

**National Institute of Technology, Raipur**  
**INVITATION LETTER**

**Package Code: TEQIP-III/nitr/35**  
**Package Name: GIII-06**

**Current Date: 15-Apr-2019**  
**Method: Shopping Goods**

To,

**Sub: INVITATION LETTER FOR GIII-06**

Dear Sir,

1. You are invited to submit your most competitive quotation for the following goods with item wise detailed specifications given at Annexure I,

<b>Sr. No</b>	<b>Item Name</b>	<b>Quantity</b>	<b>Place of Delivery</b>	<b>Installation Requirement (if any)</b>
1	Induction Melting system with casting	1	NIT Raipur	Yes

2. Government of India has received a credit from the International Development Association (IDA) towards the cost of the **Technical Education Quality Improvement Programme [TEQIP]-Phase III** Project and intends to apply part of the proceeds of this credit to eligible payments under the contract for which this invitation for quotations is issued.

**3. Quotation**

- 3.1 The contract shall be for the full quantity as described above.
  - 3.2 Corrections, if any, shall be made by crossing out, initialling, dating and re writing.
  - 3.3 All duties and other levies payable by the supplier under the contract shall be included in the unit Price.
  - 3.4 Applicable taxes shall be quoted separately for all items.
  - 3.5 The prices quoted by the bidder shall be fixed for the duration of the contract and shall not be subject to adjustment on any account.
  - 3.6 The Prices should be quoted in Indian Rupees only.
4. Each bidder shall submit only one quotation.
  5. Quotation shall remain valid for a period not less than **55** days after the last date of quotation submission.

6. Evaluation of Quotations: The Purchaser will evaluate and compare the quotations determined to be Substantially responsive i.e. which
  - 6.1 are properly signed; and
  - 6.2 Confirm to the terms and conditions, and specifications
  - 6.3 The Tenderer / Bidder need to submit the following certificates along with the quotation to
    - \* Confirm their eligibility:
    - \* Proof of establishment of Firms/shop/business/manufacturing unit etc. and Dealership certificate from the principals etc.
    - \* GST certificate should be enclosed
    - \*Previous Purchase order copy
- 7 As per government notification No.45/2017-Central Tax (rate), dated 14 Nov 2017, NIT Raipur is eligible to get concessional GST rate of 5% on purchase of equipment mentioned in Notification used for research purpose only. In this regard NIT Raipur will be providing following mentioned documents for concession :
  - a. DSIR Certificate Copy;
  - b. Certificate to supplier for purpose of GST Concession (on the Institute's Letter Head).
8. The Quotations would be evaluated for all items together.
9. Award of contract The Purchaser will award the contract to the bidder whose quotation has been determined to be substantially responsive and who has offered the lowest evaluated quotation price.
  - 9.1 Notwithstanding the above, the Purchaser reserves the right to accept or reject any quotations and to cancel the bidding process and reject all quotations at any time prior to the award of Contract.
  - 9.2 The bidder whose bid is accepted will be notified of the award of contract by the Purchaser prior to expiration of the quotation validity period. The terms of the accepted offer shall be Incorporated in the purchase order.
- 10 Payment shall be made in Indian Rupees as follows:

**Satisfactory Delivery & Installation – 0% of total cost**  
**Satisfactory Acceptance - 100% of total cost**
- 11 Liquidated Damages will be applied as per the below:

-Maximum one month extension in delivery period may be given on the receipt of written request of the successful vendor; however liquidated damage at the rate of 5% per month or part thereof will be recovered from the firm of the value of undelivered goods. Request for extension in delivery period should be made before the last date of supply as mentioned in purchase order.
11. All supplied items are under warranty of **36** months from the date of successful acceptance of items and AMC/Others is **N.A.**
12. You are requested to provide your offer latest by **15:00** hours on **30-May-2019**.
13. Detailed specifications of the items are at Annexure I.

