REQUEST FOR QUOTATION

MMI:PU:RF:003

BHARAT HEAVY ELECTRICALS LIMITED
Electronics Division
PB No. 2606, Mysore Road Bangalore - 560026
INDIA

RFQ NUMBER: KMVM900152

RFQ DATE : 12.DEC.2008

Due Date
21.JAN.2009
Time: 13:00 HRS

VENUE :
NEW ENGG. BLDG

(for all correspondence)
Purchase Executive : VEERACHARI KM
Phone : 080-26998663
Fax : 00918026740138
E-mail: veerachari@bheledn.co.in

Please submit your lowest quotation subject to our terms and conditions attached for the material mentioned below. The quotation must be enclosed in a sealed envelope / Fax superscribed with RFQ no.and due date, should reach us on or before the due date by **13.00** hours IST and will be opened on the same day

1. TENDER / OFFER SHALL BE SUBMITTED IN TWO PARTS.

2. QUOTATIONS MAY BE SUBMITTED BY OEM OR THEIR AUTHORISED DEALERS.

3. VENDOR IS EXPECTED TO HAVE ESTABLISHED SALES,SERVICE AND SUPPORT NETWORK PREFERABLY, IN INDIA. A LIST OF THE SAME NEEDS TO BE ENCLOSED WITH THE OFFER.

4. A LIST OF REFERENCES INCLUDING CUTSTOMER'S DETAILS LIKE CONTACT, MACHINES INSTALLED, DATE OF INSTALLATION IN INDIA AND ABROAD SHALL BE SUBMITTED THAT ESTABLISHES THE SATISFACTORY PERFORMANCE OF SUPPLIER'S EQUIPMENT FOR AT LEAST THREE YEARS.

5. VENDOR IS ADVISED TO GO THROUGH THE GENERAL TERMS AND CONDITIONS DOCUMENT CPD-00 ENCLOSED WITH RFQ.

6. BHEL RESERVES THE RIGHT TO RESORT TO REVERSE AUCTION BEFORE THE PRICE BID OPENING.

7. VENDOR HAS TO CONFORM TO ALL THE CLAUSES LISTED IN THE TECHNO-COMMERCIAL TERMS (ANNEXURE-B OF DOCUMENT CPD-00). DEVIATIONS, IF ANY, TO BE HIGHLIGHTED AND BROUGHT OUT CLEARLY.

8. VENDOR HAS TO CONFORM TO ALL THE CLAUSES IN THE PURCHASE SPECIFICATIONS.

9. DELIVERY REQUIRED: WITHIN 12 WEEKS FROM THE DATE OF PURCHASE ORDER.

10. TERMS OF PAYMENT: 90% WITHIN 30 DAYS AND THE REST 10% AGAINST SUBMISSION OF PBG.

Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date
1	CU9095003750 Real Time Digital simulator PS-445-093 Real Time Digital simulator as per PS-445-093	1	NO	1	09.APR.2009

Total Number of Items - 1

Please note that the tender will be opened in the presence of the bidders or his authorised representatives (maximum two per organisation) who choose to be present with authorisation letters. Refer annexure for the terms and conditions.
Preference will be given to vendors who accepts our standard payment terms i.e.100% payment - 30 days after receipt of material at our works subject to acceptance.
Please specify Terms of delivery, Excise duty, sales tax, Ex-BHEL, Ex-works surcharge, Insurance,P&F, Freight and other taxes very clearly .

i). This is only RFQ not an order.
ii). In all correspondence quote RFQ No. & due date.
iii). In Quotation BHEL material code / RFQ Sl. No. should be mentioned clearly.
iv). Quotation Envelope / Fax not superscribed with RFQ No.and due date is liable for rejection.
v). Quotation should remain valid for a minimum peiod of 90 days from due date.
vi). In case of non-receipt of Quotation or regret letter for 3 consecutive RFQs you are liable to be removed from our

For and On behalf of BHEL.

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Sl No.	Description	Qty	Unit	Delivery qty	Delivery Date

vendors list.
vii). All Prices should be written in words and numbers.
viii). Excise Chapter Heading should be mentioned for all items where VAT is applicable .

For and On behalf of BHEL.

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1. Introduction

BHEL Electronics Division proposes to procure Real Time Digital Power Electronics Simulator for the simulation of Power Electronic Systems comprising of Traction Drives and HVDC Systems.

2. Scope

The scope of this specification covers supply of Hardware & Software, installation, commissioning at EDN-BHEL Bangalore, training of BHEL Engineers, service during warranty of real-time design and simulation of circuits and systems in Power Electronics and Power Systems and also enable Hardware-in-loop testing.

3. Pre-Qualification Criteria

3.1 The vendor shall be an Original Equipment Manufacturer (OEM). Only the OEM or their authorized dealers in India along with an authorization letter can submit offers. An authorized Representative/Dealer in India, cannot quote for the same equipment from more than one OEM. Authorization letter must be submitted along with the technical offer.

3.2 Offer shall be for new equipment and not for any refurbished / used equipment. All the parts used in the machine shall also be new and not used / refurbished ones. A declaration to the above effect to be furnished.

3.3 Foreign OEM shall have Authorized Indian dealer(s) / representative(s) for after-sales service and support. The authorization letter for the dealer/ representative shall be provided from OEM. This letter must be part of technical offer.

3.4 The tenderer must have supplied similar systems either in India or anywhere in the world during the last 5 years. Similar system means a Real Time Power Electronics and Drives Simulator (Switching element IGBT) used either in Industry or transportation sector.
The tenderer has to submit:
(a) Year of Supply
(b) User /Customer contact details
The supplier must also provide documents relating to the capability to assemble a simulator with up to 16 processors and more than 100 I/O channels. The simulator shall be provided with this scalable feature for future expansion. Reference users of such system must be supplied with the proposal.

3.5 The vendor shall submit detailed technical literature /data sheet /Write-up of the proposed system. Schematic or Block diagram of the proposed system shall also be supplied along with the technical offer.

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3.6 This proposed simulator shall be capable (but not limited to) to simulate typical power electronic circuits and power grid including the following sample circuits that will be used as the main benchmark to qualify the proposed system.
(i). Traction Drive system as per Annexure I simulated at 50uS or less and
(ii) Cigre benchmark model for HVDC as per Annexure-II simulated at 50uS or less.

Vendor is required to simulate these circuits and submit the simulated results along with the offer for technical evaluation/capability of the proposed offer. BHEL reserves the option of rejecting the bid in case the sample circuit simulation is not furnished.

3.7 A demo package, with the solved sample problems, should be made available after the submission of the above results to BHEL for a period of two weeks in BHEL so as to evaluate the same. Technical support shall be provided by the vendor during this evaluation period.

3.8 Methods of validation of results from the offered software to be spelt out in the technical bid. Vendor can submit benchmarking or publication of results in any international/national journals and conferences.

3.9 The vendors are required to submit the offer in two parts - **Part A**- Techno Commercial (or technical) bid and **Part B**: price bid. Unpriced price bid to be enclosed in the technical bid.

3.10 The items covered under **all the clauses in this specification**, **except clause no.9.0**, are mandatory. The items covered under clause no 9.0 are **optional**. Vendors shall submit their quotation for the scope detailed (both for mandatory and optional items) in this specification. However BHEL reserves the option of placing the order, for either the entire scope or part thereof. Hence vendors are required to offer quotation segment wise (for segment wise items, refer clause no 5.0). For arriving at final price and comparison of price bid, only the prices of mandatory items will be considered. Ordering of Optional items will be at BHEL's discretion

3.11 Vendors are required to provide a clause wise technical compliance statement along with the technical bid. Technical compliance shall be supported by technical data sheets, technical write-ups, proposed system configuration, writeup etc..

3.12 The vendor or their authorized service representatives shall have trained engineers in India for commissioning & service for the offered equipment and shall be in a position to provide prompt after sales service and spares support for installations. The vendor shall furnish, along with the offer, the details of no. of trained engineers present in India, inventory levels to support for spares

3.13 If required by BHEL, the vendor shall arrange for a demonstration of the similar systems operating in India OR a certificate from customer for satisfactory performance may be submitted.

3.14 The proposal shall be for complete system (inclusive of all hardware and software) with total integration responsibility. In the event, any vendor proposing third party software or hardware, then it is the vendor's responsibility to ensure the total integration of such third party software/hardware with his system and demonstrate the total functionality. Vendor shall also submit list of such third party software/hardware along with the offer. An undertaking is required to be submitted by the vendor stating that vendor will take

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the responsibility of ensuring the integration of total system due to any future upgradations/changes in the third party software/hardware.

In case third party is not willing to supply software/hardware through the vendor, then the vendor may produce the letter so obtained from the third party indicating their unwillingness to quote. Then BHEL will obtain the offer from third party, as suggested by the vendor, and this price will be added for arriving at final price and hence for price comparison.

NOTE: *1. The Pre qualification criteria, as specified in clause 3 , are mandatory requirements and the technical bids will be evaluated only when the Pre Qualification criteria are met.*

2. Pre qualification will be carried out based on the details furnished by the vendor / feedback from their customers / inspection of the company / product if requ ired by BHEL and at its sole discretion

4.0 **Functional Requirement specifications:**

4.1 The simulator must be designed to facilitate a well-established model-based design approach and test the control systems and model the **plant** (the system to be controlled) and *interface with* the prototype controller in real-time, in order to study the behaviour of the system. The simulator can then be used to introduce the real controller into the simulation to test the performance of the contr oller before introducing it into the real system.

The prototype controller, made with the simulator, can be tested in closed-loop with the model of the plant also simulated with the simulator.

4.2 **Testing Real Controller with Real-Time Plant Model**

The simulator shall be designed to test the real controller (hardware-in-the-loop) with real time simulated plant model.

