Bharat Heavy Electricals Limited, Electronics Division, Bangalore, India.

Document: BHEL/EDN/SCPV/D91/EOI **Revision:** 01 **Date:** 12-Oct-2009

EXPRESSION OF INTEREST (EOI) FOR TECHNOLOGY PARTNERSHIP IN SEMICONDUCTOR DEVICE MANUFACTURING

(IGBT Encapsulation Technology, Expansion of Diode and Thyristor Plant)

This document contains 8 pages

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1.0 Introduction on BHEL:

1.1 About BHEL:

Bharat Heavy Electricals Limited (BHEL) (**www.bhel.com**) is a premier engineering and manufacturing organization with majority share holding by Govt. 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 equipments account for more than 65% of the total installed generating capacity in India and contribute 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**) 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 BHEL's Experience in Semiconductor Devices:

Since 1978, BHEL has been in the field of manufacture of discrete power semiconductor diodes and thyristors. The ratings of diode manufactured by BHEL, at the Electronics Division unit of Bangalore, are in the range of 250-2000A / 1400-4400V. The ratings of phase control thyristor manufactured by BHEL are in the range of 150-3300A and 1400-7000V. BHEL has been supplying these diodes and thyristors 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. National HVDC, Rihand-Delhi and Chandrapur-Padghe HVDC line projects in India, 3100HP and 4000HP Diesel-Electric locomotives of Indian Railways and Exciters of 250MW and 500MW Turbo-generators for power stations are some of the major contracts in which BHEL devices are used.

BHEL has acquired technology from M/s Siemens, Germany and M/s ABB, Switzerland for these products in 1978 and 1986 respectively. Subsequently, BHEL has developed and manufactured custom-specific diodes, thyristors and heat-sink assemblies against specific requirements, based on experience and technical expertise. Cumulatively, BHEL has manufactured and supplied more than 3.5 Lakhs of semiconductor devices. More details of semiconductor products can be found at www.bheledn.com. Sample photographs of various devices and heat-sink assemblies are provided in **Enclosure-1**.

2.0 Expression of Interest (EOI): BHEL's Plans

BHEL - Electronics Division proposes the following set of plans as Expression of Interest.

Plan	Objective
A	To establish facilities for manufacture of **Insulated Gate Bipolar Transistor (IGBT) modules**, through encapsulation of IGBT chips, with a technology partnership.
B	To establish facilities for manufacture of **discrete power diodes and phase control thyristors** using state-of-the-art technology with a technology partnership.
C	To establish facilities for manufacture of **heat-sink assemblies of discrete diodes, thyristors and IGBTs** with a technology partnership.
D	To undertake **contract manufacturing (buy-back)** against specific requirements.

3.0 Purpose of Expression of Interest:

This Expression of Interest is published by BHEL for the **purpose of seeking responses from interested technology partners for the above plans A, B, C and D of BHEL, as a whole or partially.** In other words, an interested partner shall submit their response to BHEL either for any one of the plans (or) for any combination of the plans (or) for all the plans together.

4.0 Business Models:

The business model proposed by BHEL EDN is **technology transfer model**, whereby the partner should be willing to transfer the technology on exclusive basis to BHEL for design, purchase, manufacture, inspection, testing, process control, quality assurance methods, etc. for the products defined under the plans A, B, C and D.

5.0 Technical Specifications and Scope of Work (Applicable to Plans A, B, C)

Plan	Technical specification	Scope of work
A	To establish manufacturing facilities for **IGBT Modules** through encapsulation of IGBT chips: 1. Location of facility: Bangalore. 2. Plant capacity: **20,000-Nos per annum** **3. Ratings of IGBT modules:** V_{CE}: **1200V, 1700V, 2500V, 3300V, 4500V, 6500V** I_C : **400-1200A**	1. Supply of product design information (datasheets, drawings and specifications of components and materials) 2. Supply of process technology information (Manufacturing, Testing and Quality protocols) 3. Supply of technical and vendor information on manufacturing and testing equipment. 4. Supply of technical information on service facilities. 5. Supply of IGBT chips and components required for encapsulation. 6. Training of BHEL personnel in manufacturing and testing of IGBT modules.