14. Training Clause (if any) **Yes**
15. Testing/Installation Clause (if any) **Yes**
16. Performance Security shall be applicable  
Performance Security (PS):The successful bidder has to furnish “Performance Security of 10% of the ordered value in Indian Rupee”, in the form of Account Payee Demand Draft, / Fixes deposit and/or unconditional Bank guarantee encashable on demand from the Director, NIT, Raipur, from a nationalized Bank with validity period of sixty (60)days beyond the date of completion of all contractual obligations of supplier including guarantee/ warranty obligations. The Performance Security is to be furnished in favor of the Director, National Institute of Technology, Raipur, within ten days of intimation, failing which his bid security will be forfeited. The performance security will be discharged by the Purchaser and returned to the Supplier not later than 60 days following the date of completion of the Supplier's performance obligations, including any warranty obligations.
17. Information brochures/ Product catalogue, if any must be accompanied with the quotation clearly indicating the model quoted for.
18. Sealed quotation to be submitted/ delivered at the address mentioned below,  
Registrar  
**National Institute of Technology, Raipur,**  
**G E Road, Raipur 492010**
19. We look forward to receiving your quotation and thank you for your interest in this project.

Registrar  
NIT Raipur

**Annexure I**

<b>Sr. No</b>	<b>Item Name</b>	<b>Specifications</b>
1	Induction Melting system with casting	<p><b>Specifications for the Induction Melting and Casting Unit (vacuum): 500 Grams Capacity</b></p> <p>The vacuum Induction melting and casting unit should be designed and fabricated as per the specifications below. The system should consists of the main units including:</p> <ol style="list-style-type: none"><li>1) Double Walled water cooled SS cylindrical chamber of ID 600 mm and 700mm long which should acts as furnace chamber.</li><li>2) Induction melting and casting power supply of medium frequency with induction coils having tilting facilities <i>etc.</i> with the crucible containing sample.</li><li>3) Casting mould mounted on a mould platform with adjustable height facility.</li><li>4) High vacuum pumping systems with turbo pump, pneumatic valves, vacuum measuring gauges, rotary pumps and compressor for the pneumatic valves <i>etc.</i></li><li>5) Temperature measurement and control through thermocouple and infrared temperature sensor and display.</li><li>6) Alloy addition facility provided to adjust alloy composition.</li><li>7) Sampling facility and stirring arrangement provided.</li><li>8) Control console housing all the controls with system interlocks and safety.</li></ol> <p>All the items should be mounted on a compact frame with all safety interlocks and system precaution. A schematic drawing should be attached along with the technical details.</p> <p><b>FURNACE CHAMBER</b></p> <p>The furnace chamber should be made out of SS 304 L material. It should have cylindrical chamber of inner diameter 600 mm and 700mm length. Wall thickness should be 8 mm minimum. It should be double walled water cooled chamber. The outer chamber should be 650 mm dia x 700 mm long and wall thickness of 3 mm. Annular space should be provided with guides for effective water- cooling. Water inlets and outlets should be provided in the outer chamber. The chamber should be mounted horizontally and both ends are torrispherical dished end. Front end should be flanged and fully openable hinged door. Rear end</p>

should be also flanged and fixed with nuts and bolts with 'O' ring. The front door should be also fixed with gasket and locking arrangement for vacuum integrity. The chamber has number of ports as per requirement. On the side a 4" port should be provided for induction coil feedthrough and tilting mechanism. Thermocouple port, view port *etc* should be provided. The furnace chamber houses induction coil with the crucible and mould assembly with mould platform. W-Re thermocouple should be used for measurement and control of temperature upto 1800<sup>0</sup>C . If the system temperature should goes above 1800<sup>0</sup>C, the thermocouple should be retracted and infrared pyrometer should be used for measurement and control of temperature. The furnace should be designed for a temperature upto 2500<sup>0</sup>C.

The chamber design should follow ASME code Section VIII and all weldings should be done by TIG Arc welding following ASME code section IX. All welding joints should be leak tested by Helium Mass Spectrometer Leak Detector to an individual leak rate of 1 x10<sup>-8</sup> std cc/sec.

The welding joints should be also radiographed for examination of weld quality. Finally the chamber should be buffed and polished to bright finish.

