



# Bharat Heavy Electricals Limited, Bhopal

Control Equipment Engineering Division

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## Technical Specifications for Power Electronic Converter Simulation, Thermal & stability Analysis and auto code generation software for DSP controller

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**Bharat Heavy Electricals Limited, Bhopal**

**Control Equipment Engineering Division**

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**SECTION – I**

**(GENERAL TERMS AND CONDITIONS OF TENDER)**



# Bharat Heavy Electricals Limited, Bhopal

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### 1 INTRODUCTION

This specification covers the requirement of Power Electronic Converter Simulation & Analysis software package required for simulation, transient and thermal analysis, and existing design optimization and for the development of new products for CEE departments. Presently, CEE is dealing with AC to DC, DC to DC and DC to AC in various applications like oil rigs control, traction controls and power plant controls.

Bidder to note that the software will be used for prototype development for CEE products, therefore, software simulation results must be very accurate i.e. simulation results should match to actual results to the best possible extent. Refer detailed specification anywhere given in the specification.

### 2 PRE-QUALIFICATION REQUIREMENTS FOR BIDDERS

Bidder should submit at-least 3 user's performance certificate. Vendor to visit BHEL Bhopal and give detail presentation demonstrating the features asked in the specification. MOM will be held with vendor. The copy of MOM will be submitted alongwith pre-qualification bid. In case, vendor has already visited and has given presentation, vendor may give the reference of their visit. Vendor should visit us within 10days from the date of tender.

### 3 SCOPE OF WORK

Refer detailed specification given in section II of these documents.

### 4 DELIVERY PERIOD

The delivery from bidder Ex-works, should be 8 weeks LOI/PO whichever is earlier.

### 5 PREPARATION AND SUBMISSION OF OFFERS

There will be e-tender for said requirement. It is advised that bid to be prepared on bidder's company letter head and each page duly signed by authorized signatory of the bidder and attached.

Bids should be submitted in Three-Part bid system:

- a) Part – I : Pre-qualification Bid
- b) Part – II : Techno commercial bid
- c) Part – III : Price Bid.

Above three documents should be prepared separately and attached with the tender.

BHEL standard terms and conditions for tendering system & purchase (BP4255) shall be applicable for the tendering system unless otherwise specified in this section-I of the specification. In case any condition mentioned in this section-I differs from above referred



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BP4255, the condition mentioned in this section-I will supersede the condition mentioned in above referred BP4255.

### 5.1 Part – I Bid: Pre-qualification Bid

Shall contain all documents as mentioned in above in sec-2 with respect to requirement of Pre-Qualifications Requirements (PQR) to be attached while filling e-tender. PQR to be prepared & attached as "PART-I : PRE-QUALIFICATION BID" , "TENDER / ENQUIRY NO....." and "DUE ON DATE .....".

### 5.2 Part-II Bid: Techno-Commercial Bid

Shall contain all Technical & Commercial conditions of the offer with respect to requirement of specification along with all the required documents to be submitted. Clause wise comments on all the clauses to be submitted with the offer.

Unfilled price-bid format should be submitted with the technical-bid with all commercial terms of the offer. However, "QUOTED" shall be mentioned against each line item of the price bid format to indicate that there is a quote against this item in the price bid.

In case BHEL makes any change in technical specifications then bidders may be asked to submit revised price bid. Techno-commercial bid to be prepared as on company letter head and attached as "PART-II: TECHNO-COMMERCIAL BID", "TENDER / ENQUIRY NO....." and "DUE ON DATE .....".

### 5.3 Part-III BID: Price Bid

In price bid, bidder shall quote as per the price bid format provided in this document at Annexure-1 for material and commissioning charges.

Price bid shall be prepared and attached as "PART-III : PRICE BID" , "TENDER / ENQUIRY NO....." and "DUE ON DATE .....".