Plan	Technical specification	Scope of work
B	To establish manufacturing facilities for **discrete power semiconductor diodes and phase control thyristors.** 1. Location of facility: Bangalore. 2. Plant capacity: **30,000 Nos per annum** **3. Technical specification:** a) Construction types: Stud-type, Square-base, Capsule b) Ratings: (U_{RRM}, I_{FAV}) **Diodes: 1400-6000V/ 250A – 4000A** **Thyristors: 1400-8500V/ 300A – 4000A** c) Sizes of Elements (chips): Diode elements: ϕ19 to ϕ100-mm; Thyristor elements: ϕ25 to ϕ125-mm.	1. Supply of product design information (datasheets, drawings and specifications of components and materials) 2. Supply of process technology information (Manufacturing, Testing and Quality protocols) 3. Supply of technical and vendor information on manufacturing and testing equipment. 4. Supply of technical information on service facilities. 5. Training of BHEL personnel in manufacturing and testing of discrete diodes and phase control thyristors.
C	To establish manufacturing facilities for **heat-sink assemblies of discrete diodes, thyristors and IGBTs.** **Technical specifications:** Heat-sink assemblies of diodes, thyristors and IGBT modules of ratings as specified in **Plans A and B.**	1. Supply of product design information (datasheets, drawings and specifications of components and materials) 2. Supply of process technology information (Manufacturing, Testing and Quality protocols) 3. Supply of technical and vendor information on manufacturing and testing equipment. 4. Supply of technical information on service facilities. 5. Training of BHEL personnel in manufacturing and testing of heat-sink assemblies and stacks.

6.0 Qualification criteria for the participants:

6.1 The participants shall be **manufacturers (OEM) of semiconductor devices** viz. diodes, phase control thyristors and IGBT Modules in the specified range.

6.2 The participants could also be **consultants (or) research institutions (or) any party other than OEM,** who will tie up with a reputed semiconductor device manufacturer (OEM) who will, in turn, accomplish the above objectives.

6.3 The OEMs shall have **experience in manufacture and supply** of discrete diodes, phase control thryistors and IGBT modules for a **minimum period of 5 years**.

7.0 Submission of response documents:

7.1 Interested semiconductor manufacturing companies (OEM) shall submit their responses as per the **Format** given in **Enclosure-2** by post or courier or e-mail to the contact person as below.

7.2 In case respondent is a consultant or a research institution or any party other than OEM:

(a) They shall provide the information pertaining to the semiconductor manufacturing company (OEM), with whom the technology tie-up is proposed by them, as per the above format.

(b) In addition, they shall submit their own information as per the above format.

7.3 Response documents shall be submitted **within end of January 2010**.
Early responses will be highly appreciated.

8.0 Contact person in BHEL and address:

Mr. P.K. Peshwe
Additional General Manager (Semiconductors and Photovoltaics – MM)
Address:
Bharat Heavy Electricals Limited, Electronics Division,
Post Box #2606, Mysore Road, Bangalore - 560 026. India.
Phone: +91 80 26998387, **Fax:** +91 80 26740137
Email: peshwe@bheledn.co.in

9.0 Evaluation of the responses received by BHEL:

9.1 **Scrutiny** of the responses received by BHEL, Electronics Division, Bangalore.
9.2 **Short-listing** of the participants, based on technical merits.
9.3 Techno-commercial **discussions** with the short-listed participants.
9.4 Formulation **of scope of work and technical details** / specifications.
9.5 Obtaining **financial and commercial offers** / terms.
9.6 Subsequent **evaluation and identification of suitable partners** by BHEL management.