#### **INDUCTION MELTING POWER SUPPLY WITH COIL**

To melt the sample a 15 KW induction power supply should be used with matching coil for 500 gms of sample melting. The coil dimensions should be suitable for containing Al<sub>2</sub>O<sub>3</sub> crucible of suitable dimensions (preferably ID 60 mm and OD 90 mm and 120 mm outer length (inner depth should be 100 mm)). It should be solid state medium frequency Induction power supply of capacity 15 KW (adjustable at any power level) and frequency of 9.56 KHz and power factor should be better than 0.95. The charge should be heated to the operation temperature and temperature should be measured and controlled either by thermocouple or infrared pyrometer through PID etc. The temperature should be displayed at the control panel.

#### **ROTARY CO-AXIAL CURRENT LEAD –IN**

The co-axial current lead in feed power and the cooling water of 4-5 lit/min at 45 PSI to the induction coil with facility for axial adjustment. Induction coil should be connected to the current lead-in by removable cap screws. The current lead should also acts as cantilever to support

the induction coil with crucible and its contents about (0.5 kgs). The current lead-in should be connected to water cooled power line from the power supply with negligible contact resistance in the atmosphere side.

The co-axial current lead –in feed through should be fixed with ball bearing and vacuum seal and can be rotated with the help of a lever rotated from outside. When the feedthrough should be rotated, it rotates along with the crucible and molten contents can be emptied into the mould located down. This rotation can be provided with worm gear, bearing assembly and stepper motor with pulse mode movement. The current lid and the connections are protected by a suitable cover.

### **MATERIAL ADDITION CHUTE**

Material addition chute facilitates addition of material in specific quantity and sequence in the melt at any time. A vacuum shut off valve at the bottom of the cylindrical container facilitates loading of material during process without vacuum interruption and a vacuum connection for roughing and high vacuum should be provided through a small turbo pump and rotary pump combination with necessary valves and plumbing line.

### **SAMPLING FACILITY**

A suitable cup through a shaft seal and gate valve should be used for sampling the melt during melting process. It should be dip to the melt and small quantity of sample should be taken out of the chamber in the cup through the gate valve into the additional sample collection chamber and the gate valve should be closed. For introduction of the cup, the sampling chamber should be evacuated to rotary level and then the gate valve should be opened and the cup should be pushed inside.

### **TEMPERATURE MEASUREMENT.**

The temperature of the furnace should be measured by:

- a) Temperature Rhenium thermocouple upto 1800<sup>0</sup>C
- b) Above 1800<sup>0</sup>C, the thermocouple should be retracted and temperature should be measured by infrared pyrometer.

An immersable thermocouple with moly casing should be used for temperature measurement and control through micro-processor based PID cum controller. The PID output should be coupled to the induction power supply and the control of the temperature should be carried out

with the negative feedback circuit. The temperature should be controlled automatically and digital indication should be provided on the front panel. The measure temperature above 1800<sup>0</sup>C, the thermocouple should be taken out of the melt and an infrared thermometer should be used through PID which should be coupled to the induction power supply and thereby measurement and control of temperature should be carried out. The temperature should be displayed on the control panel.

### **Specification for the pyrometer**

Temperature range	: 1800 <sup>0</sup> C to 3000 <sup>0</sup> C .
Detector	: Si/Si layered detector, nominal 1 um
Accuracy in degree C	: +/- (0.5% Tmeas + 2 <sup>0</sup> C), Tmeas
Repeatability	: +/- 0.3% full scale.
Temperature resolution	: 1 <sup>0</sup> C
Response time	: 10 m Sec
Emissivity one – colour	: 0.10 to 1.0 in 0.01 increments.
Slope two- colour increments	: 0.85 to 1.150 in 0.001 increments
Signal processing	: Peak hold and averaging.

### **Stirring Facility**

The material melted may have different densities and hence the melt may tend to have a density variation along the height of the melt and to overcome this difficulty as stirring facility with a suitable paddle should be provided to stir the melt continuously for uniformity in densities. The graphite paddle should be fixed with rotary shaft seal and could be pulled out or pushed in and could be rotated either manually or coupling through synchronized motor.