4.2.1 In hardware-in-the-loop application, the real controller under development is connected to the simulator where the electric plant model runs in real-time. The actual controller board and algorithms are tested in closed loop with a simulated plant of a drive, a power conversion system, etc, in order to eliminate the risks of damaging the real plant or prior to building the real electric system.

4.2.2 The simulator must be used simultaneously to simulate the controller and the plant being controlled. The control model could be connected directly with the simulated plant using internal connection (fully digital simulation) or physical prototype could be connected through the IO system.

4.3 **Testing Real Plant with Rapidly Prototyped Controller**

In this case the real plant (power electronic systems, motor, and generators) is connected to the controller, prototyped with simulation software on the real-time simulator.

4.4 **Traction Drive system simulation**

4.4.1 The simulator must be able to simulate precisely and in real-time electrical drive systems with AC to DC three phase power converter/DC to AC Inverter systems using a PWM frequency up to 10 kHz for 2-level converters and 1.5 kHz for 3-level converters.

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4.4.2 Simulation of 2-level DC-AC 3-phase drive/AC-DC 3 phase drive 3-phase Induction motor/Dc Motor using 3 kHz PWM firing with less than 0.1 degree jitter effects.

4.4.3 Different modulation methods (PWM, Space vector etc) shall be possible in simulation model.

4.4.4 The number and type of processors and IO channels supplied must be sufficient for the real-time simulation of typical circuits as presented in section 3.8.

4.4.5 The simulator must be specifically designed to be interfaced with fast real modern power electronic controllers.

4.4.6 The simulator shall model power electronic switching devices as two state impedances (i.e. low impedance in the on-state and high impedance in the off-state). Any additional device characteristics that can be modelled in real time shall be stated by the vendor.

4.4.7 The simulator must be capable to simulate power electronic device firing faults (i.e. it shall be possible to block a device from conducting even though a firing pulse is issued) occurring on any power electronic device based on external commands or commands generated in the simulated control.

4.4.8 The digital input-output standard interface must be programmable by user. The maximum latency shall not be more than two timesteps. One timestep is the duration between each numerical solution point. Line commutated schemes (e.g. HVDC and SVC) shall be simulated with a timestep of < 70 us and VSC based schemes with a timestep o f < 3 us.

4.4.9 The simulator must have the capability to simulate synchronous and asynchronous machine models operating either as motors or as generators.

4.4.10 **User programmable devices for the development of new controllers and protection systems**. It shall be possible to implement the new blocks for inclusion in real-time simulations using C code. The vendor must specify & provide all the necessary tools and train the user to develop their own models.

4.4.11 It shall be possible to create simulation circuits using either single or three line diagram drawing modes. Furthermore it shall be possible to switch between single line and three line views.

4.4.12 The simulator must include a visual programming tool to implement control systems using block diagrams. The blocks shall include the following types of functions; logic, mathematics, signal processing, input/output, signal generators, transfer functions, non-linear functions, data conversion, etc.

4.4.13 It shall be possible to include bus arrestors and arrestors for protection of series compensation models in the real time simulations.

4.4.14 Users shall be able to implement voltage protection device models like crowbar protection or over voltage limit protection.

4.4.15 Power Electronics control prototyping

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i) The simulator must permit the prototyping of advanced power electronic control systems.

ii) The simulation blocks for prototype controller must also include the firing pulse unit with a time resolution and precision better than 3 us.

4.5 **HVDC Simulation**

4.5.1 The simulator software shall include HVDC valve group models and shall be able to model three Bipoles of a multiterminal HVDC scheme (8 nos. 12-pulse valve group with converter transformers, smoothing reactors and generic controls) as shown in the SLD in Annexure III.

4.5.2 The converter transformer included in the HVDC valve group model shall have an online tap change that can be controlled either by internal or external controls.

4.5.3 The simulation of HVDC valve groups shall provide a continuously variable firing instant based on either internal or external (HIL) controls with an accuracy of 1 us or better.

4.5.4 The HVDC valve group models shall permit internal valve faults and faults from inside the valve group model to points outside the valve group.

4.5.5 The HVDC valve groups must be solved to ensure proper harmonic representation and stable operation even with very small DC smoothing reactors.

4.5.6 The HVDC valve group shall provide an end of current pulse, via digital output to external controls, with an accuracy of 1 us or better to allow the accurate and consistent calculation of gamma.

4.5.7 It shall be possible to simulate a multi terminal HVDC system with up to three HVDC converter stations with bipolar configuration along with DC-line, smoothing reactors and generic controls, fifteen AC filter sub-banks on AC side and four branches of filter banks on DC side along with their breakers at each converter end, shunt banks and two Dynamic compensation (Static Var Compensation SVC) and six machine generators at each terminal it shall also have I/Os to interface 12 firing pulses in each station per pole as shown in the SLD in Annexure III.

4.5.8 It shall be possible to simulate AC equivalent source at both ends of the HVDC link similar to the CIGRE benchmark but with circuit parameters (short circuit level, resonance frequency and damping) that can be varied.

4.5.9 It shall be possible to simulate 18 nos. generators, 1500 KM long HVDC transmission lines between bipoles and electrode lines

5.0 Scope of Supply (Segment wise items)

5.1 Hardware

(a) Processor cards
(b) Digital Input Cards
(c) Digital Output Cards
(d) Analogue Input Cards
(e) Analogue Output Cards
(f) Workstation
(g) Workstation Interface module

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(h) Interrack/chassis interface card (if applicable)
(i) Rack/Chassis
(j) Power supply

5.2 Latest Software for:
(a) Graphical User Inteface
(b) Real Time Digital Simulation
(c) Libraries (Default and Customizable)
(d) Scripting Language.

6 Specifications:

6.1 Hardware specifications

6.1.1 a) Workstation

Processor	: minimum 64 Bit CPU.
Speed	: Minimum 2GHz.
RAM Memory	: Minimum 2 GB.
HDD	: Minimum 160 GB SCSI with Controller
Monitor	: Minimum 21" colour monitor, high resolution 1920 X1440
CD Drive	: Combo Drive CD-R/CD-RW
I/O card	: Adequate I/O facility, Controllers, Dual network Interface cards etc.
Accessories	: As required if any.

b) Workstation Interface card
Suitable interface card shall be proposed.

6.1.2 **Real time system**

6.1.2.1 Real-time Operating System
The supplier shall specify the real time operating system used for the simulator in the technical bid.

6.1.2.2 Processor type
The offered processor shall be state of the art and of 64 bits minimum or above. The supplier shall specify the type and number of processors proposed. The vendor shall establish with necessary documentation the capability of the processor to meet the specification.

6.1.2.3 Physical dimensions and weight
The supplier shall specify the physical size and weight of the proposed system.

6.1.3 **Input/Output System Specification**

6.1.3.1 **General Specifications**

(i) I/O channels shall be individually programmable and connected to any signal from the models using the simulation software modelling blocks.
(ii) All I/O channels must be equipped with signal conditioning equipment to prevent damage to the main simulator in case of faulty wiring or manipulation during the installation or operation.
(iii) The I/O system must be designed to offer the minimum latency considering the conversion time, overhead and the time to transfer the data from and to the main processors.

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(iv) It shall be possible to locate the I/O system devices very close to the controller under test to minimize cable lengths and noise. To facilitate this the I/O devices shall be connected to the main simulator hardware via optical fiber(s).

(v) I/O modules shall be easily installed in an industrial rack mountable chassis or DIN rail.

(vi) Galvanic/optical isolation between the main computer equipment and the I/O systems is required.

(vii) Analog input channels must be equipped with differential input and have accuracy better than 0.2% at full scale.

(viii) Analog output ground will be common to all analog output channels.

(ix) Shielded twisted-pair cables will be used to connect analog signals.

(x) A provision for connection of shield wires shall be provided.

(xi) Screw terminals shall be supplied to interface the I/O channels to the external controller. The acceptable wire gauge shall be specified by the supplier.

6.1.3.2 **Number and Types of Input-Output Interfaces**

(i) 64 digital input channels with event capture and PWM input capability. Each channel shall be supplied with galvanic/optical isolation, compatible with logic signals having voltage range from 0V to 24V (+/-20%).

(ii) 64 digital output channels with event capture shall be supplied. Each channel shall be supplied with a galvanic/optical isolation with a maximum sourcing current capability of 100 mA, a maximum voltage of 24 V.

(iii) 36 Nos of 16-bit independent analog inputs shall be supplied with Simultaneous sampling of all channels.
6 us conversion time total for all channels.
All channels shall have High-impedance differential inputs with operating range +/- 10V

(iv) 36 Nos. 16-bit analog outputs.
1 us update and settling time of all signal simultaneously. There shall be possibility to update the analog output at the end of the time step.
Operating range shall be : +/- 10 V output, 5 mA.

7. Software specifications

7.1 Real time simulator software

7.1.1 The simulator must allow the parallel and distributed execution of any circuit model.

7.1.2 The simulator shall have the ability to monitor the execution of every model used in the real time simulation and ensure that execution of all models is complete before the end of every timestep. The servicing of all I/O must be included as part of the monitoring process. If the computation of any model, including the servicing of I/O, is not completed by the end of a timestep, the real time simulation must be stopped and the user notified.

7.2 Graphical User Interface (GUI)

7.2.1 The simulators must be equipped with a re-configurable graphical user interface capable to display simulator results and to control simulation parameters from several remote work stations interconnected to the simulators through a standard network.