Price bid should be prepared considering following:

- a) The price should be quoted for delivery of material upto destination i.e "FOR BHEL Bhopal".
- b) The rates should be quoted both in figures and words as per price bid format.
- c) No extra charges shall be payable for Packing & forwarding.
- d) Bid valid for a period of 120 days from date of opening of Part-I bid.
- e) All prices should be firm prices for entire duration of the project. No Price variation clause shall be acceptable on any account.
- f) All applicable taxes and duties to be mentioned separately.
- g) No separate charges for bidders/their representative visit to BHEL Bhopal or anywhere else in connection with this tender for collecting any information / pre-engineering survey shall be applicable.



## **6 BID SUBMISSION AND OPENING**

The Bid shall be submitted through e-tender on or before 11.00 AM of the due date of tender opening. Bid shall be opened as per BHEL Bhopal e-tendering procedure. Vendor will not be able to submit tender after 11AM of due date. BHEL will not be responsible if vendor fails to submit bid whatsoever be the reason.

Following shall be the schedule and procedure for bids opening:

### **6.1 Part-I bid - Pre-Qualification Requirements (PQR)**

Part-I bid shall only be opened on the bid opening due date as mentioned in BHEL Tender / Enquiry.

### **6.2 Part-II bid - Techno-Commercial Bid**

After evaluation of Part-I bids by BHEL, Part-II Techno-commercial bids, only of the bidders who qualify in Part-I bid (PQR) shall be opened. Part-II & Part-III bids of the bidders who do not qualify after evaluation of their part-I bids shall not be opened.

### **6.3 Part-III bid - Price Bid**

After evaluation of Part-II Techno-commercial bids of qualified bidders by BHEL, Part-III Price bids, only of the bidders whose Part-II Techno-commercial bids are found to be meeting BHEL tender requirements shall be opened.

## **7 BHEL STANDARD TERMS OF PAYMENT**

Refer document BP4255/BP11002 or 45 days from training whichever is later.

BHEL standard condition for payment is on receipt and acceptance of material and within 90 days from date of dispatch (Or as per MSMED Act).

## **8 BID EVALUATION CRITERIA (BEC)**

Bids will be evaluated for acceptance/rejection and price bid comparison to decide Lowest (L1) bidder as per conditions mentioned in the document.

## **9 PLACEMENT OF PO / LOI BY BHEL**

### **9.1 Criteria for Placement of PO / LOI**

BHEL will award the purchase order / contract to the successful bidder whose bid has been determined to be lowest evaluated bid as per BEC.



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### 9.2 BHEL's right to accept or reject the bids

BHEL reserves the right to reject, accept or prefer any bid and to annul the bidding process and reject all bids at any time prior to award of contract, without thereby incurring any liability to the affected Bidder or Bidders or any obligation to inform the affected Bidder or Bidders of the ground for BHEL's action.

### 9.3 Bid validity before PO / LOI placement

Prior to the expiration of the period of bid validity, BHEL will place the PO/LOI on successful bidder. If PO is not placed within validity period due to any reasons, BHEL may ask for extension of validity of Price Bid offer.

## 10 PACKING

Items should be suitably packed to avoid transit damage.

## 11 GUARANTEE / WARRANTY

All and every item of supply will have bidder warranty. Software shall be error free and should provide results as specified anywhere in the specification. Warranty/AMC shall be 12 months from installation of software at BHEL Bhopal works.

## 12 INSURANCE

Transit Insurance from Bidder works to BHEL Bhopal by road transport to be arranged by bidder as delivery required is F.O.R destination BHEL Bhopal. No separate charges shall be paid for transit insurance.

## 13 ADDRESS FOR CORRESPONDENCE WITH BHEL BHOPAL FOR THIS TENDER

Sr. Manager (MM) SCR  
BLOCK IV ANNEXE  
BHEL, BHOPAL – 462022, Tel. No.: 0091-755-2502530  
Email : [rbajpai@bhelbpl.co.in](mailto:rbajpai@bhelbpl.co.in), [dkumar@bhelbpl.co.in](mailto:dkumar@bhelbpl.co.in)

Contact Person : Ms Richa Bajpai

## 14 ADDRESS FOR CONSIGNEE

Bidder to mark delivery documents for material shipment to following:  
Sr. Dy. General Manager,  
Central Receiving Section (CRX),  
Block-VII, BHEL, Piplani  
Bhopal – 462022 (MP)



