
	<b>TECHNICAL SPECIFICATION</b> <b>AUTO BUSSING / INTERCONNECT EQUIPMENT</b> <b>FOR SOLAR PHOTOVOLTAIC MODULE</b> <b>MANUFACTURING LINE</b>	Spec. No	EP-PVM-EQS-03
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REVISION DETAILS: (00)	PREPARED			DATE
	AK	SM	SM	
	APPROVED	ISSUED STG		23.05.2016
	CNP	PLNG		

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### **Introduction**

BHEL is inviting tenders for the supply of an 'Automatic Bussing / Interconnect Equipment' for the Solar PV Module manufacturing line. The proposal includes the design, manufacture, supply, installation, commissioning, technology, line integration, training, process optimization, warranty and Technical Supervision & Maintenance (TS & M) contract and AMC (Annual Maintenance Contract post warranty period) of the equipment. Prospective suppliers are required to conform to all the specification and qualification criteria.

Prospective suppliers are required to quote for complete scope mentioned in this specification. A package price for the entire scope is to be offered and all the specifications shall be supported by detailed technical catalogues and data Sheets of the manufacturer. The location of the equipment supply and installation will be at Electroporcelain Division, Bharat Heavy Electricals Ltd., located at Indian Institute of Science (IISc) Post, Malleswaram, Bengaluru, INDIA 560012. The geographical information of the site / plant location, the environmental conditions and site infrastructure details are provided for the information of the bidders in this document.

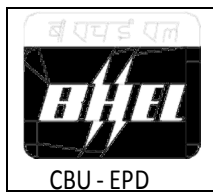
### **General Requirements:**

The broad indicative configuration and general requirements of the Automatic Bussing / Interconnect equipment for the Solar PV Module manufacturing line is described below and the vendors shall configure their offer accordingly. The offered line configuration will be evaluated and certain modifications may be made mutually discussed for the purpose of optimization and standardization during technical evaluation of the bids. The offered equipment has to be integrated with 200 MW automatic module manufacturing line having 4 nos of Tabber & Stringers and 2 nos of layup with other standard accessories and line item supplied by M/s Mondragon Assembly.

1. The basic configuration of the PV Module manufacturing at BHEL – EPD consists of 2 parallel lines each of 50 modules per hour capacity for 72 cells module (and alternatively 60 modules per hour capacity for 60 cells module) operating concurrently and together having 100 / 120 modules per hour capacity.
2. The Automatic Bussing / Interconnect equipment shall be integrated with the line available at BHEL – EPD and shall be fully compatible to meet the throughput as described above of the existing line.
3. The bidders have to assess the existing line layout and provide the auto bussing / interconnect unit without major modifications. The bidders to support their offer with detailed dimensional drawing for integration.
4. The Automatic Bussing / Interconnect equipment shall have ease of access for the operators for carrying out operation & trouble shooting, feeding & extraction of process and auxiliary inputs, on-line & off-line maintenance, data access and process supervision.
5. The Automatic Bussing / Interconnect equipment shall have full Safety features built in for ensuring total safety to the operators, line equipment and material work in-process. Onboard the equipment, vital points of the line and remote safety / emergency stoppage provision shall be provided at accessible/vantagepoints.

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6. The selection of individual equipment / components for the Automatic Bussing / Interconnect shall be of state of the art and industry standard. The details and features shall be explained in the techno-commercial bid by the vendors.
7. The Auto Bussing / Interconnect shall have data acquisition and monitoring for vital process parameters. The data thus acquired shall be connected to the centralized SCADA of the existing line.


**Pre-Qualification Criteria**

The supplier shall necessarily meet the following pre-qualification criteria.