7.2.2 The software package GUI shall consist of following functionality:

i) Graphical construction of the real time simulation circuit consisting of the electrical

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plant and control system using predefined blocks present in the various libraries.

ii) Operator console to start and stop the real time simulation.

iii) During the real time simulation, the operator console shall allow the user to monitor the state of the system through quasi-real time updates of simulation quantities (i.e. RMS voltages and currents, machine speeds, etc.). It shall be possible to set the update frequency to a minimum value of 0.1 seconds and it shall be possible to monitor a minimum of 50 quantities simultaneously.

iv) The operator console shall also have a facility to plot simulation data and display the result of different events. The plotting facility shall allow any combination of signals to be displayed in one or multiple graphs having a common time reference.

v) A facility to calculate the traveling wave characteristics of transmission line and cable models.

vi) Post processing and analysis facility for the evaluation and presentation of simulation data.

vii) Users must be able to build their own user interface from a pallet of standard components and control objects and assign these objects to signals calculated in real-time by the simulator.

viii) The graphical interface must include high-end sophisticated waveform display objects such as analog or digital virtual oscilloscopes with features similar to real oscilloscopes such as manual or auto scaling as well as X-Y zoom functions and X-Y measurement with cursors.

ix) The user interface software must support several simultaneous graphs of simulation signals for example the simultaneous display of three phase voltages and three phase currents.

x) It shall be possible to perform complex post processing operations with GUI.

7.3 Data Logging System

7.3.1 The simulator data logging system must be designed to allow the display of waveforms while waveforms are being calculated and recorded.

7.3.2 The data display on the host station shall be done using graphical software. These models shall be integrated within the simulator GUI.

7.3.3 The data logging shall be in real-time using dedicated memory located on the simulator to ensure that no data is lost during the recording of a data frame.

7.3.4 The size of the buffer memory dedicated to real-time data storage must be large enough to record 50 signals at 20 kilo-samples per second per signal during 1 second.

7.3.5 The start of the signal recording must be synchronized with an event defined by users such as when an arbitrary signal exceeds a specified value with a positive or negative slope.

7.3.6 Users must be able to specify data logging parameters without stopping the simulator. These parameters include the list of signals to be recorded as well as the decimation factor.

7.3.7 The data logging system must allow to record signals in several groups sharing the same data logging parameters such as time reference, triggering parameters (trigger signal, levels, and slope) decimation factors, re-arming delay and recording period.

7.3.8 Recorded real-time data can be transferred to the host stations over the network for

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display and stored on hard disks in for off-line analysis.

7.3.9 Recorded real-time data can be stored on hard disks in real-time. User shall be able to automatically transfer the data from the real-time computer disk to the host disk. Vendor shall furnish the details of how this data transfer is achieved.

7.4 Test Automation

7.4.1 The simulator must be fully controllable by means of a high level application programming interface (such as C) to implement automated test sequences.

7.4.2 The simulator GUI shall allow the implementation of complex Monte-Carlo optimization studies including starting and stopping the simulator, selecting and loading the model, model parameter looping, analysis, setting new parameters based on previous results.

7.4.3 The simulator GUI shall have the capability to interface with third-party waveform analysis tools, report generation tools, data base and other open tools.

7.4.4 The simulator GUI must allow the relevant scripting language to implement testing sequences with a timing precision of plus and minus one model time step.

7.4.5 The simulator must have the capability to record testing scripts as they are execute d by user commands. Users must be able to edit these recorded scripts and to play them back.

7.5 Load Flow Initialization

7.5.1 The simulator GUI must include a load flow package that can be run as part of the circuit definition software.

7.5.2 The simulator GUI must include the possibility to initialize the real time simulation based on the load flow result.

7.6 Customized user models and interfacing using low-level languages

7.6.1 The simulator must allow users to develop their own graphical co mponents and C code to run on the real-time processors.

7.6.2 The simulator must allow users to develop their own signal processing or control functions that will run on the simulator.

7.6.3 It shall be possible for the user programmed models to inter face with the simulator I/O system and/or with other models running in real time.

7.7 Multi-User Capabilities

7.7.1 The simulator must have the capability to allocate several subsystems to one or a group of processors or to dedicate any processor to the execution of one subsystem only.

7.8 Software Licensing

7.8.1 The vendor shall offer all the software's with PERPTUAL license (life time without any renewal).

7.8.2 The software shall be used on Local Area Network (LAN) and the license should be

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single user floating type. The users shall also be able to use the modules independently. Vendors to confirm the same in the technical bid.

7.8.3 Microsoft windows environment shall be used for operating system. However vendor has to specify the OS requirements and the hardware configuration in the technical bid.

8.0 Modelling and Simulation Software

8.1 Network solution

8.1.1 The standard network solution used for circuits running with timesteps in the range of 50us or less.

8.1.2 The standard network solution shall allow a minimum of 66 single phase nodes per subsystem (i.e. no decoupling techniques are allowed within a subsystem).

8.1.3 The network solution applied to VSC circuits shall allow a minimum of 30 single phase nodes per subsystem.

8.1.4 The network solution must allow the inclusion of continually varying impedances & modification without stopping the simulator or recompiling the model

8.1.5 User shall be able to interface the network solution with user models implemented with differential equations expressed with block diagram or standard A, B, C, D state-space matrices

8.1.6 Differential equations as mentioned in 8.1.5 shall be solved at the same time step as the standard network solution and at a rate specified by the user that is a multiple of the basic network solution.

8.1.7 Users shall be able to modify differential equation parameters of 8.1.5 at run-time without stopping the simulator or recompiling the model.

8.2 The simulation software shall have following minimum Network Elements

8.2.1 Tools

i) point on wave
ii) 3-phase bus
iii) 1-phase bus
iv) Multiplex bus
v) User code block
vi) subsystems
vii) IN/OUT ports
viii) Meters /Scope for monitoring

8.2.2 Sources and Machines

i) AC source (programmable)
ii) Current Source (programmable)
iii) Synchronous thermal machines (multimass)
iv) Synchronous Hydraulic Machine
v) Synchronous cross-compound
vi) Voltage controlled sources
vii) Current controlled sources

8.2.3 Lines

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i) Frequency distributed lines
ii) Coupled Lines (6, 9 and 12 Phases)
iii) PI section (6, 9 and 12 Phases)
iv) Marti Lines (6 Phases)
v) DC line
vi) All models shall have internal breakers for faults

8.2.4 Passives
i) Ground
ii) RLC series (all combinations)
iii) RLC shunt (all combinations)
iv) Mutual Inductor
v) Non-Linear Resistor
vi) different filter configuration

8.2.5 Loads and Motors
i) Harmonic Load
ii) Arc Furnace
iii) DC Motor
iv) Induction Motor
v) Dynamic load
vi) Synchronous motor

8.2.6 Switches
i) 6 Pulse
ii) 12 Pulse
iii) Breakers
iv) Switches (all configurations)
v) 2 and 3 level IGBT/GTO/Thyristor Bridge
vi) Routers
vii) Multiplexers/Demultiplexers

8.2.7 Miscellaneous
i) Frequency measurement
ii) Digital In/Out
iii) Analog In/Out
iv) V/I Measure

8.2.8 Transformers
i) 2 or 3 windings
ii) Linear
iii) Saturation
iv) Hysteresis
v) Tap changers
vi) Constant Voltage Transformer
vii) Current Transformer
viii) Potential Transformer
ix) Phase Shifter

8.3 The simulation software shall have following Control Elements

8.3.1 Mathematical Operators
i) Sum/Gain
ii) Division/Abs
iii) Sin/Cos/tan
iv) ArcSin/ArcCos

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v) ArcTan
vi) $10^2/e^n$
vii) log10/logn
viii) sqrt()
ix) mod
x) dynamic functions
xi) H(s) or H(z) with dynamic or static limiters and reset

8.3.2 Logic
i) AND/NAND
ii) OR/NOR
iii) XOR/XNOR
iv) NOT
v) Edge-up
vi) Edge-down
vii) Comparator
viii) Bit-encoding
ix) Timer

8.3.3 Sources
i) Integer
ii) Float
iii) Random generator
iv) Trigger
v) Pulse train
vi) Square wave
vii) Triangular wave
viii) Sine wave

8.3.4 Non-Linear and Delay
i) Limiter
ii) Max
iii) Min
iv) Delay
v) Non-Linear
vi) Ramp
vii) Rate limiter
viii) Dead zone
ix) Step delay
x) PWM
xi) Flip/Flop

8.3.5 Electrical Motor/Generator Simulation
i) The simulator shall be able to simulate D-Q synchronous and asynchronous (induction) motor and generator models in real-time.
ii) Excitation Control
iii) DC Motor
iv) Multimass model

8.3.6 Multi-Winding Transformer Simulation
i) The simulator shall be able to simulate in real-time multi-winding transformers (2 and 3 winding) typically used in high-power drive circuits
ii) The simulator shall be able to simulate transformer saturation effects.

8.3.7 Line and Cable Simulation
The simulator shall be able to simulate in real-time

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i) 25 KV 50 Hz AC power line and associated power cable models.
ii) Line and cable models of any capacity.

8.3.8 Instrument transformers

i) Current transformers
ii) Potential transformers
iii) Capacitive voltage transformers
iv) Models shall include saturation and hysteresis effects

Models should be customizable by changing the parameters of each model.