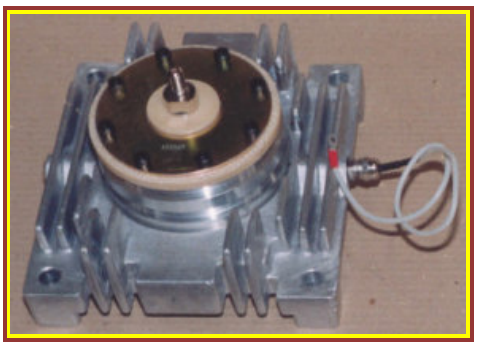
10.0 Additional remarks:

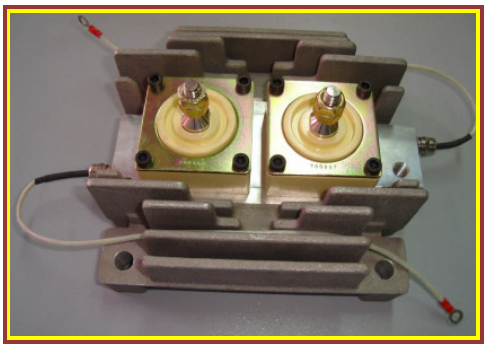
10.1 This Expression of Interest (EOI) is **aimed at exploring suitable partners** for enhancing BHEL's semiconductor business.

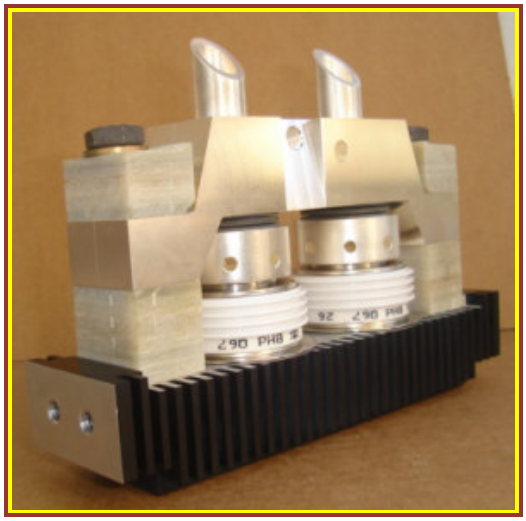
10.2 BHEL **reserves their right to evaluate the responses**, based on technical merits, in the process of short-listing and identification of the participants for further discussions.

Enclosure-1

Sample Photographs of BHEL-make Semiconductor Devices and Heat-sink assemblies







Enclosure-2

Format for Response from the Participants

1.0	General information	
	1.1 Name of company: (Manufacturer)	
	1.2 Head Office: Address: Telephone: Fax: E-mail: Website:	
	1.3 Factory / Works: Address: Telephone: Fax: E-mail: Website:	
	1.4 Indian representative / Marketing agent, if any Address: Telephone: Fax: E-mail: Website:	
	1.5 Chief Executive:	
	1.6 Contact person(s) Name(s): Official capacity: Address: Telephone: Fax: E-mail:	
	1.7 Year of establishment of the company	
	1.8 Particulars of products (IGBT Modules, Diodes, Thyristors, etc.) including technical specifications, ranges and installed capacity: **Attach company profile, product profile, technical brochures / catalogues.**	

2.0	**Financial Information** Physical and annual turn-overs, and profit-after-tax for last 3 years: Year-1: Year-2: Year-3:	
3.0	Quality and Environmental Management System: 3.1 Is the company ISO:9001 certified? If Yes, enclose copy of certificate.	Yes / No
	3.2 Is the company ISO:14001 certified? If Yes, enclose copy of certificate.	Yes / No
	3.3 Is the company ISO:18001 certified? If Yes, enclose copy of certificate.	Yes / No
4.0	Experience data for the products offered to BHEL: a) List of major customers b) Application segments c) Year-wise major supplies during last 3 years	
5.0	Concurrence to BHEL's Plan Proposals: (With specific reference to Plans A, B, C, D as per Clauses 2.0, 3.0, 4.0 and 5.0 of BHEL "Expression of Interest" document) **Attach detailed response against each plan, whichever is applicable.**	
6.0	Details of counter proposals, if any: **Attach details of counter proposals against each of the Plans A, B, C and D, whichever is applicable.**	

Important Notes:

In case respondent is other than semiconductor device manufacturer (for instance, a consultant (or) a research institute (or) any party other than manufacturer)

a) They shall provide the above information pertaining to the semiconductor device manufacturer (OEM) with whom the technology tie-up is proposed by them.
b) Additionally, they shall submit their own information in the above format against the applicable clauses.