

## Enlistment of vendors and sub-contractors for Semiconductor product group of BHEL

### TABLE OF CONTENTS

|     |  |
|-----|--|
| 1.0 | General introduction about BHEL  |
|     | 1.1 About BHEL (overall)   |
|     | 1.2 About Electronics division unit at Bangalore (BHEL-EDN)                |
|     | 1.3 About Semiconductor product group of BHEL-EDN unit at Bangalore        |
| 2.0 | BHEL's requirement to enlist vendors / sub-contractors                     |
|     | 2.1 List of components for which vendors are sought by BHEL                |
|     | 2.2 List of chemicals and consumables for which vendors are sought by BHEL |
|     | 2.3 List of out-sourcing jobs for which sub-contractors are sought by BHEL |
| 3.0 | Guidelines for interested vendors / sub-contractors                        |
| 4.0 | Contact person at BHEL and address for correspondence                      |
| 5.0 | Important notes  |

### 1.0 General introduction about BHEL

#### 1.1 About BHEL (Overall)

**Bharat Heavy Electricals Limited (BHEL)** ([www.bhel.com](http://www.bhel.com)) is a premier engineering and manufacturing organization with majority shareholding by Government of India. BHEL offers a wide spectrum of products and services to the core infrastructure sectors of Indian economy viz. Power Generation, Transmission, Industry, Transportation and Renewable Energy. BHEL has been in this business for more than five decades now. In India, BHEL has 14 manufacturing units, 4 power sector regions, 8 service centers and 15 regional offices besides host of project sites spread all over India and abroad. BHEL-supplied equipment account for more than 65% of the total installed generating capacity in India and contributes approximately to 73% of the total power generation in the country. More details about BHEL and the products and services can be found at the website.

#### 1.2 About Electronics Division unit of BHEL

**Electronics Division (EDN)** ([www.bheledn.com](http://www.bheledn.com)) unit of BHEL was formed in 1976 at Bangalore, mainly to establish a strong base in the areas of Automation and Power Electronics to supplement the Company's pioneering efforts in the above mentioned core sectors. Most of the power plants and industries in the country today are equipped with electronics products and systems that have been manufactured and supplied by BHEL EDN. We also have a good international reference by way of our exports to European, Middle-East and South-East Asian markets. EDN has been accredited with ISO 9001, ISO 14001 and OHSAS 18001 standard certifications.

#### 1.3 About Semiconductor product group of BHEL (EDN), Bangalore

Since 1978, BHEL has been in the field of manufacture of discrete **power semiconductor diodes and thyristors** in the ratings ranging up to 2000A / 7000V, catering to various domestic and export market segments such as traction locomotives, variable frequency drives, high-current rectifiers, high-voltage DC transmission stations, static excitations systems, brushless exciters in turbo-generators and alternators and high-frequency inverters.

## 2.0 BHEL requirement to enlist vendors / subcontractors

BHEL is looking forward to register **eligible vendors for a certain identified components** that form part of the semiconductor devices. A list of these components, with brief overall particulars, is provided under section 2.1. Further, BHEL also requires **eligible vendors for a certain chemicals and consumables** that are used in the manufacturing of semiconductor devices. A list of these items is provided under section 2.2. Detailed drawings and specifications, as applicable, will be provided by BHEL at the time when vendors contact / visit BHEL. Please refer guidelines under section 3.0.

Similarly, BHEL is looking forward to register **eligible sub-contractors in certain identified areas of out-sourcing** such as electro-nickel plating, surface lapping, machining and blanking / forming / piercing. A list of such areas, with brief overall particulars, is provided under section 2.2. Detailed drawings and specifications will be provided by BHEL at the time when vendors contact / visit BHEL. Please refer guidelines under section 3.0.