8.3.10 Processor and I/O Technology

i) The simulator must allow the addition of processors and I/O channels as needed to simulate more complex systems as this may be requested within the next ten years. Adding processors may require the addition of additional rack/chassis and communication interfaces optimized for real-time simulation. Supplier to indicate the additional rack/chassis requirement during processor addition and up gradation

ii) The processors used for the real time simulation shall operate with a minimum of 64 bits and a minimum clock speed of 2 GHz.
iii) Processors within a chassis shall be able to transfer information directly or via a broadcast message to any other or all processors in the chassis.

iv) If more than one computer chassis or rack is used in the simulator, communication between the units must be adequate to ensure real time simulation of circuits implemented using the multiple units.

v) The simulator construction must allow the system to be upgraded when new and more powerful compatible components become available in the market. Supplier to assist during capability addition and up gradation.

vi) The supplier must ensure the availability of compatible components to upgrade or expand the simulator for a period of 5 years after the initial delivery. This MANDATORY specification will ensure that the user will be able to upgrade their simulator with the latest technology.

vi) Keeping user's long term objectives, the simulator manufacturer should provide the cost of hardware warranty to replace any defect components for at least ten years by the same or equivalent components to maintain the complete simulator operation and performance.

9.0 **Optional requirement specification.**

9.1 **Workstation**

The minimum requirement are 2GHz. Processor, 2GB RAM, optical mouse, LCD monitors (minimum 20 inch). The vendor shall submit the detailed specification.

9.2 **Amplifiers (Optional Items)**

The supplier shall offer two sets of 3-phase voltage and current amplifiers to facilitate protective relay testing.

9.2.1 **Voltage Amplifiers**

The voltage amplifiers shall be able to provide a maximum voltage of 200 V RMS from 0-6kHz. Detailed data sheets, catalogues etc shall be submitted along with technical offer.

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9.2.2 **Current Amplifiers**

The current amplifiers shall be able to provide a maximum current of 35 A peak from 0 - 6kHz.n Detailed data sheets, catalogues etc shall be submitted along with technical offer.

10.0 Pre-shipment Inspection and Training:

Pre-ship inspection shall be carried out by BHEL Engineers as per the approved Quality Plan and test protocol. The supplier shall also provide training for three BHEL personnel at the premises of manufacturer in the field of complete operation and maintenance of the equipment of for a cumulative period of 30 man working days free of cost at the said premises. Travel and living expenses shall be borne by BHEL. Detailed structure of the training shall be finalised with the vendor after the placement of purchase order.

11.0 Spares

11.1 Supplier shall supply spares necessary for two years of trouble free operation. The spares shall include critical PCB cards, add-on cards, if any, cables etc. List of spares and quantity shall be provided along with offer.

12.0 Calibration Certificates

12.1 Calibration certificates (with minimum 2 years of validity) for measuring components/instruments wherever applicable shall be provided. Calibration procedures are also to be indicated in detail.

13.0 Test Certificates

13.1 The supplier shall submit test certificates.

14.0 Quality Plan and Test Protocol

14.1 Supplier shall submit quality plan & test protocol for BHEL's approval along with the offer.

15.0 Installation and commissioning

15.1 Vendor will be responsible for Installation, commissioning and demonstration of the performance of the equipment at BHEL's site.

16.0 Tools/Hardware/Instruments

16.1 All the tools, hardware and instruments that will be required for installation and commissioning shall be arranged by the vendor.

17.0 Warranty & Annual Maintenance

17.1 The vendor shall quote with warranty of one year. During warranty period, the vendor will provide all technical updates and technical support free of cost.

17.2 After the end of warranty period of one year, Annual Maintenance Contract (AMC) shall start. Vendor shall submit year wise charges of AMC for next five years and they would be binding during the tenure by an agreement. This agreement is binding on the vendor even if the company is acquired by any other company. The payment of AMC charges shall be payable after the first year and beginning of every maintenance year. Vendor may note, for arriving at Lowest bid price (L1), this AMC charges for 5 years will be added with the basic (software and hardware) price.

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18.0 Documentation

18.1 **Information required along with techno-commercial offer without which offer is liable for rejection**

18.1.1 Supplier shall furnish clause wise confirmation/comments to this technical specification in the typical format given in clause no.20.0. Deviation, if any, shall be clearly brought out indicating the clause no., original specification, deviation sought with proper technical backup (catalog, technical brochure, International standards etc) for seeking such a deviation. If no deviations are required, then supplier shall furnish a certificate indicating "*No Deviations requested and we comply fully with all the technical requirements of this specification no. PS/445/093*".

18.1.2 Supplier shall take a copy of this specification and sign on each page and submit the signed copy along with the offer.

18.1.3 Service / Calibration contact details in India and abroad.

18.1.4 List of Spares.

18.2 Information required after the placement of order.

18.2.1. Quality Plan and Test Protocol for BHEL's approval as per clause 13.0

18.3 **Information required along with material supply** .

18.3.1 Three set of operation and maintenance manual in English and one CD (with soft copy of complete manual) shall be supplied along with the equipment.

18.3.2 Technical write-ups/data sheets of all the pcb cards viz. processor cards, IO Modules, Power supplies etc.

18.3.3 Three sets of Test certificates and calibration certificates.

18.3.4 BHEL's Engineers approved pre-shipment inspection report.

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20.0 General

20.1 The vendors, if in doubt, are requested to interact with the user group in BHEL before submission of offer to make sure that the specifications are understood by the vendor.

20.2 The supplier is expected to provide all the items required for proper functioning of the equipment in accordance with the latest international practices/standards, whether included in this specification or otherwise.

20.3 Any deviation from specification intended to improve the performance, reliability and efficiency of the equipment as a whole or part thereof may be proposed for consideration. All such proposals shall, however be accompanied with complete technical details and justification for proposed deviation.

20.4 The equipment shall be designed taking into account all safety and environmental requirements. Hazards/Risks associated with operation & maintenance of the equipment shall be brought out explicitly and instructions for minimizing the hazards / Risks are to be indicated.

20.5 Supplier's operators /Engineers deputed for installation of the equipment at the BHEL works shall comply with safety regulations and precautions. They shall be trained adequately in environmental/health/safety hazards associated with the installation and operation of the equipment.

20.6 Supplier shall provide details of local infrastructure (in India) for providing service locally.

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Annexure I

TRACTION DRIVE CIRCUIT

The Auxiliary load is 130 KVA

Parameters to be monitored.

1. Input Voltage
2. FEC Switching Pulses and Firing Angles
3. FEC Input Current
4. DC Link Voltage
5. Traction Inverter Input Current
6. Traction Inverter Switching Pulses
7. Traction Inverter Output Current and Voltage

Waveforms of the above listed parameters should be displayed at the time of acceptance test.

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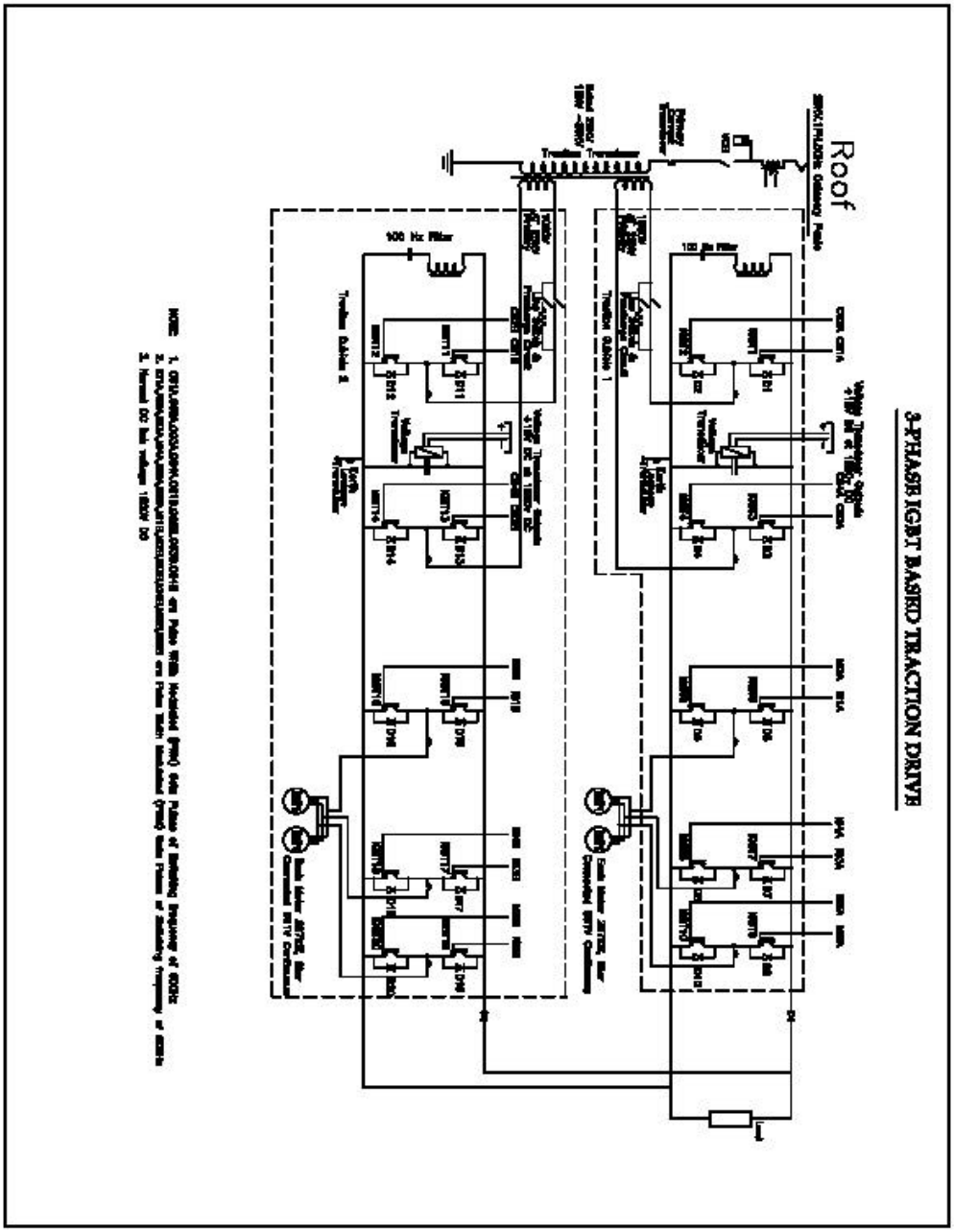
Annexure I



