



**NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA-769008
(ODISHA)**

An Institute of National Importance under Ministry of HRD, GOI

NOTICE INVITING TENDER

Tender Notification No: NITRKL/SRIC/EE-FIST/2016/M/04 Dated: 29.03.2016

Sealed bids from eligible bidders are invited for the supply of (1) Multilevel Inverter for Induction Motor Drive, (2) Configurable Matrix Converter for Induction Motor Drive

Last date of Submission of Bid: 28.04.2016 by 5.00 PM

Opening date of Bid: 29.04.2016 at 5.00 PM

Details: http://www.nitrkl.ac.in/Jobs_Tenders/9Equipment/Default.aspx

Contact : (i) **Prof. Anup Kumar Panda, Professor, Department of Electrical Engineering**, Ph: 0661-2462407; Email: akpanda@nitrkl.ac.in

REGISTRAR



National Institute of Technology, Rourkela, Odisha (India)
Department of Electrical Engineering

Tender Notification No.: **NITRKL/SRIC/EE-FIST/2016/M/04**

Date: 29.03.2016

Name of the Equipment: (1) Multilevel Inverter for Induction Motor Drive
(2) Configurable Matrix Converter for Induction Motor Drive

Quantity required: One Set Each

EMD Amount: Rs.50,000/-

Delivery: Within 03 months from the date of order

Last Date of submission of Tender: 28.04.2016 by 5.00 PM

Date of opening of bid: 29.04.2016 at 5.00 PM

Address for submission of Tender: The Director, National Institute of Technology

Rourkela- 769008, Odisha, India

With Kind Attention to: Prof. Anup Kumar Panda, Department of Electrical Engineering



National Institute of Technology, Rourkela, Odisha-769008
Department of Electrical Engineering

Tender Notification No.:NITRKL/SRIC/EE-FIST/2016/M/04

Dated: 29.03.2016

NOTICE INVITING TENDER

The National Institute of Technology, Rourkela (NITR) is an autonomous body under MHRD, GOI, imparting Technical Education and engaged in Research Activities. It is proposed to procure the following equipment for the departmental academic research activities.

Sealed Quotations under two cover systems are invited for the following equipment subject to the following terms and conditions from the reputed manufacturers or their authorized dealers so as to reach this office on or before scheduled date and time. The technical cover will be opened on the next day in the presence of bidders or their authorized agents who may choose to be present.

Name of the Equipment:(1) Multilevel Inverter for Induction Motor Drive

(2) Configurable Matrix Converter for Induction Motor Drive

Quantity required: One set Each

EMD Amount: Rs.50,000/-

Delivery: Within 03 months from the date of order

Performance Security to be given by: BG upto 1 year (Successful bidder after release of purchase order (Rs.50,000, (Rupees Fifty thousand only))

Warranty:One years of comprehensive warranty from the date of installation, commissioning and acceptance by NITR.

Last Date of submission of Tender:*As mentioned above*

Address for submission of Tender: The Director, National Institute of Technology, Rourkela, Odisha, 769 008, With Kind Attention to: Prof.Anup Kumar Panda, Department of Electrical Engineering

Place, Date and time of opening of bid: Department of Electrical Engineering, 29.04.2016

Note: *The Institute shall not be responsible for any postal delay about non-receipt/ non delivery of the bids or due to wrong addressee.*

Section 1: Instruction to Bidders

Bids should be divided into two parts:

1. **Cover 1:** The cover 1 shall be superscribed as "Technical Bid" duly indicating the Tender reference No. and the due date of opening.
Cover 1 should contain the following:
 - a. EMD by Demand Draft drawn on any scheduled bank in favour of "The Director, NIT, Rourkela" payable at Rourkela should be submitted. EMD shall bear no interest. Any bid not accompanying with EMD is liable to be treated as non-responsive and rejected.
 - b. Technical pamphlets.
 - c. Detailed technical specifications.
 - d. The agency should furnish Income Tax PAN number.
 - e. Warranty period offered for the tendered item to be specified. If the warranty period is not conforming with the schedule of requirements given in the bid document, the bid is liable to be treated as non-responsive and rejected.
 - f. Duly filled up technical questionnaire, if any.
 - g. Duly filled up deviation schedules to technical specification.
 - h. If the prices are revealed in the cover 1, the offer will be summarily rejected.
 - i. Commitment for quick service in case of any break down.
 - j. List of spares and consumables to be supplied.