## 2.1 List of components for which vendors are sought by BHEL

|   |                               |  |
|---|-------------------------------|--|
| 1 | Copper components (Machining) | <p><b>Material:</b> Electrolytic copper<br/> <b>Raw material form:</b> Rods<br/> <b>Finished product:</b> Machined as per BHEL drawing<br/> <b>Final finish:</b> Electroplating (Nickel), 6-8 microns</p> <p><b><u>Dimensions and finish:</u></b></p> <ol style="list-style-type: none"> <li>1) Different variants are required.</li> <li>2) Overall diameter: 15-27 mm range</li> <li>3) Overall length: up to 50 mm</li> <li>4) Actual profile as per BHEL Drawings</li> <li>5) One end is a flat contact surface with ground/ lapped finish, surface roughness, Ra = 0.8 microns, flatness = 50 microns.</li> </ol> <p><b>BHEL nomenclature of items:</b> Inner conductor</p> |
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| <p>2</p> | <p>Copper components brazed with steel ring</p>    | <p>Component made up of two items (copper block and steel ring) joined together using high temperature brazing in forming gas ambience, cold forged to desired hardness and further, machined to drawing.</p> <p><b>Finish:</b> Natural, without plating<br/> <b>Contact surface:</b> ground / lapped finish, Ra= 0.8 microns</p> <p><b><u>Copper item:</u></b><br/> Material: Electrolytic copper<br/> Overall size: 60 x 60x 15mm<br/> Further, machined to profile as per BHEL drawing</p> <p><b><u>Steel ring item:</u></b><br/> Different variants are required.<br/> Material: EN2A<br/> OD/ID/thickness range : 40-46 / 32-37 / 3 mm<br/> Further, machined to profile as per BHEL drawing</p> <p><b><u>Brazing alloy:</u></b><br/> Silver : Copper = 72:28</p> <p><b>BHEL nomenclature of items:</b> Base assembly</p> |
| <p>3</p> | <p>Copper discs clad with silver on both sides</p> | <p><b><u>Copper item:</u></b><br/> Material: Electrolytic copper<br/> Dimension: 40-50 mm diameter x 4-5 mm thickness</p> <p><b><u>Silver cladding:</u></b><br/> 0.2 mm thick silver of 99.95% purity</p> <p><b><u>Machining:</u></b><br/> Overall, item to be machined as per BHEL drawing.</p> <p><b><u>Finish:</u></b><br/> Both sides ground/ lapped finish, Ra=0.8 microns.<br/> Parallelism, planeness as per BHEL drawing.</p> <p><b>BHEL nomenclature of items:</b> Contact disc</p>   |

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| 4 | Copper strips clad with silver on both sides      | <p><b><u>Material:</u></b><br/>Electrolytic copper<br/>Silver purity 99.95%</p> <p><b><u>Overall dimensions:</u></b><br/>500 x 60 x 0.2 mm<br/>500 x 45 x 0.2 mm<br/>500 x 36 x 0.2 mm<br/>500 x 45 x 0.3 mm</p> <p><b><u>Silver cladding:</u></b><br/>20 microns thick each side</p> <p><b>BHEL nomenclature of items:</b> Silver clad copper strips</p>  |
| 5 | PTFE (Teflon) components                          | <p><b><u>Material:</u></b><br/>Poly-tetra-fluoro-ethylene (PTFE)</p> <p>Different variants are required.</p> <p><b><u>Overall dimensions:</u></b><br/>1) Rings of OD/ID/thick: 24-40 / 20-38 / 3-10 mm<br/>2) Tubes of OD/ID/Length: 8-10 / 7-9 / 12-35 mm<br/>3) Pins of 3-6 mm diameter x 6-10 mm length</p> <p><b><u>Fabrication:</u></b><br/>Compression moulding using PTFE granules.<br/>Sintering at high temperature.<br/>Further, to be machined to profile as per BHEL drawing.</p> <p><b><u>BHEL nomenclature of items:</u></b><br/>Centering ring, insulation tube, plug, ring</p> |
| 6 | Steel component, tubular shape<br><br>(Machining) | <p><b><u>Material:</u></b><br/>Steel EN1A</p> <p><b><u>Overall dimensions:</u></b><br/>OD=23 mm, ID=20 mm, Height = 25 mm<br/>Further, machining as per BHEL drawing.</p> <p><b><u>Fabrication:</u></b><br/>Machining from steel rod.</p> <p><b><u>Finish:</u></b><br/>Copper flash with electro-nickel plating.</p> <p><b>BHEL nomenclature of items:</b> Retaining cup</p>   |