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Annexure II

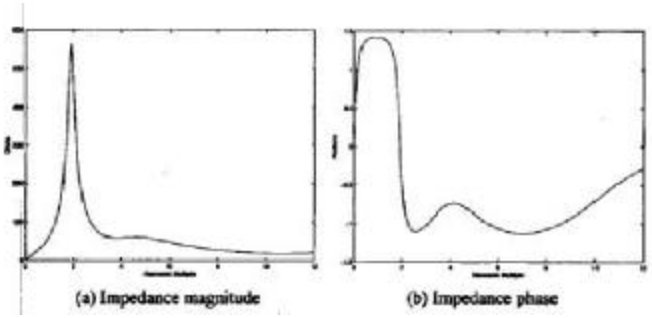
CIGRE HVDC BENCHMARK-MODEL PARAMETERS

Parameter	Rectifier	Inverter
AC-system voltage	345 kV *l–l*	230 kV *l–l*
AC-system impedance magnitude	119.03 Ω	52.9 Ω
Converter transformer tap (prim.side)	1.01	0.969
Equivalent commutation reactance	27 Ω	27 Ω
DC voltage	505 kV	495 kV
DC current	2 kA	2 kA
Firing angle	15°	15°
DC power	1010 MW	990 MW

Parameters For CIGRE BENCHMARK Rectifier

Power base	603.73 MVA
Primary-voltage base	345 kV
Secondary-voltage base	213.4557 kV
Nominal DC current	2000 A
Nominal firing angle	15°
DC-voltage source	4.179 p.u.
Transformer-leakage reactance	0.18 p.u.
Transformer series resistance	0.01 p.u.
Thyristor forward-voltage drop	8.11E-6 p.u.
Thyristor-on resistance	0.001325 p.u.
DC-current transducer time constant	0.001 s/rad
PI-controller proportional gain	1.0989 rad/A(p.u.)
PI-controller time constant	0.0091 s/rad

Frequency Scan of CIGRE Rectifier – AC System Impedance



(a) Impedance magnitude (b) Impedance phase

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Annexure I I

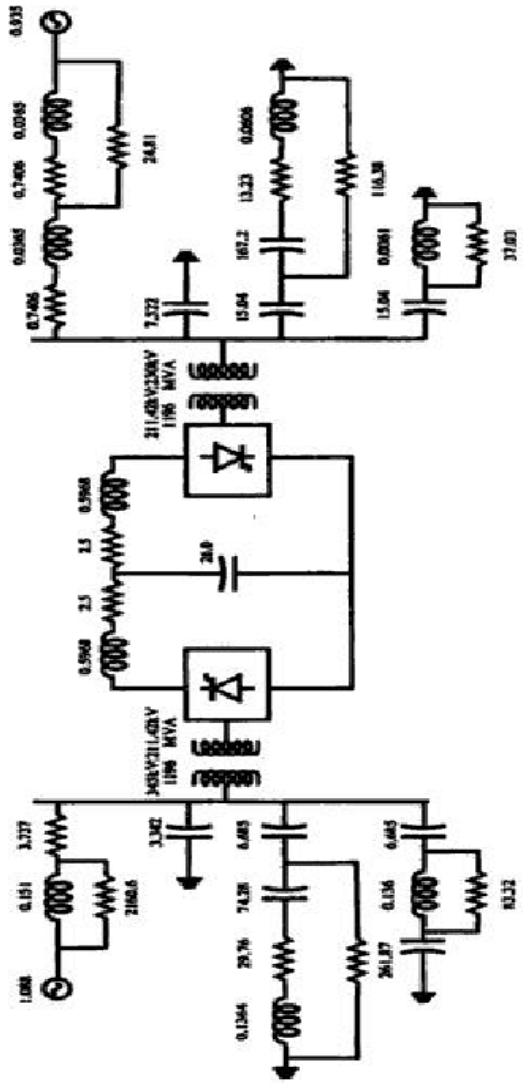

Figure III.1 CIGRE HVDC benchmark model

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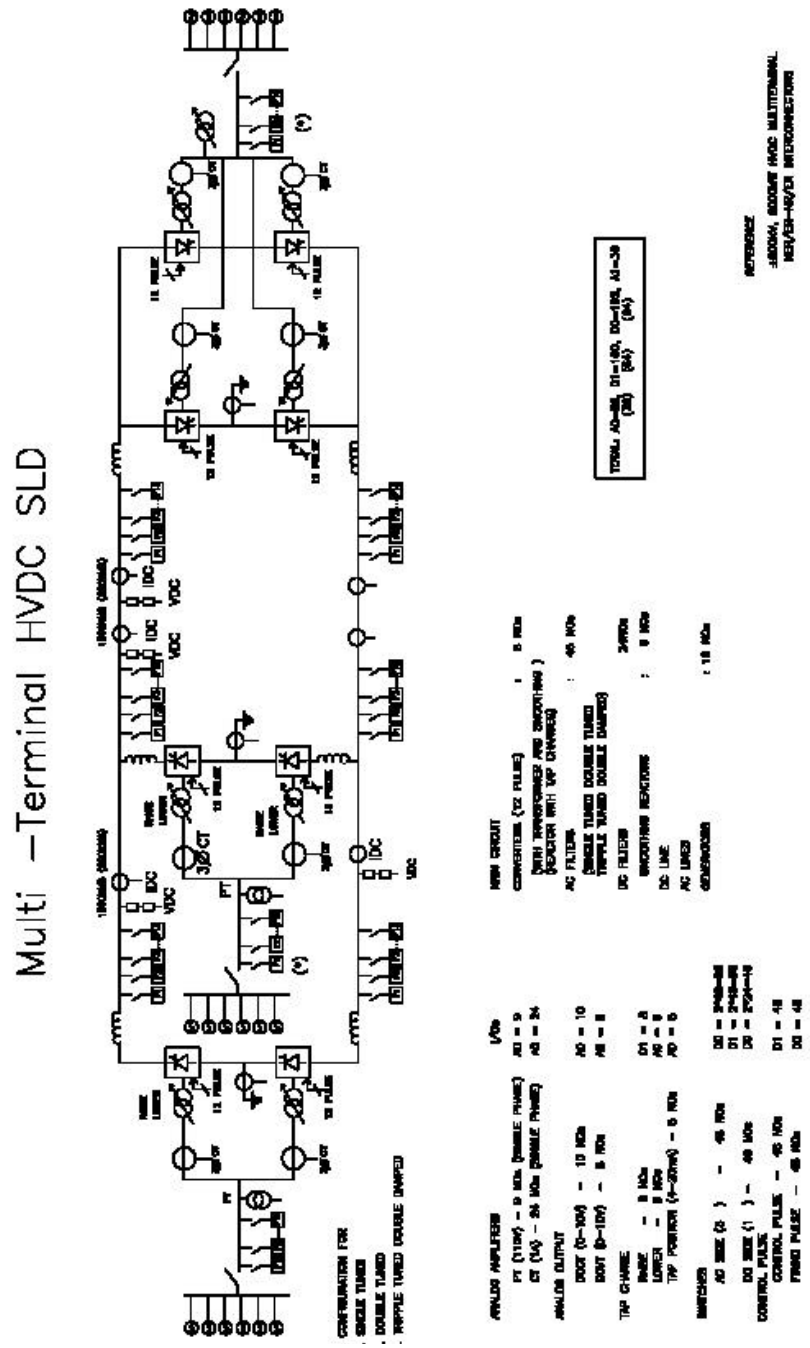
Annexure III



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General Terms & Conditions for Supply of Imported & Indigenous Capital Items (Two part bid)

Bidders are required to read the general terms & conditions carefully and submit their quotation covering all the points. Any order resulting from this enquiry shall be governed by the general terms and conditions listed below.

1. **TWO PART BID:** Quotation shall be submitted in two part bid i.e.

   a) **Techno-commercial i.e., Un-priced Bid:** Techno-commercial bid shall be submitted with complete description of the equipment, specification compliances to the enquired specification and all the commercial terms & conditions indicated in the **QUOTATION FORMAT (**ANNEXURE - A / ANNEXURE - B) preferably in the same format. Any other enclosure, which the supplier wishes to submit like product catalogue, technical literature etc., may also be submitted in a sealed envelope super scribed clearly as **"TECHNO-COMMERCIAL BID" with RFQ No. and DUE DATE.** Un-priced copy of price bid (without price) shall also be enclosed with the techno-commercial bid i.e. a copy of the price bid without prices.

   Confirmation to BHEL specifications shall be indicated by the vendor in the respective columns provided in the purchase specification wherever applicable. Deviations to the specification / item description, if any shall be brought out clearly indicating "DEVIATION TO BHEL SPECIFICATION" without fail as a part of technical offer.

   Compliance to Pre-qualification criteria (if applicable) shall also be enclosed with the Techno-commercial bid.

   Manufacturer's name, their trade mark and brand if any, should be invariably mentioned in the tender and illustrative leaflets giving technical particulars etc., are to be attached to the tender to facilitate consideration of the offer.

   b) **Price Bid :**

   Price bid should contain basic unit prices, discount if any, applicable taxes & duties, packing & forwarding charges (if applicable), Freight & insurances (if applicable) FOB charge (if applicable) etc., in a sealed envelope super scribed clearly as **"PRICE BID" with RFQ No. and DUE DATE.** Installation, commissioning, start-up and training charges (if any) shall also be included in the price bid.

