipment, calibration certificate (traceable to Inter national standards) shall be issued. Periodic in-house / supplier based recalibration arrangements shall be indicated.
	Targets requirements	• Suitable state of art devices like targets (self illuminated targets or LEDs emitting IR / LASER LIGHT or other sticker reflective targets) without affecting the job areas are to be offered as a part of equipment to locate / identify the measurement points. The method should provide convenient and easy identification (with out requiring any cumbersome calculations) along with very good repeatability of location. (location repeatability has to be better than 100 microns). All directional viewing is an essential feature for such locating devices. The targets should be of universally available type and in case of requirement , we should be in a position to get the same immediately. Lead time of purchase should be very minimum (less than 30 days). Alternately, suppliers can provide fully automated, CNC target less versions. The targets or attachments for measurement points identification should take care of both direct view areas and out of view areas.
	Resolution	• Resolution of measurements (expressed in terms of linear measurement) = 10 microns or better.
	Repeatability	• Measurement repeatability = better than 10 microns (expressed in terms of linear measurement).
	Measuring accuracy	• Measuring accuracy in every axis (expressed in

		terms of linear measurement) = 15+L/200 microns or better where L is the length (dimension) of measurement in mm.
	Measuring capability	• Measuring capability : In addition to X, Y and Z measurement, the equipment shall be capable of angles measurement and all geometric features' measurements like parallelism, flatness, perpendicularity, concentricity, co-axiality, etc of single and related features of various elements such as points, lines, planes, curves, circles, polygons, prisms, sphere, cylinders, cone, etc. in line with National and International standards. Both standard geometric shapes and free form surface shapes and profiles (to establish best fit geometric shapes) are required to be handled by the equipment.
	Control system features.	• Control system features: Fully computerised and the feed back systems should be from reputed companies. The control system shall be operable in regular shop floor environments. The interface between measuring /sighting system and control system should be smooth and user friendly by means of cables or remote controls / both. Using suitable plug chords, it is required to connect our own computer monitor / laptop / display devices in addition to the supplier given display devices.
	Diagnostic features.	• Equipment shall be able to work between 16ºC and 50ºc and with humidity levels between RH 45% and 95% without any problem. The equipment should be suitable for 230V +/-20% (AC-50Hz) and accordingly it should have a built-in stabilizer. Built- in diagnostic features regarding equipment malfunction / break down by means of message display or indication or signal or alarm is required. i.e. the system should be intelligent with on-board self diagnostic mechanisms to ensure correct measurement. The system should have in-built tools and accessories to conduct on-site accuracy checks. Standard startup calibration system is to be provided.
		• In case of power cuts, the stored / processed data and the reference settings of the equipment should not get disturbed. In other words, on resumption of

	No disturbance to initial references.	power, we have to start from where we left and not right from the beginning. This data back up storage to take care of power cuts or for starting the next day work on the same job is essential. The equipment shall be provided with Standard, reliable, proven and fool-proof electrical and electronic safety systems and devices as per the supplier recommendations.
	Personal Safety.	• The equipment and the control system should not warrant any special preparations / gadgets to take care of personal safety while operating the equipment. No adverse effects are envisaged from laser / optical line of sight / other illuminations or radiations used for targets.
	General lighting conditions.	• Measurement has to be made in general in the standard industrial environment, i.e. in work shops – under roof or in open yards (where there will be no power for exclusively illuminating the measurement site using flood lights or other wise). The shop area will have natural ambience with fumes / smokes and dust generated in fabrication and machining and the equipment and its control systems should work without any problem in such practical industrial environments. Measurement should be independent of LUX level of ambient light. Measurement should be possible in dark also with suitable gadgets. Even the very bright sun light should not lead to glare or other troubles during measurement. The equipment shall be capable to measure on dull to well painted bright surfaces.
	Mechanical construction.	• Mechanical construction: All movable parts shall be of high accuracy and rigidity along with mechanical stability to with stand shop area vibrations / disturbances. The equipment should be suitable for measuring tight pockets, small holes, gaps, surface fractures, difficult to access areas, etc using suitable gadgets / accessories .
	Sensor capability.	• The sensor should have a quick measurement speed and feasibility for immediate set up. Time taken for locating reflectors / targets is to be controlled critically. Targets / reflectors / sensors have to be wireless to provide unlimited