2. **Cover 2:** Cover 2 shall contain Price only and shall be superscribed as "Price Bid" duly indicating the Tender Reference No. and the due date of opening.

Each Cover shall be sent in a double sealed cover. The inner covers (Cover 1 and Cover 2) should be sealed individually with the seller's distinctive seal and superscribed with the tender reference no. and due date of opening. Both the inner covers shall be placed in a common outer cover which shall also be sealed with seller's distinctive seal and superscribed with the tender reference no. and due date of opening. *Mention "Kind Attention: Prof. Anup Kumar Panda, Department of Electrical Engineering", and submit at the address given in the Notice Inviting Tender.*

1. Cover 1 will be opened on the scheduled date and time mentioned in the tender enquiry. Cover 2 of the technically and commercially qualified bidders alone will be opened on a date which will be intimated later to those bidders only.
2. The agencies should submit their rate as per the format given in Section 3 of the Notice Inviting Tender in this cover. **Rate should be quoted Indian Rupee. The rate should be quoted both in words and figures.** All the pages of the bid should be signed affixing the seal. All corrections and overwriting should be initialled.
3. The tender will be acceptable only from the manufacturers or its authorized supplier.

4. The bid shall be in the format of price schedule given in Section 3. The contract form as per format given in section 4 shall be submitted. Incomplete or conditional tender will be rejected.
5. Details of quantity and the specifications are mentioned in technical specifications appended to this Tender.
6. The item to be used is strictly according to the specification and subject to test by the Institute/concerned authorities. It must be delivered and installed in good working condition.
7. The Institute reserves the right to cancel or reduce the quantity included in the schedule of requirements at any time after acceptance of the tender with a notice. The Contractor/Supplier shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the work/supply in full but he did not derive in consequence of the foreclosure of the whole or part of the works.
8. Performance Security of Rs.50,000/- (Fifty Thousand only) of the contract value in terms of Bank guarantee of any scheduled banks shall be given by the successful bidder for the total period up to three months beyond the warranty period.
9. Release of EMD: The EMD shall be released after receipt of performance security from successful bidder.
10. Validity of bids: The rate quote should be valid for a minimum of 90 days. No claim for escalation of rate will be considered after opening the Tender.
11. Imports: In case, goods are to be imported, the Indian agent should furnish authorization certificate by the principles abroad for submission of the bid in response to this Notice Inviting Tender.
12. Clarification of Tender Document: A prospective bidder requiring any clarification of the Tender document may communicate to the contact person given in this notice inviting tender.
13. **Amendment of tender document:** At any time prior to the last date of receipt of bids, Institute may for any reason, whether at its own initiative or in response to a clarification requested by prospective bidder, modify the Tender document by an amendment.
14. L. D. of the institute (Back side of POs)
15. This institute is liable to pay Customs Duty in concessional rate under Notification No. **39/96 dated 23rd Jul 1996 & Amended by 60/96 dt 22nd Aug 1996** and exempted of Excise Duty under Notification No. **10/97 Central Excise dated 01 Mar 1997**. However, prices should be quoted indicating clearly customs/Excise Duties. If agreed, the necessary exemptions certificate may be provided.
16. **The Institute may at its own discretion extend the last date for the receipt of bids.**
17. The bids shall be written in English language and any information printed in other language shall be accompanied by an English translation, in which case for the purpose of interpretation of the bid, the English translation shall govern.
18. The Institute reserves the right of accepting any bid other than the lowest or even rejecting all the bids without assigning any reasons therefore. The decision of the Director is final in all matters of tender and purchase.
19. The bidder should give the following declaration while submitting the Tender.
20. Any other details required may be obtained from the contact person given in the notice inviting tender during the office hours.