   Please indicate the rates in both figures and words. However in case of difference / discrepancy, the rates indicated in figures shall be considered as correct.

   Both these sealed envelopes [(a) Techno-commercial i.e., un-priced Bid and (b) Price Bids] shall be kept in a single sealed envelope and superscribed clearly with **RFQ No. and DUE DATE.**

2. The above sealed envelope (Tender) shall reach our office on or before the due date by **13:00 hrs.** Quotations are to be dropped in the tender box marked for the OPENING ON respective days i.e., MONDAY / WEDNESDAY / FRIDAY kept at BHEL-EDN's Reception area of our works with caption "CE, M&C, SC&PV, TSC, DEFENCE, TELECOM, CPD". Quotations also can be dispatched by Couriers / Registered post / FAX / e mail to the Purchase Executive indicated in the RFQ. Late Tenders i.e. Tenders received after due date & time are liable to be rejected.

3. The rates quoted against each item shall be in the same units stated in the enquiry. If the quotations are submitted in any other unit than specified, relationship between two sets of units must be furnished in the offer.

4. As far as possible, the quotations shall be free from corrections / overwriting. Corrections if any should be initialed with your seal and signature. Any typographical errors, totaling mistakes, currency mistakes, multiplication mistakes, summary mistakes observed in your priced bids, BHEL may consider whichever is beneficial to BHEL for evaluation.

5. Quotations are to be duly signed. Unsigned bids/offers are liable for rejection.

6. All the bidders or their authorized representatives (with authorization letter from their principals) can witness opening of techno-commercial bid on the due date.

7. After evaluation of techno-commercial bids, price bids of only those which are technically & commercially accepted, will be opened on a subsequent date, which will be intimated to the concerned in advance for witnessing of price bid opening.

8. The quantities in each item to be purchased may vary from quantities enquired according to the actual requirement at the time of placing the purchase order. Quantity discount if any should be mentioned in your offer.

9. BIDDERS (for indigenous purchase) shall indicate clearly Excise duty, Education cess, Sales Tax/VAT, Octroi, Entry tax, Service Tax as applicable for the quoted items. In the absence of clarity of these, any claim at a later date will not be entertained. Any changes in Taxes and duties after award of the contract will not be considered except such are those, which are imposed by Govt., notification within the contractual delivery. Seeking price amendments for change in Excise duty due to crossing of turnover limits will not be considered under any circumstances.

10. **TOTAL COST TO BHEL:** Purchase order will be placed on the lowest bidder (L1) only among the technically & commercially accepted offers. Lowest Bid (L1) is determined on the basis of the total cost to BHEL.

(a) FOR FOREIGN PURCHASE:

Total cost to BHEL = Total basic value in foreign currency + FOB charges (if any) + Packing & Forwarding charges (if any) + Cost Insurance Freight (CIF) + Basic Custom Duty (BCD) + Counter Veiling Duty (CVD) + Educational Cess + Special Additional Duty (SAD) + Entry TAX + Service TAX (if applicable) + Loading factors for deviations to commercial terms & conditions.

.

Note: Exchange rate ruling on the date of Tender opening (Techno-commercial / un-priced Bid) will be considered for converting foreign currency to Indian currency. Exchange rates published in Economic Times (TT selling) will be considered.

(b) FOR INDIGENOUS PURCHASE:

Total cost to BHEL = Total basic value + Packing & forwarding charges + Excise duty Education cess + sales Tax/VAT + Octroi + Exit/Entry tax + Freight & Insurance + Service Tax (if applicable) + Loading factors for deviations to commercial terms & conditions.

11. FIRM PRICE: Rates quoted should be firm and no enhancement in the rates and changes in the techno-commercial terms will be allowed once the quotation is accepted and order is placed.

If Installation & Commissioning is in supplier's scope, then the price shall remain FIRM till commissioning & handing over of the complete system.

12. TERMS OF PAYMENT:

(a) FOR FOREIGN PURCHASE:

Payment will be made against **"SIGHT DRAFT"** on presentation of documents to our bankers. Payment through LC is also made subject to loading factors as per **Clause 26 (Ai).**

The payment terms are as follows:

a) 100% against complete dispatch documents i.e. AWB / BOL, Invoice, Packing list, Nil shortage certificate, Certificate of country of origin etc., (where commissioning & warranty is NOT involved).

b) 90% against complete dispatch documents i.e. AWB / BOL, Invoice, Packing list, Warrantee certificate, Nil shortage certificate, Certificate of country of origin etc., & 10 % on submission of Performance Bank Guarantee (PBG) (where commissioning is NOT involved).

c) 75% against complete dispatch documents i.e. AWB / BOL, Invoice, Packing list, Warrantee certificate, Nil shortage certificate, Certificate of country of origin etc., 15% on successful installation, commissioning and start-up trials & 10% on submission of Performance Bank Guarantee (PBG).

d) If PBG is not submitted by the vendor, then the final 10% payment will be made against submission of supplementary invoice after warranty period + 6 months of claim period.

(b) FOR INDIGENOUS PURCHASE:

a) 100% within 30 days from the date of receipt of equipments / materials (where commissioning & warranty is NOT involved).

b) 90% within 30 days from the date of receipt of equipments & balance 10% against submission of PBG (where commissioning is NOT involved).

c) 75% within 30 days from the date of receipt of equipments, 15% after the successful installation, commissioning & start-up trials & balance 10% against submission of PBG (wherever commissioning & warranty are involved).

d) If PBG is not submitted by the vendor, then the final 10% payment will be made against submission of supplementary invoice after warranty period + 6 months of claim period.

13. **ADVANCE PAYMENT:** Quotations with payment terms of **"Advance"** or **"Inland Letter of Credit"** will not be considered and such offers are liable for rejection commercially.

14. **PENALTY:** Failure to supply the item within the delivery date specified in the purchase order will make the supplier liable to an unconditional penalty of ½% (One half percent) of the basic value of the goods in arrears per week subject to a maximum of 10%.

If pre-shipment inspection is involved, date of issue of pre-shipment call by the vendor along with test certificates / test reports / certificate of conformance / calibration reports as proof of completion will be treated as date of dispatch for the purpose of penalty calculation.

In the absence of reports stated above, actual date of inspection will be considered as date of dispatch for penalty calculation.

15. **PBG:** Performance Bank Guarantee (PBG) to be submitted as per the BHEL prescribed format given in **ANNEXURE - D / ANNEXURE - E** for 10% of the basic equipment value obtained from any BHEL member banks.

PBG shall be valid for 12 months from the date of commissioning or 18 months from the date of dispatch whichever is earlier. The PBG shall also have 6 months claim period from the date of dispatch / commissioning.

The Bank Guarantee shall be submitted directly to the concerned Purchase Executive by the issuing Bank with their forwarding letter.

16. **WARRANTY:** Goods dispatched shall have warranty period of 12 months from the date of dispatch or as mentioned in the RFQ.

17. **TERMS OF DELIVERY:**

(a) FOR IMPORTED PURCHASE:

Price offered shall be for goods packed and delivered **F.O.B.** (named international Airport) including packing, forwarding, Handling, Ancillary charges like processing of Sight Draft, Letter of credit (L/C) if applicable, negotiation of bank documents, Export declaration, Certificate of origin etc.

Packing shall be Airworthy & Roadworthy, best suitable for trans-shipment and to prevent transit damages.

Vendors shall indicate the name of International Airport.

Note: Name of International Airport has to be selected from any one of the airports indicated in the table provided in **ANNEXURE - C** herewith.

(b) FOR INDIGENOUS PURCHASE:

Equipment shall be delivered on EX-EDN/BHEL, Bangalore basis, inclusive of packing & forwarding charges.

Packing shall be Road / Air / Rail worthy, best suitable for transshipment and to take care of transit damages.

Dispatch the consignments through EDN/BHEL approved transporters on Door Delivery basis furnished below.

1. M/s Awagaman Road Carriers ltd., Bangalore. (AWG)
2. M/s BLR India pvt., ltd., Bangalore. (BLR)
3. M/s Delhi Assam Roadways corporation ltd., Bangalore. (DRL)
4. M/s Indo Arya Central transport ltd., Bangalore. (IACT)
5. M/s Prakash parcel Services, Bangalore. (PPS)
6. M/s Road Carrier of India, Bangalore. (RCI)
7. M/s Union Roadways ltd., Bangalore. (URL)

Small consignments can be dispatched through M/S First Flight Couriers Ltd.

Transit insurance shall be arranged by BHEL. Vendor shall intimate the dispatch details to BHEL immediately after effecting shipment, to arrange transit insurance accordingly.

18. DELIVERY REQUIREMENT: Equipment shall be delivered, as per the delivery schedule indicated in the RFQ.

19. VALIDITY: Quotation should remain valid for a period of **90 days** from the date of technical bid opening.

20. BHEL reserves the right to RE-FLOAT/REJECT/CANCEL the TENDER ENQUIRY (RFQ) without assigning any reason or cause thereof. Quotes received against this TENDER ENQUIRY are subject to and governed by all these terms and conditions. BHEL's decision will be final in awarding of the contract and binding on all vendors.