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**SECTION – II**

**(TECHNICAL SPECIFICATION OF TENDER)**



### 1 INTRODUCTION

Power Electronic Converter Simulation and Analysis software package is required for simulation, transient and thermal analysis, existing design optimization and for the development of new products. Presently, we are dealing with AC to DC, DC to DC and DC to AC in various applications like oil rigs control, traction controls and power plant controls. The software package must be a specialized package meeting the simulation and analysis requirement of CEE products. Software must be capable to simulate analog electronic, Power Electronic Circuit and DSP peripheral jointly to simulated total system in one window. Simulation engine must be fast enough to simulate Induction motor drive/ DC motor drive/ permanent magnet drive in no time.

### 2 SOFTWARE MOUDULES/FEATURES

The software should have menu based icon for quick access to generally used components. Software must have symbol representation as per IEC60617. It should have following modules/features:

#### 2.1 PROFESSIONAL

- Software should have II level component models of components to simulate the actual behaviour of component/system
- Grid type workspace for easy placement and alignment of components
- Drag and drop option for library elements
- Elements configuration with individual block configuration and through parameter txt file
- Parameter sweep and AC Sweep option to vary particular parameter in a range with specific step size
- It should have all types of sources (Dependent, independent, single phase & 3-phase, current & voltage sources), power electronics switches, single phase & 3 phase RLC loads, transformers, cables etc.
- Power electronic Elements like diode, thyristor, MOSFET, IGBT etc. It should have feature of adding actual component parameter
- Simulation of reverse recovery feature of power devices
- Magnetic elements for electromagnetic behaviour analysis like air gap, core, winding, etc
- Material BH curves modelling.
- Analog & Digital electronics library which includes OP-AMPS, logic gates with parameter editing options
- Mathematical computation blocks like sine, cosine, multiplier, etc.
- Probes for measurement of voltage, current, power, power factor, etc. with run time graph analysis facility by which user can see waveforms when simulation is running.
- Analog control system (S-domain control system) blocks which includes P, PI, differentiator, filters, s domain transfer functions, etc.





- Function blocks for FFT, RMS, Clarke, Parke, Inverse Clarke, Inverse Park, Space vector etc. All these blocks must be code gen compatible
- C coding facility with C block having inbuilt compiler for code validation
- DLL files interface feature.
- Scope with built-in math function graph analysis, max, min, avg, rms, powers, THDs, etc.

### 2.2 MOTOR DRIVE SIMULATION MODULE

This module must have the at least following models in the library:

- 3 phase induction motors with squirrel cage & wound rotor type
- PMSM machine with inbuilt speed measurement & feedback facility
- BLDC machine with inbuilt speed & hall effect sensors
- 3 phase, 4 phase and 5 phase switch reluctance machines
- Linear & nonlinear configurations of all machines.
- Mechanical loads like general, constant speed, constant torque, constant power, etc.
- Absolute & incremental encoders and resolver.
- Mechanical accessories like couplings, gear box, etc.
- Sensors for speed, torque, & position measurement.
- Field weakening control, max torque per ampere, etc.
- Torque measurement built-in feature

### 2.3 DIGITAL CONTROLS SIMULATION MODULE

- Logic gates AND, OR, XOR etc
- Built-in library for Digital Filters like lowpass, highpass, bandpass, 1<sup>st</sup> order, 2<sup>nd</sup> order etc
- Built-in blocks for detecting rising edge, falling edge, rising or falling edge etc
- Built-in digital blocks for Monostable, PLL etc
- Block for measurement of phase angle, pulse-width, frequency etc
- S2Z utility converter for converting s domain blocks to z domain (discrete domain)
- Transformation methods like Backward Euler & Bilinear are inbuilt
- Schematic as well as mathematical representation of conversion results
- Discrete domain control system blocks like P, PI, filters, z domain transfer function, delay, zero order hold, arrays, memories, etc.
- RMS, Average and FFT block
- All digital control blocks must be code generation compatible.