### **Melting Crucible**

The melting crucible used should be made out of Al<sub>2</sub>O<sub>3</sub> and graphite (3 numbers each) with suitable dimension compatible to this unit (suggested dimensions: ID 60 mm x depth 100 mm and the OD should be 90mm x 120 mm height). The crucible thus made will have a internal volume of about 600 cc to contain the sample for melting. This melting crucible serves two purpose. One containing the material and two as a susceptor to concentrate the magnetic lines of force. The induction coil should be fixed on the OD of the melting crucible and thereby efficient heating can be realized.

### **Mould Platform with Height Adjustment**

For mounting the mould a stainless steel mould platform should be provided inside the furnace chamber below the induction coil arrangement. The platform should be fixed with a special rotary seal at the bottom of the furnace and can be moved up and down and the rotary seal shaft should be water cooled. The mould platform with mould can be viewed through the view port. The mould platform can be slightly rotated to adjust the mould exactly below the melting crucible when it is tilted for casting. The casted material should be taken out through the side port.

### **Mould**

A water cooled copper mould of cylindrical shape (diameter 10 mm) should be provided to hold upto 500 gms of alloy. **The system must allow to cast/pour the molten alloy in the copper mould under vacuum.**

### **High Vacuum Pumping System**

The furnace chamber should be evacuated in the range of  $10^{-7}$  mbar of vacuum by a combination of turbo pump backed by rotary pump. The same rotary pump should be used for roughing the furnace chamber from atmosphere to  $1 \times 10^{-3}$  mbar . The pumping unit essentially consists of :

- Rotary Vacuum pump
- Diffusion pump with controller
- Pneumatic right angle valve as high vacuum valve
- Pneumatic butterfly valves as roughing and backing valve
- Pirani – penning combined gauges
- SS plumbing line
- Air and gas admittance valves
- Control console

Brief description of the main components are given below:

### **Rotary Vacuum Pump**

#### **Specifications**

Displacement

50Hz

$40 \text{ m}^3\text{h}^{-1} / 47.1 \text{ ft}^3\text{min}^{-1}$

60Hz

$96 \text{ m}^3\text{h}^{-1} / 56.5 \text{ ft}^3\text{min}^{-1}$

Number of stages	2
Ultimate vacuum	
Without gas ballast (total pressure)	1 x 10 <sup>-3</sup> mbar / 7.7 x 10 <sup>-4</sup> Torr
With gas ballast (partial pressure)	5 x 10 <sup>-3</sup> mbar / 3.8 x 10 <sup>-3</sup> Torr
Ultimate with Fomblin®	
Without gas ballast	1 x 10 <sup>-2</sup> mbar / 7.7 x 10 <sup>-3</sup> Torr
Inlet connection	ISO40
Outlet connection	25 mm flange suitable for NW25
Max outlet pressure	0.5 bar gauge
Max inlet pressure for water vapour	5 mbar / 3.8 Torr
Max water vapour pumping rate	0.3 kg h <sup>-1</sup> / 0.7 lb h <sup>-1</sup>
Motor protection rating	IP55
Motor power	
50Hz	2.2 kW / 3 hp
60Hz	3 kW / 4 hp
Standard oil capacity	
maximum	6.3 litre
minimum	4 litre
PFPE oil capacity	
maximum	4 litre
minimum	2.2 litre
Recommended oil	Ultragrade 70
PFPE prepared version	Fomblin® Y06/6
Noise level	Below 70 dB (A)

### **12 inch Diffusion Pump Diffstack (with suitable controller)**

Pumping speed	
nitrogen	3000 l s <sup>-1</sup>
hydrogen	3000 l s <sup>-1</sup>
Min backing pump displacement*	40 m <sup>3</sup> h <sup>-1</sup>
Recommended fluid	Santovac® 5
Fluid charge (dry)	1000 ml
Inlet connection compatible with	ISO250
Backing connection	NW40
Cooling water connection	10 mm compression fittings
Heater power	2.25 kW
Min cooling-water flow at 20°C	180 l h <sup>-1</sup>
Pneumatic connections†	6mm coupling x ¼ BSP male stud
Pneumatic actuating pressure	
Minimum	2.4bar / 35psi