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| <p>7</p> | <p>Steel component plates, washers</p> | <p><b><u>Material</u></b><br/>CRCS sheet, stainless steel SS304</p> <p><b><u>Shapes:</u></b><br/>Square and circular</p> <p><b><u>Dimensions:</u></b><br/>Square: 55 x 55 x 3 mm<br/>Circular: OD=10–25 mm , ID=8-12 mm, thk=0.5–1 mm<br/>Slots in some cases.</p> <p><b><u>Fabrication:</u></b><br/>Blanking, piercing, slitting</p> <p><b><u>Finish:</u></b><br/>Zn plated (yellow passivation)<br/>Copper flash with electro-nickel plating</p> <p><b><u>BHEL nomenclature of items:</u></b><br/>Pressure plate, spacer, washer, etc.</p>                  |
| <p>8</p> | <p>Flexible braided copper leads</p>   | <p>Braided copper connectors</p> <p><b><u>Construction:</u></b><br/>Braided, multi-strand, tinned copper wires</p> <p><b><u>Dimension:</u></b></p> <ul style="list-style-type: none"> <li>- Cross sections: 35, 50, 70 mm<sup>2</sup></li> <li>- Lengths: 200 – 270 mm</li> </ul> <p><b><u>Finish:</u></b></p> <ul style="list-style-type: none"> <li>- Terminals ends</li> <li>- Silicone insulation sleeves</li> </ul> <p>Further details as per BHEL drawing and specification.</p> <p><b><u>BHEL nomenclature of items:</u></b> Outer conductor, lead</p> |

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| 9  | Ceramic components  | <p><b>Material:</b> Alumina, 99% purity<br/> <b>Shape:</b> Circular rings</p> <p><b>Dimension:</b><br/> OD: 20 - 27 mm, ID: 7 – 11 mm, Thickness = 3 - 5 mm</p> <p><b>Fabrication:</b><br/> Moulding, sintering, machining.</p> <p>Further details as per BHEL drawing.</p> <p><b>BHEL nomenclature of items:</b>_ Ceramic ring</p>   |
| 10 | Aluminium<br>Heat sinks<br><br>Gravity die casting and<br>machining | <p><b>Material:</b> Aluminium alloy LM25</p> <p><b>Overall size:</b><br/> 200 x 215 x 45 mm<br/> Details of profile and dimension as per BHEL drawing</p> <p><b>Fabrication:</b><br/> Gravity die casting, heat treatment, machining</p> <p><b>Finish:</b><br/> Natural<br/> Contact surfaces with Ra = 1.6 microns</p> <p><b>BHEL nomenclature of items:</b>_ Heat sinks</p> |
| 11 | Aluminium<br>Heat sinks<br><br>Machined from extruded<br>bar        | <p><b>Raw material:</b> Extruded bar of nearest size<br/> <b>Material:</b> AlMgSi1 (64430 WP)</p> <p><b>Overall size:</b><br/> 60 x 250 x 60 mm<br/> Details of profile and dimension as per BHEL drawing</p> <p><b>BHEL nomenclature of items:</b>_ Heat sinks</p>   |
| 12 | Disc spring (Belleville type)                                       | <p><b>Material:</b> Steel 50 Cr V4</p> <p><b>Dimension range:</b><br/> OD: 40–63 mm, ID: 12-30 mm, t: 1-3.5mm</p> <p><b>Finish:</b> Phosphated</p> <p><b>BHEL nomenclature of items:</b>_ Plate spring, disc spring</p>   |

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| 13 | Glass epoxy components | <p><b>Material:</b> NEMA grade G11 Laminate</p> <p><b>Shapes:</b> Rectangular blocks, tubes</p> <p><b>Dimension range:</b><br/>36 x 25 x 20-30 mm<br/>OD: 14 mm, ID: 10.5mm, 69mm long</p> <p><b>Fabrication:</b><br/>Machined from laminated sheets.</p> <p><b>BHEL nomenclature of items:</b><br/>Insulation bush, insulation tube</p> |
|----|------------------------|--|

## 2.2 List of chemicals and consumables for which vendors are sought by BHEL

|   |                   |   |
|---|-------------------|---|
| 1 | Chemicals         | <p><b>Grade:</b> Selectipure / MOS / VLSI</p> <p>Acetone<br/>Ammonia solution 28-30%<br/>Ammonium fluoride etchant NH<sub>4</sub>F:HF = 7:1<br/>Ammonium-peroxo-di-sulfate<br/>Citric acid monohydrate crystals<br/>Ethanol<br/>Hydrochloric acid 37-38%<br/>Hydrofluoric acid 40%<br/>Hydrofluoric acid 48%<br/>Hydrogen peroxide 30-32%<br/>N-butyl acetate<br/>Nitric acid 65%<br/>Nitric acid 69-70%<br/>Ortho-phosphoric acid 85-87%<br/>Photoresists (positive, negative)<br/>Potassium hydroxide pellets (equivalent to Merck part: 5019)<br/>Sulfuric acid 95-97%<br/>Toluene 99.5%<br/>Trichloroethylene, &gt; 99.5%</p> |
| 2 | Other consumables | <p>a) Alumina powder, grain size 18 micron size<br/>b) Silicon carbide powder, size 500 grit<br/>c) Lubricant oil (equivalent to Castrol make Honilo 980)<br/>d) Tungsten carbide inserts 20 x 20 x 5 mm<br/>e) Wafer carrier with slots, material: hyperpure polysilicon<br/>f) Circular spacers 50-60mm dia, 5 mm thk, material: hyperpure polysilicon<br/>g) Silver wire (2mm diameter), 99.99%</p>  |