DECLARATION

I/we have not tampered/modified the tender forms in any manner. In case, if the same is found to be tampered/modified, I/we understand that my/our tender will be summarily rejected and full Earnest Money Deposit (EMD) will be forfeited and I/we am/are liable to be banned from doing business with NIT, Rourkela and/or prosecuted.

Signature of the Bidder:

Name and Designation:

Business Address:

Seal of the Bidder's Firm

SECTION 2: CONDITIONS OF CONTRACT

1. The rates should be quoted in Indian Rupee FOR NIT, Rourkela for supply within India.
2. In case of import CIF rate should be quoted in foreign currency.
3. The Institute is eligible for excise duty exemption and concession customs duty.
4. The rate quoted should be on unit basis. Taxes and other charges should be quoted separately, considering exemptions if any.
5. Rate quoted should be inclusive of Testing, commissioning and installation of equipment and training. In this bid the equipment should be shown categorically.
6. Payment: No advance payment will be made. Payment will be made only after the supply of the item in good and satisfactory condition and receipt of performance security (if applicable) by the supplier. In case of imports, the payment will be made through LC and performance security need to be submitted before LC commitment (if applicable).
7. Guarantee and Warrantee period should be specified for the complete period mentioned in this tender document.
8. Period required for the supply and installation of item should be mentioned in this tender document.
9. In case of dispute, the matter will be subject to Rourkela, Orissa Jurisdiction only.

SECTION 3: PRICE SCHEDULE
[To be used by the bidder for submission of the bid]

1. Equipment Name:
2. Specifications (confirming to Section: 5 of Tender document – enclose additional sheets, if necessary)
3. Currency and Unit Price:
4. Quantity:
5. Item cost (Sl.No.3 &Sl.No.4) :
6. Taxes and other charges:
 - (i) Specify the type of taxes and duties in percentages and also in figures:
 - (ii) Specify other charges in figures:
7. Warranty period should be mentioned in Technical and Financial bid:
8. Delivery Schedule:
9. Name and address of the firm for placing purchase order :
10. Name and address of Indian authorized agent (in case of imports only) :

Signature of the Bidder:

Name and Designation:.....

Business Address:

Place:

Date:

Seal of the Bidder's Firm

SECTION 4: CONTRACT FORM

[To be provided by the bidder in the business letter head]

1. (Name of the Supplier) hereby abide to deliver the by the delivery schedule mentioned in the tender document for supply of the items if the purchase order is awarded.
2. The item will be supplied conforming to the specifications stated in the tender document without any defect and deviations.
3. Warranty will be given for the period mentioned in the tender document and service will be rendered to the satisfaction of NIT, Rourkela during this period.

Signature of the Bidder:

Name and Designation:

Business Address:

Place:

Date:

Seal of the Bidder's Firm

SECTION: 5 DETAILED TECHNICAL SPECIFICATIONS

(1)Multilevel Inverter for Induction Motor Drive

It consists of the following Items

a) Five phase 9 level cascaded H-bridge inverter power module	-1
b)FPGA SPARTAN6 controller	-1
c) 1HP 5-phase AC induction motor coupled with 1HP DC shunt generator load setup	-1
d)1HP 3-phase AC induction motor coupled with 1HP DC shunt generator load setup	-1
e)1kVA Isolation Transformer	-20

Detailed Specifications:

9 level cascaded H-bridge inverter power module with provision to Drive both 3-phase and 5-phase Induction Motor:

- ❖ 80 no's of IGBT rating @1200v,15A used to form 5phase 9level cascaded h-bridge Inverter power circuit ,
- ❖ All IGBT are mounted on proper heat sink.Each H-bridge consist of 4 IGBTs with Antiparallel diodes totally 20 H-bridges used to form 5phase 9level Inverter power module.
- ❖ Snubber capacitor provided for each H-bridge for dv/dt protection.
- ❖ 80nos of TLP250 Ic based driver circuits used to isolate and Drive IGBT PWM signals.
- ❖ 60nos of Isolated Regulated power supply rating @+15v/0.5A Used for IGBT PWM driver circuits.
- ❖ 20nos of current sensor used to sense the dc link current of 20H-bidge Inverters. All sensor o/ps used for current protection and terminated in front panel for measurement purpose.
- ❖ 5nos of CT used to sense the 5phase load currents. Sensor o/ps used for over load Trip and terminated in front panel for measurement purpose.
- ❖ Necessary Interfacing connectors provided for PWM Input from FPGA controller and analog o/ps To FPGA controller.
- ❖ All 80 PWM signals terminated in front panel through BS2 connector.User can view the PWM pulses through CRO.User can give PWM signals from external controller (5 V amplitude) through this connector.
- ❖ All 20 H-bridge Inverter I/Ps and O/ps terminated in Front panel through ST12 connector. So user can view all inverter i/ps and o/ps through cro.
- ❖ Over load trip and indication circuit is available.
- ❖ Over load fuse protection also provided.
- ❖ 20nos of 1kva single phase isolation transformer and 1ph, 35A diode bridge rectifier is used to provide the isolated DC supply to each H-bridge Inverter.

- ❖ The mentioned above all equipment covered with a Nice industrial type cabinet and Front panel covered with Power circuit diagram sticker.

- Each Inverter Dc Link volt-----300 V dc max
- Each Inverter o/p voltage -----0-200 Vacrms
- Each inverter o/p current-----5A max
- Overall 9 level inverter rating suitable for 1hp 5-ph and 3-ph ac Induction motor.

FPGA spartan6 controller:

*SPARTAN6 Development Board

[Model: SP6_LX9 Rev-1.0]

On-Board Features:

- ✓ Processor speed 20 MHZ
- ✓ 100 output lines / inputs lines are in 3.3/5V level
- ✓ Isolated serial communication interface through USB connector
- ✓ 4MB PROM for code execution memory.
- ✓ External JTAG header for programming
- ✓ 20x4 (or 16x2) LCD interface header.
- ✓ 8 user LEDs/4 position user DIP switch
- ✓ 2 up & down input push switch
- ✓ Up to 100 Individually Programmable GPIO Pins
- ✓ ADC

No of ADC input : 8 Channels

- Resolution : 12 bit
- Sampling rate : 1MSPS
- Analog input range : $\pm 10V$
- Buffer section for voltage protection

▪ DAC

- No of DAC output : 4 Channels
- Resolution : 12 bit
- Settling time : $6\mu s$
- Analog input range : -5v to +5V

▪ Connectors

- 16 pin header for ADC input
- 16 pin header for PWM OUTPUT
- 2 no's of 50 pin headers for GPIO line termination
- External Programming header

- Total 100PWM signals can be generated.

1HP 5PHASE AC INDUCTION MOTOR COUPLED WITH 1HP DC SHUNT GENERATOR LOAD SETUP:

- ❖ POWER RATING 1.0 HP
- ❖ VOLTAGE-200 V phase to phase rms
- ❖ SPEED-1400 RPM
- ❖ FREQUENCY-50 Hz.
- ❖ Star connected
- ❖ Foot Mounted

DC GENERATOR SPECIFICATIONS:

- ❖ **Power** -1hp Shunt type
- ❖ **Armature voltage** -180V DC, 5Amp
- ❖ **Field voltage** -220V DC,0.3Amp
- ❖ **Speed** -1500 rpm
- ❖ **Make** -BENN

- ✓ **1No of field Power Supply box will be provided.**
- ✓ **Both motor and generator are coupled with Common base plate.**
- 1no of proximity sensor will be provided to sense the speed
- 1no proximity sensor interface card also will be provided.

3-PH 1HP AC INDUCTION MOTOR COUPLED WITH 1HP DC SHUNT GENERATOR LOAD SETUP:

- **Power Rating** -1hp
- **Voltage** -415 V Star connection
- **Current** -1.8A
- **Speed** -1415rpm
- **Pole** -4pole

DC GENERATOR SPECIFICATIONS:

- **Power** -1hp Shunt type
- **Armature voltage** -180V DC, 5Amp
- **Field voltage** -220V DC, 0.3Amp
- **Speed** -1500 rpm
- **Make** -BENN

- *1No of field Power Supply box will be provided.
- *1no of proximity sensor will be provided to sense the speed
- *1no proximity sensor interface card also will be provided

Important Features

*User can perform 3-ph and 5-ph 5 level, 7 level, and 9 level inverter operation by varying modulation index and separate programs also will be provided to perform 5 level,7 level and 9 level operations.