21. REVERSE AUCTION: BHEL reserves the right to resort to reverse auction / online Bidding before opening of price bid.

22. POST-ORDER REQUISITES:

a) Pre-shipment inspection at vendor's works, if required, will be carried out by BHEL. Required assistance will have to be provided by the vendor at the time of pre-shipment inspection.

b) Test certificates, Calibration certificates and warranty certificates as stipulated at the time of ordering shall be furnished.

c) Items shall be dispatched by Air/Road/Sea worthy packing. Any damage and later rejection, due to poor / improper packing shall be to supplier's account.

d) Any damage/rejection should be made good or replaced immediately without any extra cost to BHEL.

e) Wherever commissioning is involved, it shall be carried out by the vendor's qualified engineers. Scope of work includes installation, commissioning and start-up trials till satisfactory performance level is reached as certified by BHEL.

f) BHEL will not be responsible for any loss, damage or injuries to vendor's personnel sustained during installation / commissioning / start-up trials. Vendor shall ensure compliance with all statutory requisites as laid down by local bodies, state & Central Government.

g) Performance Bank Guarantee to be executed on Rs.100/- non-judicial stamp paper as per BHEL prescribed format as given as Annexure (c).

23. Any dispute arising out of this contract shall be referred to the sole arbitration of Head of Materials Management, Control Equipment, BHEL, EDN, Bangalore or any other officer nominated by him and his decision shall be final and binding on the parties. The venue of the arbitration in all cases shall be Bangalore.

24. All suits in respect of the above lie in the court of Jurisdiction of Bangalore (India) only.

25. Equipment shall comply with the standard requirements of ISO 14001 & OHSAS 18001.

26. **REGRET LETTER:** In case, the supplier is unable / not willing to quote (for BHEL's registered vendors), a letter of regret shall be sent.

27. **LOADING FACTORS:**

Loading factors as detailed below will be added to the quoted price (basic) to evaluate the lowest quote for non compliance of BHEL standard commercial terms.

A(i). For non compliance of standard Terms of payment (For Foreign Purchase Orders)

Sl. No.	BHEL standard term	If you quote	Loading factor in % for non-compliance
1	100% against "SIGHT DRAFT" on presentation of dispatch documents to our Bankers.	(a) 100% Through Letter of Credit (LC)	(a) 3.50 %
2	90% against "SIGHT DRAFT" + 10% against PBG (wherever PBG is involved)	(b) 90% Through Letter of Credit (LC)	(b) 2.25 %
3	75% against "SIGHT DRAFT" + 15% after commissioning + 10% against PBG (wherever commissioning & PBG is involved)	(c) 75% Through Letter of Credit (LC)	c) 1.875 %

A(ii). For non compliance of standard Terms of payment (For Indigenous Purchase Orders)

Sl. No.	BHEL standard term	If you quote	Loading factor in % for non-compliance
1	100% within 30 days from the date of receipt (credit payment)	Payment through bank	2 % x percentage quoted through bank
		Payment against proforma invoice	1.25 % x percentage quoted through proforma invoice
2	90% within 30 days from the date of receipt + 10% against PBG (wherever PBG is involved)	Payment through bank	2 % x percentage quoted through bank
		Payment against proforma invoice	1. 25 % x percentage quoted through proforma invoice
		100% within 30 days from the date of receipt & PBG	Nil

3	75% within 30 days from the date of receipt + 15% after commissioning + 10% against PBG (wherever commissioning & PBG is involved)	Payment through bank	2 % x percentage quoted through bank
		Payment against proforma invoice	1. 25 % x percentage quoted through proforma invoice
		100% within 30 days and after commissioning & PBG	Nil

B. *For non compliance of Penalty clause*:

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	Penalty of 0.5% per week subject to max. of 10% on the basic value of the items not supplied /delayed	Not agreed.	10 %
		5% max., agreed.	5%
		Other than the above.	10% - (minus) agreed max. %

C. For non compliance of Performance Bank Guarantee (PBG):

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	PBG for 10% of the basic material cost shall be furnished in the BHEL prescribed format.	Not agreed.	10 %
		5% agreed.	5 %
		Other than the above.	10% - (minus) agreed max. %

D. For Non conformance to delivery requirement indicated in the RFQ:

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	Delivery requirement as indicated in the RFQ in number of weeks from the date of issue of PO or from the document approval	Not agreed for the stipulated delivery in the enquiry	1 % per week up to max. of 10% for the difference in period

E. For non compliance of Warranty:

Sl. No.	BHEL standard term	If you quote	Loading factor for non-compliance
1	12 months from the date of dispatch or as indicated in the RFQ	Not agreed.	6%
		Less than 12 months or as indicated in the RFQ	0.5 % per month for the difference in period

ANNEXURE - A

TECHNICAL BID (TO BE ENCLOSED WITH TECHNO-COMMERCIAL BID)

(for Foreign Purchase Orders)

Sl. No.	Particulars	Bidder's confirmation
1	**Price basis:** Firm i.e., from the date of PO to completion of supply [Price Variation Clause (PVC) not acceptable]	Acceptable / Not acceptable
2	**Terms of Payment**: Against "SIGHT DRAFT" on presentation of documents to our bankers. (a) 90 % is payable on negotiation of complete set of original documents & balance 10% against submission of PBG (where commissioning is NOT involved). (b) 75 % is payable on negotiation of complete set of original documents, 15% after satisfactory commissioning & balance 10% against submission of PBG (wherever commissioning & PBG is involved). (c) Deviation if any please specify Note: Refer clause 12 above.	(a) Acceptable / Not acceptable (b) Acceptable / Not acceptable (c)
3	**BHEL's penalty clause:** (a) Delay in delivery as per PO delivery date will result in penalty of 0.5 % per week subject to maximum of 10% on the value of the items not supplier/delayed. (b) Deviation if any Please specify	(a) Acceptable / Not acceptable (b)
4	**Performance Bank guarantee**: PBG for 10% of the basic material cost shall be furnished in the BHEL prescribed format as detailed in clause 15.	Yes / No
5	**Terms of delivery:** (a) F.O.B international Airport/Seaport as per clause 17 Indicate name of International Airport/Seaport (b) Deviation if any Please specify	(a)Acceptable / Not acceptable (b)
6	**Warranty:** (a) 12 months from the date of dispatch (b) Deviation if any Please specify	(a)Acceptable / Not acceptable (b)
7	**Delivery period:** Indicate number of weeks from the date of issue of Purchase order	_____Weeks
8	**Validity:** (a) Quotation should remain valid for a period of 90 days from the due date (b) Deviation if any Please specify	(a) Acceptable / Not acceptable (b)

Signature of renderer / with seal

ANNEXURE - B

TECHNICAL BID (TO BE ENCLOSED WITH TECHNO-COMMERCIAL BID)

(For Indigenous Purchase Orders)

Sl. No.	Particulars	Bidder's confirmation
1	**Price basis:** Firm i.e., from the date of PO to completion of supply [Price Variation Clause (PVC) not acceptable]	Acceptable / Not acceptable
2	**Excise duty:** If applicable indicate %.	Applicable / Not applicable ED:_____%
3	**Sale tax:** If applicable indicate %	Applicable / Not applicable (a) VAT_____% (b) CST_____% against form C
4	**Payment terms:** (a) 90 % basic + 100% taxes, duties & freight charges within 30 days from the date of receipt & balance 10% against submission of PBG (where commissioning is NOT involved) (b) 75 % basic + 100% taxes, duties & freight charges within 30 days from the date of receipt, 15% after satisfactory commissioning & balance 10% against submission of PBG (wherever commissioning & PBG is involved). (c) Deviation if any please specify Note: As per clause 12	(a) Acceptable / Not acceptable (b) Acceptable / Not acceptable (c)
5	**BHEL's penalty clause:** (a) Delay in delivery as per PO delivery date will result in penalty of 0.5 % per week subject to maximum of 10% on the value of the items not supplier/delayed. (b) Deviation if any Please specify	(a) Acceptable / Not acceptable (b)
6	**Performance Bank guarantee (PBG):** PBG for 10% of the basic material cost shall be furnished in the BHEL prescribed format as per clause 15.	Yes / No
7	**Terms of delivery:** (a) Ex EDN / BHEL, Bangalore (Free delivery to EDN/BHEL Bangalore including packing & forwarding charges) (b) Deviation if any Please specify	(a)Acceptable / Not acceptable (b)
8	**Warranty:** (a) 18 months from the date of dispatch or 12 months from the date of commissioning (b) Deviation if any Please specify	(a)Acceptable / Not acceptable (b)
9	**Delivery period:** Indicate number of weeks from the date of issue of Purchase order	_____Weeks
10	**Validity:** (a) Quotation should remain valid for a period of 90 days from the due date (b) Deviation if any Please specify	(a) Acceptable / Not acceptable (b)

Signature of renderer / with stamp

ANNEXURE - C

LIST OF INTERNATIONAL AIRPORTS

Sl. No	Country	Air Ports
1	Austria	Vienna, Linz, Graz
2	Australia	Sydney, Melbourne, Perth
3	Belgium	Antwerp, Brussels
4	Canada	Toronto, Montreal
5	China	Shangai
6	Cyprus	Lamaca
7	Czech Republic	Prague (Via Frankfurt)
8	Denmark	Copenhagen
9	Egypt	Cairo
10	Finland	Helsinki
11	France	Paris (Rossy), Lyon
12	Germany	Darmstadt, Manihiem, Nurnberg, Hamburg, Stutttgart, Munich, Koln, Dusseldorf & Hannover, Frankfurt, Berlin
13	Hongkong	Hongkong
14	Italy	Rome, Milan, Turin, Bologna, Florence
15	Ireland	Dublin
16	Isrel	Telaviv
17	Japan	Tokyo, Osaka
18	Malaysia	Kaulalampur, Penang
19	Neatherlands	Amsterdam, Rotterdam
20	Newzealand	Auckland
21	Norway	Oslo
22	Oman	Muscat
23	Philiphines	Manila
24	Romania	Bucharest
25	Russia	Moscow
26	Saudi Arabia	Riyad
27	Singapore	Singapore
28	Slovakia	Bartislowa
29	South Africa	Johannesburg, Durban
30	South korea	Kimpo
31	Spain	Barcelona
32	Sweden	Stockholm, Gothenburg, Milano
33	Switzerland	Basle, Zurich, Geneva
34	Taiwan	Taipei
35	U.A.E.	Dubai
36	U.K.	Landon (Heathrow), Newcastle, Oxford, Cheltham, Bristol, Wellingborough, Birmingham, East Midland, Manchester,Leeds, Glasgow.
37	U.S.A.	Newyork, Chicago, Sanfrancisco, Los Angeles, Atlanta
38	Ukraine	Kiev

ANNEXURE-D

PERFORMANCE BANK GUARANTEE (FOR FOREIGN PURCHASE ORDERS)

BANK NAME AND ADDRESS

Bharat Heavy Electricals Limited (BHEL),
Electronics Division,
PB No. 2606,
Mysore Road,
BANGALORE- 560 026
INDIA

Dear Sir,

Ref: CONTRACT PERFORMANCE GUARANTEE.