## **Holding pump**

### **ROTARY VACUUM PUMP- 250 LPM**

#### **Specification**

Technical specifications	: 250 lit/min or better
Nominal pumping speed	: 15 m <sup>3</sup> /hr.
Ultimate vacuum (on Mcleod gauge)	
Gas Ballast closed	: 1 x 10 <sup>-3</sup> mbar
Gas ballast open	: 5 x 10 <sup>-2</sup> mbar
Oil Capacity	
Motor Rating	: ½ HP
Rotational Speed	: 1400
Max. nominal power rating	: 0.36 KW
Inlet flange	: NW 25
Exhaust flange	: NW 25
Weight	: 26 Kgs.

#### **Chiller Unit**

Suitable chiller unit should provided such that the unit can operate for one hour, without use of liquid Nitrogen for the diffusion pump.

#### **Electro-Pneumatic Gate Valve**

6" Size gate valve acts as a high vacuum valve. It should be operated electro- pneumatically. It should be made out of SS 304 material and electro-polished, sealing should be 'O' ring seal.

#### **Vacuum Measuring Gauges**

Vacuum measuring gauges used are manufactured by Pfeiffer/Equivalent with pirani gauge heads and one penning gauge head. It should be a micro processor based gauge operated on cold cathode penning discharge principle . The pirani gauge measures vacuum from atmosphere to 1x 10<sup>-3</sup> mbar and penning gauge measures from 10<sup>-3</sup> mbar to 5 x 10<sup>-8</sup> mbar and the combined pirani- penning gauge measures vacuum from atmosphere to 5 x 10<sup>-8</sup> mbar.

#### **Plumbing line**

2" Size SS Plumbing line should be fabricated using SS pipe for backing and roughing line with backing and roughing valves. There should be provision for mounting the pirani gauge head in the plumbing line. Rigid line with KF coupling dismountable flange with SS flexible

bellows gives flexibility of connecting all the component easily.

### **Backing & Roughing Valve**

2 Nos. of 2” Size quarter swing Butterfly valve (Electro-Pneumatically operated) should be used as backing and roughing valve. 1” holding valve should be used to connect the holding pump to the backing of turbo pump while the main backing pump should be engaged in roughing the chamber.

### **Air Admittance Valve**

A solenoid operated Air admittance valve should be used in the system for venting the system.

### **Control Console**

19” size standard rack contains all the controls for the Induction furnace. At the top a mimic diagram should be provided with status indication which indicates status of the vacuum system. Digital combined gauge for vacuum measurement, IR Pyrometer for temperature measurement and control coupled through PID to the induction power supply, thermocouple temperature indication, mains ON-OFF contactor and manual over ride switch *etc.* all are provided and housed in control console. All the electrical switch gears are accommodated in the control console. They are easily removable for servicing and maintenance. Back door can be locked for safety reasons. All safety interlocks are provided in the control console. It should be separated from the main unit and 3M long connecting cable integrate them. The induction power supply control unit should be separate self standing unit containing all the controls of the power supply. All the safety interlocks of the power supply should be provided in this control unit.

### **Mounting Frame**

The furnace should be assembled in a compact and sturdy MS frame (neatly painted) made out of rectangular channels. The furnace chamber should be mounted on the top of the frame and pumping system should be accommodated below the frame.

### **Protection and interlock**

- i. Switch of Turbo pump should be interlocked with mechanical Pump.
- ii. Interlocking of roughing valves with high vacuum valves.
- iii. Close of backing valve should be interlocked with opening of roughing valve.
- iv. High vacuum valve should be interlocked with closing of roughing valve & opening of backing valve.
- v. In case of large leakage in furnace chamber, high vacuum valve and roughing valve should be closed. Flash light and alarm start operating should be in built.
- vi. High Vacuum valve should be interlocked with:
  - Backing valve.
  - Vacuum level.
  - Diffusion Pump on.
  - Door lock.
  - Water supply.
  - Air supply.
- vii. Turbo pump should be provided with mains operated vent valve to air the pump during power failure / switching OFF the pump.
- viii. Water failure indication with alarm.
- ix. Air failure indication with alarm.
- x. Valves status should be sensed by
  - Physical opening / Closing.
  - Micro switches.