S.No.	Item	Bidder Confirmation
1.	Offer shall be for new equipment and not for any refurbished or used equipment.	
2.	<p>Bidder shall have the prior experience of manufacturing, supply, installation and commissioning of Automatic Bussing / Interconnect for Solar PV Module Manufacturing line(s)</p> <ol style="list-style-type: none"> <li>i. Of not less than 200 MW cumulative capacity during the period from 01.04.2012 to 31.03.2016.</li> <li>ii. Have at least one reference of satisfactory working for a minimum of 50 MW automated module manufacturing line with auto bussing / interconnect.</li> <li>iii. The references provided for the above experience shall be successfully and satisfactorily working plants for a minimum period of one year.</li> </ol> <p>Documentary evidence for the above shall be provided in the form of the satisfactory certificate issued by the customer, purchase order, commissioning certificate and the performance certificate from the customers. BHEL reserves the right to independently verify the claims and if found to non- conforming and or non-satisfactory, such bids are liable to be rejected at techno-commercial evaluation stage.</p>	
3.	Bidder / Supplier shall be the original equipment manufacturer or are their authorized company / organization.	
4.	Bidder / Supplier shall take full responsibility for successful integration, performance proving, warranty, TS & M contract, AMC for the Auto Bussing / Interconnect equipment with the automatic line at BHEL – EPD, Bengaluru	
5.	Automatic Bussing / Interconnect shall bear the 'Conformité Européenne (CE)' Marking. The relevant certificates and technical documentation shall be made available in the techno-commercial bid.	

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6.	Foreign bidders / suppliers shall have their branch office or an authorized company / organization located in India with requisite number of service engineers / technicians for providing service and support. The authorization letter for the Indian company/organizations shall be provided in the techno-commercial bid.	
7.	Recent Dun & Bradstreet (D&B) report indicating DUNS number shall be submitted with the techno-commercial offer. If not available, the audited financial statement for the last three (3) years shall be submitted.	

Note:

1. Pre-qualification will be carried out based on the details furnished by the supplier / feedback from their customers / inspection of the company / product if required by BHEL and at its sole discretion.
2. The Pre-qualification criteria are mandatory requirements and the technical bids will be considered only if all the above Pre-Qualification Criteria are met as on the date of techno-commercial bid opening.
3. All supporting documents related to PQC shall be enclosed in the techno-commercial offer.

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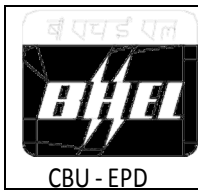
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3.	<b>Features of Auto Bussing / Interconnect Equipment</b>		
01	General Features : The Auto Bussing / Interconnect equipment shall have fully automatic mechanism for soldering the strings onto the main bus bars. The equipment shall be capable of automatically moving in the lay-up panel, identifying the soldering spots, scan and analyze the ribbon & tab alignment accuracy, alert for deviations, prepare the solder joints by pre-heating as necessary & flux infusion, carry out soldering and move out the soldered panel.		
02	Loading & Unloading of the Panels : Shall be done automatically on conveyors by sensor based on the module manufacturing line. The equipment shall be integrated with the existing line and shall be able to receive and deliver the panel in synchronization at rated throughput levels. The equipment shall also be able to interact with the line and utilize the buffers for pre-defined un-hindered flow.		
03	Ribbon loading: The equipment shall have provision for ribbon loading either manual / automatic. Bidders to specify the feature		
04	Soldering: The equipment shall have built-in provision for holding the ribbons, scan and position the soldering spots, pre-heat if necessary, dose the flux and carryout the soldering. The equipment control system shall have built in software feature for programming the soldering the process with variable parameters. The software shall also have feature for incorporating multiple pre-set parameters / recipes.		
05	System Controls: The equipment shall have built in hardware and necessary software for programming the auto bussing operation and have provision for interconnecting with the central SCADA for integrated operation and data acquisition.		
4.	General requirements for the equipment The equipment offered shall comply with the following general requirements.		