### 2.3 List of outsourcing jobs for which sub-contractors are sought by BHEL

|   |                         |  |
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| 1 | Electro-nickel plating  | <p>Power semiconductor devices</p> <p>Various shapes and sizes</p> <p>Plating thickness = 6 – 8 microns, matt finish</p>   |
| 2 | Surface lapping         | <p>Copper components and silver clad copper components of various shapes and sizes.</p> <p>Surface roughness, Ra = 0.8 microns.</p> <p>Lapping to be achieved using silicon carbide abrasive mixed with lubricant oil.</p>   |
| 3 | Machining of heat sinks | <p>Aluminium bars of 60 x 60 x 2000 mm will be provided by BHEL.</p> <p>To be machined and black anodized as per BHEL drawing and specification.</p> <p>Anodizing thickness = 20 microns</p>   |
| 4 | Blanking and forming    | <p>1) Silver clad copper strips of 0.2 – 0.3 mm thickness (500 x 60 mm size) will be provided by BHEL.</p> <p>Circular blanks of 20-55 mm diameter with piercing and formed edges to be fabricated and supplied by vendor. Tools are available with BHEL.</p> <p>2) Aluminium strips of 80 microns thick (60 mm width) in spools.</p> <p>Circular blanks of 20-55 mm diameter to be fabricated and supplied by vendor.</p> <p>Tools are available with BHEL.</p> |

### 3.0 Guidelines for vendors / sub-contractors

- 1) Interested vendors / sub-contractors, who are in the related field and equipped with required infrastructure facilities to meet the BHEL requirements, shall convey their interest to the contact persons mentioned under section 4.0 by e-mail. They can also send the complete information (company profile, product brochures, credentials, certifications, customer reference, etc) by e-mail to all contact persons or by post addressed to Mr. SLV Nityanand, Sr Deputy General Manager (SC&PV-MM).
- 2) In case discussions are preferred by the interested vendors / sub-contractors in person, they can meet the contact persons at the BHEL office address given under section 4.0 after fixing up appointment with any of them over phone / mobile / e-mail.
- 3) After the preliminary contacts and discussions with BHEL contact persons, detailed drawings and specifications of the related components and outsourcing jobs shall be collected from BHEL for in-depth understanding of the requirement.

#### 4) Qualification criteria

Vendors/ sub-contractors shall meet the following requirements:

- (i) For items under section 2.1, they shall be original manufacturers with necessary fabrication facilities located within India.
  - (ii) For items under section 2.2, in addition to original manufacturers, agents or representatives will also be considered but on the merit of their principals who shall be original manufacturers.
  - (iii) For the outsourcing jobs under section 2.3, sub-contractors shall essentially be within Bangalore or in close proximity, since the items for processing will be provided by BHEL on a routine basis.
- 5) Vendors / sub-contractors, who meet the above basic qualification criteria, will be provided with an opportunity to go through the vendor registration formalities of BHEL, after preliminary evaluation by the technical / purchase departments of the semiconductor product group of BHEL-EDN, Bangalore.
  - 6) BHEL will explain the details of registration procedure to the eligible vendors / sub-contractors, identified based on the above steps. The registration will be only after initial steps of evaluation that will be carried out by BHEL team, whereby there will be a visit to the vendor works, if found necessary.

### 4.0 Contact persons in BHEL and address for correspondence

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**5.0 Important Notes**

- 1) This advertisement is not to be treated a purchase tender / enquiry. This is an effort by the organization towards development and enlisting of eligible vendors / sub-contractors for the various components of semiconductor devices.
- 2) BHEL reserves right to evaluate the responses from the vendors / sub-contractors based on their technical merits with reference to the specification of the components / sub-contract jobs.