		measurement volume. The system should have provisions for expanded line of sight to measure around objects / hidden objects / out of view objects without changing sensor locations. Operator Skill dependence should not be there and even unmanned systems are preferred.
	Reverse engineering capability.	• The system should generate data that can be imported into other leading soft wares for quality assessment and reverse engineering. The system should support a traceable metrology 3D graphical software platform that can simultaneously communicate to virtually any number and type of dimensional measurement system and perform complex analysis of tasks simply.
	Computer hardware and software details.	• Computer hardware and software details : the equipment shall have a computer supported measuring system for tracking entire measurements with programming and printing facilities. Auto alignment, temperature compensation, software for measurement of 2D / 3D - linear, angular and all types of geometric aspects, etc are required in the computer system. Standard computer of current model with very good memory and with provisions for handling CD/FLOPPY/PEN DRIVE/RS 232C port is required. Multi colour printer (up to A3 size printing) is required.
	Data export and import features.	• The data export and import in CAD file formats interface with standard CAD software packages will be preferred. The computation of best fit for line, plane, circle, sphere, cylinder, cone, parabolic shapes, etc (all curves, shapes & surface profiles) are to be provided. Geometric data evaluation including intersection, perpendiculars, bisection, distance check, angles check on geometric entities, etc are required. Transformation of one co-ordinate system to another by translation, rotation and scaling is required. Software used for data acquisition and analysis shall be of the latest one.
3.0	Specific requirements of measurement system.	• The accompanying software should automatically inspect points and produce 3D data and it has to be aligned to any co-ordinate system. Successive measurements are to be analysed for required

		dimensional characteristics as per software and provision of statistical tools is also needed for data analysis. Provision shall include easy operator access for viewing measurement locations – points and camera/equipment stations. • Auto calibration of camera line is required. This self calibration is a very powerful technique that allows the camera line of sight to be calibrated at the time of measurement under the conditions that exist. • Internal estimates on accuracy for each measured point is required. These accuracies have to be demonstrated to be correct using standard bars, artifacts, known distances, etc as external measures of accuracy.. • The camera system has to be compact, clear for vision and structurally rigid and robust for accurate viewing and measurement.. • The camera has to be operated off-line and on-line. Off-line feature works on data storage and interpretation when needed and on-line is near real time interpretation of data. • Remote control provision is required for equipment operation using cables or wireless system. • In camera versions, powerful picture viewing facilities including movable, sizable zoom window, automatic contrast adjustment and picture number viewer are required. • By virtue of multiple points tracking, the position and orientation of points (6 degrees of freedom) in space has to be determined for better accuracy levels. • The typical data analysis shall cover best fit lines, planes, spheres, cylinders, curves, surfaces, vector point calculation, average point calculation, point to point, point to line, point to circle, point to plane calculation and projection, line to line and line to plane intersection, plane to plane intersection, point cloud to point cloud comparison, automatic repeatability check, data alignment and transformation and report generating capabilities are few examples – but not exhaustive – for data analysis. • Measurement and inspection may have to be made in busy industrial settings where environment and vibration effects are often found. In spite of this precise measurements are required even if sighting is done from lifts, scaffolds, roofs, cranes, etc. large