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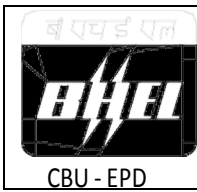
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4.1	<p><b>General construction</b></p> <ol style="list-style-type: none"> <li>1. The design &amp; manufacture of the equipment shall adhere to appropriate standards for the electrical and mechanical systems to minimize risks to the operators and the equipment. The standards followed for the manufacture of the equipment shall be declared and certification as applicable shall be provided.</li> <li>2. The equipment must be designed for ease of maintenance and safe accessibility to electrical, electronic and other components.</li> <li>3. The materials used must be chosen on the basis of the intended working environments, with particular regard to corrosion, abrasion, impacts, extreme temperatures, fatigue, brittleness and ageing.</li> <li>4. All equipment shall have the provision for remote fault diagnostics through internet.</li> <li>5. The computer interfacing for operation, data logging, communication and fault diagnostics wherever required shall be provided with latest operating systems and operating software. Backup of software shall be provided for maintenance purposes.</li> <li>6. The equipment shall be designed for continuous duty (24 X 7) operation.</li> <li>7. The equipment shall be aesthetically fabricated and all exposed parts shall be painted with corrosion-resistant paint or coating. The choice of equipment color shall be provided to BHEL.</li> <li>8. Three hard copies and one soft copy of all the operation &amp; maintenance manuals shall be provided for all line equipment and turnkey line.</li> <li>9. All the manuals shall be in English language. All the software and operating systems shall be in English language.</li> </ol>	
4.2	<p><b>Electrical &amp; related Safety requirements</b></p> <ol style="list-style-type: none"> <li>1. All equipment shall be protected against the risk due to electrical shock and failures with respect to earth fault and residual current.</li> <li>2. Live parts in the equipment shall be protected by suitable insulation that can only be removed by trained and competent person.</li> <li>3. The insulation shall be capable of withstanding the mechanical, chemical, electrical, and thermal stresses to which it can be subjected under normal operating conditions.</li> <li>4. The emergency stop must supersede all modes of operations and functions. There must be no automatic restart of the machine on reset.</li> </ol>	

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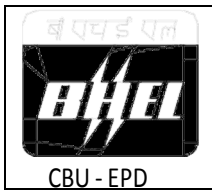
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4.3	<p><b>Uninterrupted Power Supply - UPS</b></p> <ol style="list-style-type: none"> <li>1. The control systems/PCs/PLCs/conveyors and systems critical for safety shall have provision for supporting by uninterrupted power supply (UPS) for all the equipment.</li> <li>2. Supplier shall indicate the appropriate rating of the UPS to satisfy the conditions as mentioned in serial number 1 above for all the turnkey line equipment. Providing UPS will be in the scope of BHEL.</li> <li>3. Load details of the equipment shall be provided for Design of the UPS rating.</li> </ol>	
4.4	<p><b>Equipment details</b></p> <p>The technical bid shall include the following information about the equipment and the turnkey line :</p> <ol style="list-style-type: none"> <li>1. A clear, comprehensive description of the equipment, installation and mounting, and connection to the services instructions.</li> <li>2. The utility requirements like electric power (voltage, current rating &amp; consumption), compressed air (pressure, quality of air &amp; consumption), Lubrication if required and any other utility for each of the equipment.</li> <li>3. Wear parts required for each of the equipment and its consumption rate.</li> <li>4. Information on the physical environment like temperature, humidity, cleanliness level and any other parameter as required.</li> <li>5. Overview (block) diagrams and schematic wiring diagrams where appropriate.</li> <li>6. List of recommended support tools.</li> <li>7. List of suggested personal protection equipment required for safe operation.</li> <li>8. Dimensions and weight of the equipment.</li> </ol>	
4.5	<p><b>Marking and Signage</b></p> <ol style="list-style-type: none"> <li>1. The equipment must be marked with all mandatory signage and appropriate warning labels and signs in English language, and identifiers such as marking for electrical shocks, hot surfaces etc. with suitable signage.</li> <li>2. All equipment must be marked visibly, legibly and indelibly with the following minimum particulars: <ol style="list-style-type: none"> <li>a. The business name and full address of the manufacturer</li> <li>b. Marking of the standard or norm followed for manufacturing</li> <li>c. Serial &amp; model number</li> <li>d. The year of construction, that is the year in which the manufacturing process is completed.</li> </ol> </li> </ol>	