WHEREAS you have entered into a contract reference No PO NO. _____ with M/s _____ having its registered office at_____for the supply of _____ as detailed in your purchase order No. _____ which is hereinafter referred to as "the said contract" and WHEREAS M/s _____ has undertaken to produce a Bank Guarantee for 10% (Ten Percent) of the contract price amounting to _____(_____ _____) to secure its obligations to Electronics Division, BHEL having its registered office at New Delhi for the performance of the contract including the warranty of the equipment supplied, We_____ Bank ,_____hereby expressly, irrevocably and unreservedly undertake and guarantee as principal obligors on behalf of M/s_____that in the event Bharat Heavy Electricals Ltd. (B.H.E.L.) declares to us in writing that M/s_____ has not fulfilled any obligation according to the contractual obligation of the said contract, to pay you on demand and without demur to Bharat Heavy Electricals Ltd., Electronics Division , Mysore Road, P.B.No. 2606, Bangalore-560 026, India an amount of _____(in words _____) subject to as may be determined below:

1) Notwithstanding any right M/s. _____ may have directly against you or any disputes raised by M/s _____, Your written demand shall be conclusive evidence to us that repayment is due under the terms of the said contract and shall be binding on us.

2) We shall not be discharged or released from this undertaking and Guarantee by any arrangements, variations made between you and M/s. _____ with or without our consent and Knowledge or by any alterations in the obligations of M/s. _____ by any forbearance whether as to payment, time, performance or otherwise.

3) This guarantee shall remain valid until the end of twenty-four weeks after the close of the warranty period or until the same is reported by BHEL to us whichever is earlier.

4) We agree and undertake not to revoke this guarantee during its validity unless discharged in writing by you subject to the provision of clause (7) below.

5) This guarantee shall be a continuing guarantee subject to the foregoing and shall not be discharged by any change in the constitution of the Bank or M/s. _____.

6) This guarantee shall be governed by and constructed in accordance with the Laws of India.

7) At any time _____ Bank may render this guarantee null and void by paying to Bharat Heavy Electricals Ltd. the full amount being _____ (in words _____)

For and on behalf of Bank
by its Authorised Signatory

Note:

(1) To be executed in INR 100 Non-Judicial stamp paper by any authorized Indian Bank.

(2) To be submitted directly by banker to concerned executive in purchase dept., Please give BHEL address to banker.

(3) Do not enclose with Bank document.

(4) Any Modification & omissions to this are not permitted

ANNEXURE - E

PERFORMANCE BANK GUARANTEE
(FOR INDEGENOUS PURCHASE ORDERS)

THIS DEED OF GUARANTEE made and executed on the _____ day of _____(year), by the _____ (Bank), registered under the Companies Act 1956/Nationalised Bank constituted under the Banking Companies (acquisition and transfer of undertakings) Act constituted under the State Bank of India Act / Subsidiary Banks Act, having its registered / head office at _____ represented herein by its Branch Manager / authorised representative Sri. _____ & Sri._____(Hereinafter called 'guarantor ' which term shall mean and include its successors and assigns)

IN FAVOUR OF BHARAT HEAVY ELECTRICALS LIMITED

_____ (Buyer's Name), a company registered under the companies Act, 1956 having its registered office at BHEL House at Siri Fort , New Delhi-100 049 and its Electronics Division at Mysore road, Bangalore-26 (hereinafter referred to as the 'Company' Which term shall include its successors and assigns):

Whereas the company has placed an order on _____ (State the name of the company / firm and its address) (hereinafter referred to as the 'Supplier' which term shall mean and include its liquidators, successors and assign) for the supply of system under order / Contract No_____Dt _____.

AND WHEREAS the supplier has agreed to supply the materials and carryout the works as detailed and in accordance with the terms set out in the said order/contract.

AND WHEREAS the company is not required to pay to the supplier a sum of Rupees _____being the 10% of the value of the goods supplied / Works performed / Services rendered under the said order / contract between the supplier and the company, till the company is satisfied with the mechanical Warranties and the performance standards stipulated in the said order / contract between the company and the supplier has been duly fulfilled, except against a Bank Guarantee for the said sum of Rs_____ in favour of the company by reputed Bank, in which case the company has agreed to make payment to the supplier of the said sum of Rupees _____ being (…%) of the value of the goods supplied / Works performed / Services rendered under the agreement between the supplier and the company and the Guarantor has at the request of the supplier, agreed to furnish this Guarantee subject to the terms and conditions stated below:

NOW THIS DEED WITNESSES THAT IN pursuance of the above said agreement, the guarantor hereby agrees and covenants With company is as follows :-

1) That during the period this contract of Guarantee remains effectual, the guarantor shall be liable in respect of the amount due and owing to the company in respect of the payments to the extent of Rs _____ (in words) _____ against any loss or damage caused to or suffered by the company by reasons of any breach of the terms of the said order / contract / Agreement by the supplier.

2) The Guarantor hereby undertakes to pay the amounts due and payable under this guarantee without any demur, merely on demand from the company intimating that the amount claimed is due by way of loss or damage caused to or suffered or would be caused or suffered by the supplier of any terms contained in the said order / contract. Any such demand made on the

guarantor shall be conclusive as regards the amount due and payable by the Guarantor irrespective of the fact whether the Contractor / supplier admits or denies.

3) The Guarantor further agrees that the agreement herein contained shall remain in force and effect till all the supplies to be made / Works to be performed / Services to be rendered under the said order / contract / agreement are completed to the entire satisfaction of the company or till company certifies that the terms and conditions of the said order / contract / agreement have been fully and properly carried out by the said supplier and accordingly discharges the Guarantee. Unless a demand or claim under this guarantee is made on the guarantor in writing on or before the expiry of claim period indicated in clause 6 below , the guarantor shall be discharged from all the liability under this guarantee thereafter.

4) The guarantor further agrees with the company that the company shall have the fullest liberty without the consent of the guarantor and without effecting in any manner the obligations of the guarantor hereunder to vary any of the terms of the said order / contract / agreement or extend the time of performance by the said supplier from time to time or refrain from exercising the power exercisable by the company against the said supplier or to forebear or omit to enforce any of the terms and conditions relating to the said order / contract / agreement, and the guarantor shall not be relieved of its liability in whole or in part , by reason of any act, commission or forbearance on the part of the company or by reason of any such variation, or extension being granted to the said supplier or by reason of any such matter or thing whatsoever which under the law relating to sureties would but for this provision have effect of so relieving the guarantor.

5) The guarantor undertakes not to revoke this guarantee during its currency except with the previous consent of the company in writing.

6) Notwithstanding anything herein above contained, the liability of the guarantor under these presents is restricted to Rs_____. The guarantee shall be in force till its expiry on _____ unless a demand is made on the guarantor within SIX months from the date of expiry, all the liability of the guarantor under this guarantee shall stand fully discharged. The decision of the claimant in regard to breach of contract is final and binding on the Bank.

IN WITNESS whereof, the guarantor, acting through it authorised representative has executed this deed of Guarantee on the day, month and year first above written.

(Seal of the Bank to be affixed)

WITNESS

1.

2.

ANNEXURE - F

BHEL MEMBER BANKS

PBG SHALL BE ISSUED FROM THE FOLLOWING BANKS OR THEIR BRANCH OFFICES ONLY

State Bank of India, CAG Branch 10th Floor, Vijaya Building Barakamba Road, NEW DELHI - 110 001	Deutsche Bank, Tolstoy Marg, NEW DELHI - 110 001
Canara Bank, 74, Janpath, NEW DELHI - 110 001	HDFC Bank Ltd, 5TH floor, H T House, K G Marg, , NEW DELHI - 110 001
Punjab National Bank, 74 Janpath, NEW DELHI - 110 001	CITI Bank NA, Jeevan Vihar Building, Sansad Marg NEW DELHI - 110 001
Bank of Baroda, Corporation Banking Branch, 11th Floor, BOB Building, Sansad Marg, NEW DELHI - 110 001	Standard Chartered Bank, H2, Block Connaught Place NEW DELHI - 110 001
State Bank of Hyderabad, Surya Kiran Building, K G Marg, NEW DELHI - 110 001	ICICI Bank Ltd, ICICI Tower, Bisham Pitamah Marg, Pragati Vihar, NEW DELHI - 110 003
State \Bank of Mysore, Antrikash Bhawan, K G Marg, NEW DELHI - 110 001	IDBI Bank Ltd, 19 K G Marg, Surya Kiran Building, NEW DELHI - 110 001
State Bank of Mysore, Industrial Finance Branch, 18, Ramanashree Arcade,, M G Road, BANGALORE 0 560 001	HSBC Ltd, ECE House, 28K G Marg, NEW DELHI - 110 001
State Bank of Travancore, Travancore House, IF Branch, NEW DELHI - 110 001	

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