**Power Requirement:** 415 V +/- 10% 3 Phase, 50 Cycles, 30 KW  
Approx.

**GENERAL NOTE:**

- i) The offered furnace should be suitable for synthesis of alloys and other material under high vacuum or in inert gas atmosphere.
- ii) The vacuum chamber should be a double walled cylindrical chamber which should be more suitable for manufacturing without compromising any technical parameters.
- iii) With the offered pumping system a vacuum of  $10^{-6}$  mbar can be achieved in about 2 hrs time.
- iv) All electrical items used are of standard quality of reputed make like AE, Siemens etc.
- v) All electrical wires are bunched and numbered for ease of identification.
- vi) View ports (2 Nos) provided.
- vii) Inert gas admittance valve should be provided with pressure gauge.
- viii) Melt temperature can be measured by radiation pyrometer

- through the view port window.
- ix) 4 nos of spare 1" size port with dummy flanges are provided for future use.
  - x) The maximum temperature of the furnace should be 2500 °C.

**GROSS LEAK:**

The Gross leak of the clean empty furnace chamber at ambient temperature should be of  $1 \times 10^{-3}$  mbar lit/sec (measured by pressure rise method).

**Design:**The design of the system follows ASME Code section VIII.

**Welding:** Follows ASME Code Section IX.

**Hydro Test**

Upto 3 Bar. Hydro Test should be done on the double walled Chamber to test water leakage.

**Helium Leak Test**

After complete assembly of the chamber, it should be tested with Helium Mass Spectrometer Leak Detector to an individual leak rate of  $1 \times 10^{-8}$  std. cc/sec. The user reserves the right to visit your manufacturing premises to witness these test results.

**Pre-dispatch inspection**

The user reserves the right to visit your manufacturing premises for the pre-dispatch inspection of the unit.

**Instruction manual**

An instruction manual along with all circuit diagram, sub-assemblies both mechanical and electrical should be supplied along with the unit.

**Warranty**

The entire unit should be under warranted for a period of 3 years from date of installation.

**DELIVERY:** 60 days including supply and installation.

		<p><b>SPARES:</b> Tool kits and spares for smooth running of the unit for three years should be provided without additional cost.</p> <p><b>INSTALLATION:</b></p> <p>The unit should be installed at our site by your Engineers at no additional cost. However, the utilities will be provided at free of cost.</p> <p>.</p>
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**FORMAT FOR QUOTATION SUBMISSION**

(In letterhead of the supplier with seal)

Date: \_\_\_\_\_

\_\_\_\_\_

To: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Sl. No.	Description of goods (with full Specifications)	Qty.	Unit	Quoted Unit rate in Rs. (Including Ex Factory price, excise duty, packing and forwarding, transportation, insurance, other local costs incidental to delivery and warranty/ guaranty commitments)	Total Price (A)	GST		
						GST taxes mentioned as under	Percentage (%)	In figures (B)
						<b>CGST</b>		
						<b>SGST</b>		
						<b>IGST</b>		
<b>Total Cost</b>						<b>Total</b>		

Gross Total Cost (A+B): Rs. \_\_\_\_\_

We agree to supply the above goods in accordance with the technical specifications for a total contract price of Rs. \_\_\_\_\_ (Amount in figures) (Rupees \_\_\_\_\_ amount in words) within the period specified in the Invitation for Quotations.

We confirm that the normal commercial warranty/ guarantee of \_\_\_\_\_ months shall apply to the offered items and we also confirm to agree with terms and conditions as mentioned in the Invitation Letter.

We hereby certify that we have taken steps to ensure that no person acting for us or on our behalf will engage in bribery.

Signature of Supplier

Name: \_\_\_\_\_

Address: \_\_\_\_\_

Contact No: \_\_\_\_\_