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5.	<p>Consumables / Spares</p> <p>The key consumables, equipment spares and wear parts as required for the operation of the line un-interruptedly and must necessarily be maintained in stock for periodic / scheduled maintenance and as necessary for a minimum period of six months shall be indicated in the techno-commercial offer. The item wise description and quantity shall be provided in the techno-commercial offer and the item wise price shall be indicated separately in the price bid.</p> <p>For the warranty period, the responsibility of providing and maintaining the consumables, equipment spares and wear parts rests with the successful bidder.</p>	
6	<p>Technical documentation</p> <p>The following documents have to be submitted with the offer.</p> <ol style="list-style-type: none"> <li>a. The datasheets and catalogues for the equipment shall be provided.</li> <li>b. Detailed technical write-up for integration with the existing automatic line, schematic diagram and automation features shall be clearly explained indicating movement of modules in the process and the operational parameters.</li> <li>c. The price list of all the spare parts for corrective maintenance i.e., parts that are needed to be replaced only in case of malfunction or breakdown shall be provided.</li> <li>d. The price list and quantities of wear parts for one (01) year of preventive maintenance shall be provided.</li> <li>e. The price list of the consumables shall be provided.</li> </ol>	
7	<p>Pre-dispatch inspection</p> <p>The pre-dispatch inspection of the equipment will be carried out by BHEL personnel or their authorized representatives at the OEM site with the following conditions.</p> <ol style="list-style-type: none"> <li>a. The supplier shall inform BHEL one month in advance for the inspection date.</li> <li>b. The equipment shall be shown for the completeness in accordance with the specification.</li> <li>c. The design, sizing and utility connections with respect to the drawing shall be shown.</li> <li>d. The equipment shall be operated and the performance parameters specified shall be demonstrated.</li> <li>e. Vendor has to provide requisite consumables / input materials for the purpose of demonstration and proving at their site.</li> <li>f. The safety circuits, alarms and interlocks shall be demonstrated.</li> <li>g. BHEL will bear the expenses for their personnel travel and stay for the pre-dispatch inspection.</li> </ol>	

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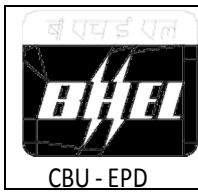
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8	<p><b>Packing</b></p> <ol style="list-style-type: none"> <li>i. The equipment shall be packed for sea-freight worthiness</li> <li>ii. The design of the packing shall take care of possible damage to the equipment while normal handling and transportation.</li> <li>iii. Packing slips / labels / BHEL PO Reference shall be fixed indicating the items packed inside on each of the box.</li> <li>iv. Each and every box shall be clearly marked indicating the consignee and port of destination.</li> <li>v. Fragile items shall be packed separately with appropriate packing indicating "Fragile" slip outside</li> <li>vi. Packing material used shall be environmentally benign.</li> <li>vii. Provision for inspection windows or ease of accessibility during custom or other verification shall be provided.</li> </ol>	
9	<p><b>Moving in, positioning and integration</b></p> <ol style="list-style-type: none"> <li>1. It is recommended that the supplier visit BHEL facility prior to submission of offers for better understanding.</li> <li>2. The module manufacturing line shall be examined and the integration of the auto bussing / interconnect shall be planned and designed.</li> <li>3. The scope of the Supplier includes move in and position the equipment and integrate with the existing module manufacturing line.</li> </ol>	
10	<p><b>Installation and commissioning (I&amp;C)</b></p> <p>Supplier shall complete the following activities and demonstrations for the completion of Installation and commissioning:</p> <ol style="list-style-type: none"> <li>a. The demonstration of properly routed and working utility connections.</li> <li>b. The demonstration of the safety circuits and other safety provisions.</li> <li>c. The demonstration of successful integration of utilities and processing of auto bussing / interconnect with the defined throughput.</li> <li>d. The demonstration of the working conditions of the offline repair of the module equipment supplied with the line.</li> </ol>	
11	<p>The successful bidder have to depute their competent Technicians / Engineers for carrying out the installation of line equipment, integration of the module manufacturing line, commissioning and proving of the turnkey line. The techno-commercial offer to indicate the number of personnel visiting BHEL and their duration of stay.</p> <p>BHEL will provide assistance for handling of the equipment and associated materials from the store yard on to shop floor along with the requisite material handling equipment. Bidders to indicate in the techno-commercial bid, the requirement of material handling equipment required for installation &amp; commissioning. Any special tools, tackles, instruments, commissioning spares and other materials required for installation and commissioning are under the scope of vendors.</p>	