- ✓ Various modulation techniques like PS, PD, POD FPGA programs will be provided.

- ✓ 5-ph induction motor speed control program also will be provided.
- ✓ 3-ph induction motor speed control program also will be provided.

LIST OF EXPERIMENTS

FPGA BASED FIVE PHASE 9-LEVEL CASCADED H-BRIDGE INVERTER BASED 5-PH AND 3-PH INDUCTION MOTOR DRIVE

- **Study of 3-ph 3 level ,5 level,7 level and 9 level Inverter operation using R and RL load**
 - Study of 5-ph 3 level ,5 level,7 level and 9 level Inverter operation using R and RL load
 - **Study of 3ph induction motor speed control (V/F) using 3 level, 5 level, 7 level and 9 level inverter.**
 - Study of 5-ph induction motor speed control (V/F) using 3 level, 5 level, 7 level and 9 level inverter.
 - **Study of Inverter Voltage THD comparison with various PWM techniques like PS, POD, PD and APOD**
 - Study of Inverter Voltage THD Comparison between Symmetrical and asymmetrical H-bridge Configuration.
-

Research Possible with this Set up:

- ❖ This setup can be used for motor control, STATCOM and DSTATCOM purpose.
- ❖ **User can use this module as a Grid connected inverter by using proper control technique they can control Active and reactive power to the Grid.**
- ❖ User can develop SVPWM technique for 5-phase AC motor.
- ❖ **User can do Research work on Vector and Direct torque Control for 5-ph Induction motor.**

(2)Configurable Matrix Converter for Induction Motor Drive

It consists of the following Items:

- a) 3-Phase to 9 phase Matrix converter power module-----1
- b) FPGA SPARTAN6 controller-----1
- c)1hp 5-phase Ac induction motor coupled with 1hp dc shunt generator load setup-----1
- d) 0.5 hp 3-phase AC induction motor coupled with 1hp dc shunt generator load setup-----1

Detailed Specifications

3-PHASE TO 9-PHASE CONFIGRABLE MATRIX CONVERTER POWER MODULE:

*27 Nos of Bidirectional IGBT Rating @1200v/15A with proper heatsink used to form the 3-phase to 9- phase matrix converter power circuit. Each bidirectional Device consists of two IGBTs with antiparallel diodes.

* Snubber capacitor provided for each IGBTs for dv/dt protection

*54 nos of TLP250 IC based driver circuits used to Isolate and Drive IGBT PWM signals.

*27 nos of Isolated Regulated power supply rating @+15v/0.5A Used for IGBT PWM driver circuits.

*3phase ZCD circuits used to generate the synchronized PWM signals. ZCD o/ps terminated in front panel user can view the signals using CRO.

*3phase LC filter provided to remove harmonics present in the source side while switching.

*3nos of current sensor used to sense the source current and sensor o/ps used to protect module from over current and sensor o/ps terminated on front panel. User can view the signals using CRO.

*9 nos of current sensor used to sense the 9-phase o/p currents. Sensor o/ps terminated on front panel and used to protect the module from over current.

*OPAMP based signal conditioning circuit used for all 12 current sensors.

*Over load indication using led and manual reset switch provided.

*All 54 PWM signals terminated in front panel using BS2 connector. User can see pump pulses using CRO.

*3phase I/p and 9phase o/ps are terminated on front panel using ST12 connector.

3-Phase synchronization circuit:

*3 nos of 230 V/9 V transformer used to sense the mains voltage.

*3 nos of OPAMP based buffer and ZCD circuit used to generate the synchronized square pulse.

*+15v and +5v power supply provided for the operation of the above circuit.