### 2.4 THERMAL MODULE

This module should be capable for calculating switching & conduction losses of devices/stack for heat management. It should have the following:

- Diode, IGBT, MOSFET and inductors for thermal analysis.
- Feature for measurement of switching and conduction losses.



- Feature for measurement of diodes loss connected across IGBT & MOSFET.
- Device database editor for entering datasheet of device.
- Feature for entering device datasheet parameters & curves.
- Temperature measurement facility
- Core & winding losses measurement facility for inductor

### 2.5 DSP CODE GENERATION MODULE

This module is required for the DSP TMS320F28335/TMA320F28069 compatible code generation ready for Texas Instrument code composer v6/v5/v3.3. This module should have the following features:

- C code from control circuits
- C code block/feature to generate DSP compatible code
- Library of TI-F2833x peripherals like Digital Inputs, Digital Output, PWM generation, A/D, SPI, SCI, Encoder, Counter, QEP, Capture, CAN communication etc
- Feature for DSP clock configuration
- Feature for Hardware configuration
- Built-in features for parameter turning and real-time trending of variables. There should not be limitation of nos of parameters.
- Efficient code generation
- Code must be easily debug-able
- Code generated shall be efficient and traceable
- Instaspin library shall be supplied alongwith this module.
- If any other modules is required to function Instaspin that should also be included as a part of scope of supply.

### 2.6 CONTROLLER DESIGN & STABILITY ANALYSIS MODULE

This module is required for designing controller for various CEE product mentioned above. It should have the following features:

- Defining power electronic converters like buck, boost, buck-boost etc.
- Option for selecting power circuits, feedback sensors, controllers, etc.
- Simultaneous simulation of complete schematic.
- Direct representation of stable region of system on frequency response.
- Graphical selection of required phase margins just by click on graphs.
- Magnitude plot, phase plot, time domain response, Nyquist plot can be seen in same window.
- Bode plots for sensors & compensators.
- All transfer functions export feature
- Multiple control loop designing

Note: Vendor to supply hardware required for serial, canbus & ethernet communication between Texas DSP ezDSP kit and PC.



### 2.7 Software License

The software license must be a dongle license and shall be supplied & installed by vendor. Licence manager should have provision of monitoring and controlling the users. License manager should have provision of license borrowing from one PC to other PC for a period of 3 months or less. After the expiry of defined period, license will automatically activated in server. The license must be permanent & should also work even after AMC period.

### 2.8 Software Library

The software must the data library of all electrical and electronic components of major manufacturers. Vendor to provide update/upgrade of library during AMC period.

### 2.9 Software AMC

The offered price shall include the AMC for 1 year. Vendor has to provide the software upgrade/update in AMC period and will also support in the development of various controller for our department (if needed).

**Vendor to mention (mandatory) the AMC charges for 2<sup>nd</sup> and 3<sup>rd</sup> years.**

### 2.10 Training

Vendor has to organize the training of software at BHEL Bhopal. It shall covers all modules of the software alongwith case study, demo analysis and report preparation. Vendor to demonstrate the process of sensorless PMSM controller simulation, thermal and stability analysis, code generation for DSP tms320f28335. Necessary hardware boards, inverter and PMSM motor shall be arranged by BHEL. Communication protocol asked in specification anywhere should also be demonstrated in the training program. Vendor to inform the training programme at-least 15 days in advance.

Vendor has to make own arrangement for travel, lodging and boarding.

## 3 PC REQUIREMENT

Software should run on PC/Notebook to the specification given below:

Processor	• Intel® Core2 duo & i3/i5/i7
Operating System	• Windows XP/ win-7/win-8/win10 ( both 32 and 64bit )
Display	• 14"/15.6/19"
Graphics	• NIL
Memory	• 4 GB
Storage	• HDD 300GB

## 4 SERVICE SUPPORT

Vendor has to demonstrate various communication protocols working with examples and also to demonstrate features asked in the specification. Vendor to help in the process of development of controllers for CEE products (if needed).



## **5 DOCUMENTATION**

Printed manual of software inclusive of all modules and software CD/ manual CDs to supplied alongwith software package.

Vendor to provide hardcopy of the manual of each module of the software.