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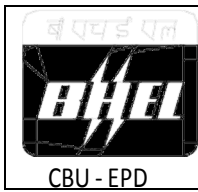
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12	<p><b>Time schedule</b></p> <p>The bidders shall indicate the supply schedule and activity chart for the installation &amp; commissioning and Site Acceptance Test in the techno-commercial bids.</p>	
13	<p><b>Warranty</b></p> <p>a. Supplier shall provide the warranty for a period of 24 (twenty four) months from the date of completion of I&amp;C or 30 (thirty) months from the date of receipt.</p> <p>b. The warranty shall cover all the essential spares and wear parts for the entire warranty period.</p> <p>c. The spare and wear parts needed for the smooth operation shall be stocked locally/at BHEL sufficient for a period of 6 (six) months and shall be replenished. There shall not be any interruption of production due to want of spare and wear parts.</p> <p>d. All the preventive maintenance tasks defined in the TS &amp; M contract shall be performed during the complete warranty period as well without any extra payment.</p> <p>e. During the warranty period, the responsibility of providing and maintaining the consumables, equipment spares and wear parts rests with the successful bidder &amp; turnkey line supplier.</p>	
14	<p><b>Technical Supervision &amp; Maintenance (TS&amp;M) Contract:</b></p> <p>a. The Turnkey supplier shall agree for providing “Technical Supervision &amp; Maintenance (TS &amp; M)” services for the equipment. The TS &amp; M contract shall be for a minimum period of 2 years from the date of successful commissioning of the system.</p> <p>c. The purpose of TS&amp;M contract and the scope is provided in Annexure – II</p> <p>d. For the purpose of TS &amp; M contract, the vendor has to depute their trained / skilled technicians round the clock throughout the year as required. (At least one technician per day)</p> <p>e. For general overseeing the turnkey line and equipment operation, parameter setting and modification, programming and other equipment monitoring and maintenance a trained supervisor / engineer shall be deputed who can be present during the dayshift.</p> <p>f. The general terms and conditions of the TS &amp; M contract governing the deployment of the vendors personnel at BHEL is provided in Annexure – II</p> <p>b. All the preventive maintenance tasks defined and recommended by the OEM’s shall be performed during the warranty period and is part of the TS &amp; M contract.</p>	

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15	<p>Comprehensive Annual Maintenance Contract (AMC)</p> <ol style="list-style-type: none"> <li>a. The supplier shall agree for providing comprehensive AMC for all equipment for a period of three (03) years after the expiration of warranty period.</li> <li>b. AMC shall cover labour, spare and wear parts for the entire period of AMC.</li> <li>c. The price for comprehensive AMCs for three (03) consecutive years after the warranty period shall be quoted. The AMC value will be considered for arriving at the lowest bidder.</li> <li>d. All the maintenance checks and activities to be performed at quarterly and annual basis as per the 'Maintenance Schedule' provided for each equipment shall be completed by the service engineer during the visit to BHEL in assistance with BHEL personnel.</li> <li>e. The service engineer(s) shall be deputed as and when required by BHEL within 24 hours of notification during the remaining AMC period.</li> </ol>	
16	<p>General Terms &amp; Conditions:</p> <ol style="list-style-type: none"> <li>i. The commercial terms of this tender shall be applicable for the future purchases of the spares/consumables/sub-systems and consumables for the equipment to be procured from the supplier.</li> <li>ii. Supplier shall confirm adequacy of the equipment and accessories quoted for the intended use of turnkey line. Any other requirement shall not be entertained later.</li> <li>iii. Any deviation from the BHEL specification shall be clearly brought out. Otherwise, it is understood that BHEL specification is accepted in total and there is NIL deviation.</li> <li>iv. Supplier shall keep BHEL indemnified against any damage during installation, commissioning, repairs and maintenance of the equipment. Personnel deputed at BHEL shall be covered by relevant statutory provisions of the ESI/Workmen compensation Act or other acts as applicable.</li> </ol>	

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