3-Phase Line Filter:

*3 nos of inductors with 5 A rating will be provided.

*3 nos of capacitors 12.5 microfarad/440 V will be provided

*1no of 3Phase 1 kVA 230/110 V isolation transformer will be provided.

*The mentioned all equipment covered by nice industrial type cabinet. Front panel covered by matrix converter power circuit diagram.

*Necessary connecting Patch chords will be provided

*1no PC power chord will be provided

Ratings of power module:

*Input voltage-----3-phase,220 V rms,50hz

*Output power-----Variable volt & frequency suitable to run 1hp,5 phase ac induction motor and 3-phase induction motor.

FPGA SPARTAN6 CONTROLLER:

***SPARTAN6 Development Board**

[Model: SP6_LX9 Rev-1.0]

On-Board Features:

- Processor speed 20 MHZ
- 100 output lines / inputs lines are in 3.3/5V level
- Isolated serial communication interface through USB connector
- 4MB PROM for code execution memory.
- External JTAG header for programming
- 20x4 (or 16x2) LCD interface header.
- 8 user LEDs/4 position user DIP switch
- 2 up & down input push switch
- Up to 100 Individually Programmable GPIO Pins
- ADC
 - No of ADC input : 8 Channels
 - Resolution : 12 bit
 - Sampling rate : 1MSPS
 - Analog input range : $\pm 10V$
 - Buffer section for voltage protection
- DAC
 - No of DAC output : 4 Channels
 - Resolution : 12 bit
 - Settling time : $6\mu s$
 - Analog input range : -5v to +5V
- Connectors
 - 16 pin header for ADC input
 - 16 pin header for PWM OUTPUT
 - 2 no's of 50 pin headers for GPIO line termination
 - External Programming header
 - Total 100PWM signals can be generated.

1HP 5-PHASE AC INDUCTION MOTOR COUPLED WITH 1HP DC SHUNT GENERATOR SETUP:

- *POWER RATING----- 1.0 HP
- *VOLTAGE----- 200 V phase to phase rms
- SPEED----- 1400 RPM
- FREQUENCY----- 50 Hz.
- * Star connected
- * Foot Mounted

DC GENERATOR SPECIFICATIONS :

- *Power -----1hp Shunt type
- *Armature voltage-----180VDC,5Amp
- *Field voltage----- 220VDC,0.3Amp
- *Speed-----1500 rpm
- *Make-----BENN
- *1No of field Power Supply box will be provided.
- *1no of proximatey sensor will be provided to sense the speed
- *1no proximatey sensor interface card also will be provided.

3 PHASE INDUCTION MOTOR COUPLED WITH 1HP DC SHUNT GENERATOR LOAD SETUP :

AC MOTOR SPECIFICATIONS:

- *PowerRating-----0.5hp
- *Voltage-----200 V
- *current-----1A
- *Speed-----1415rpm
- *Pole-----4pole

DC SHUNT GENERATOR SPECIFICATIONS:

- *Power -----1hp Shunt type
- *Armature voltage-----180VDC,5Amp
- *Field voltage----- 220VDC,0.3Amp
- *Speed-----1500 rpm
- *Make-----BENN
- *1No of field Power Supply box will be provided.
- *1no of proximatey sensor will be provided to sense the speed

*1no proximatey sensor interface card also will be provided

9-PHASE RESISTIVE LOAD:

*1no 1kW 9-phase resistive Load with variable selector switch will be provided.

9 PHASE INDUCTIVE LOAD:

*1no 9-phase variable inductive load will be provided.

Important Features`

*3-phase to 3-phase,3-phase to 5-phase and 3-phase to 9-phase FPGA programs will be provided.

*5-phase induction motor speed control program also will be provided.

*3-phase induction motor speed control program also will be provided.

*VB based front end software will be provided to plot the reference and actual speed of the motor.

*VenturniePWM scheme program will be provided for 3-phase to 1-phase, 2-phase,3-phase upto....9-phase matrix converter.

*Indirect Space Vector PWM technic program will be provided for 3-phase to 3phase matrix converter.