		volume jobs may pose resistances due to crossing workers, movements, obstacles, etc and the portability of the system should compensate without loss of reference / loss of measurement accuracy. In all such occasions, set up time between two set ups should be the least. • Details on International standards followed in Design of the Equipment (including analysis methodology and verification of equipment). Calibration standards and their traceability to inter-national standards. Details regarding periodic recalibration using standard bars of suitable types / masters (to be supplied by the equipment supplier along with the procedure / methodology for in-house calibration) and sources / tie-ups for such recalibrations including the proposed cost of recalibration and lead time for recalibration.
1.	Principle of Operation	Electronic 3D co-ordinate determination system (ECDS) with Non contact type of operation. Triangulation is the basic principle adopted for dimensional measurement. The points of measurement are sighted by digital cameras and associated accessories.
2.	Design Base	Supplier has to indicate the details including codes / standards adopted. IS 15635 (PART 1 to PART 6) or ISO 10360 -1 to 10360-6 or VDI 2617 or other equivalent INTERNATIONAL standard will be the basis for the Quality requirements of the equipment and systems.
3.	Scope of Supply - clear in all respects	a. Detailed Design, Manufacture and supply as per our BHEL Specifications**.** b. Assembly and inspection before Despatch. Pre-despatch inspection and field demo before despatch will be witnessed by BHEL. c. Supply of Electrical, Electronic & Mechanical Spares / panel boards, spares for control systems and computer system spares – Both for operation and maintenance for a period of 3 years. d. Erection (Assembly), Commissioning and Performance Prove-Out / field demo at BHEL works. (BHEL will provide required support for installation and commissioning). e. Training on Operation and Maintenance for BHEL Staff – at least for 1 week after successful commissioning. f. Performance Guarantee for 24 months, from the date of commissioning for both the equipment and

		accessories. g. O & M Manuals and related documents. Operating and maintenance manuals (for equipment and accessories in English language only) shall be supplied (both in soft form and hard form). Soft copies and hard copies of equipment & accessories ' catalogues / photos / video clips of the model are to be provided.
4.	System Configuration with name of subsystems involved	Covered in 2 & 3
5.	Operating Parameters	Covered in 2 & 3
6.	Constructional Features	Refer 2 & 3
7.	Consumables, Spares and Accessories - Description & Quantity required	The offer shall include the necessary list of consumables and spares for the smooth operation and maintenance of the equipment for the next 3 years minimum. This should be part of the scope of supply. Optional accessories to be furnished separately.
8.	Maintenance Aspects - Trouble Shooting & Documentation	Manuals - Operating & Maintenance manuals, Engineering drawings, Circuit diagrams, PCB drawings, control system drawings, etc. shall be given for main equipment and accessories – hard copy is required in English with a soft copy.
9.	Erection & Commissioning - Performance Prove-Out at BHEL	Erection and commissioning shall be done by the supplier free of cost. After the installation, the supplier has to run the equipment and demonstrate its performance. Guarantee: Two years minimum shall be provided, Free service during Guarantee period shall be provided.
10.	Service Support Requirements.	Vendor shall ensure AMC service facilities in India after the guarantee period, through trained service personnel in India
11.	Training on Operation & Maintenance for BHEL Staff at BHEL/Trichy	Training for our personnel- from operation / maintenance shall be given free by the supplier for a period of one week after the successful commissioning and prove-out of the equipment.

12	Surface	All steel parts of the equipment are to be shot blasted or

	Cleaning & painting	chemically treated for surface cleaning, after completion of all operations but prior to painting.
13	Dimensions	BIDDER has to indicate the tentative dimensions for the equipment.
14	Drawings and Documents	GA Drawing of the measuring system and control systems – electrical, electronic and mechanical (including accessories). . Wiring Diagram with Logic Circuits. if any. Weight of the Equipment with its supports and Handling arrangements..
15	INSPECTION	The following Schedule of Inspection is to be carried out, prior to dispatch from the Supplier's Works : a. Prove out / field demo Test reports of the equipment. (on mutually agreed norms). b. Other applicable Test Reports and calibration certificates including accessories.

NOTE: If required, suppliers may have to visit our works for the demonstration of their equipment and systems during technical bidding. During this demo typical 3D measurements, marking of references and alignment of components in assy. may have to be demonstrated. Light, medium and heavy jobs like header, heat exchanger, pipe bend, valve, fixture, critical tool, etc will have to be demonstrated for various measurements and alignments and the results obtained by the equipment measurement will be compared with other type of measurement as a part of validation. Alternately, if required, demo may please be planned at supplier's works or any other customers' works nearer to Trichy.