Government of India
Bhabha Atomic Research Centre
Electromagnetic Applications & Instrumentation Division

Ref: EmA&ID /EMAS/UG/19/10720-A

Date: 23/10/19

Supply, fabrication, integration, testing of vacuum vessel & thermal shields along with vertical superconducting magnet as per technical specifications: VV/SC/UG/19/01 dated 16/09/2019

Dear Sir/Madam,

1. Quotations are invited for the Supply, fabrication, integration, testing of vacuum vessel & thermal shields along with vertical superconducting magnet as per technical specifications: VV/SC/UG/19/01 dated 16/09/2019
2. Bidder shall quote for fabrication of these components with material as per the enclosed tender technical specification.
3. Taxes and Excise Duties shall be quoted separately. Form AF / H whichever is applicable shall be provided, if required.
4. The quotation must reach The Head, Electromagnetic Applications Section by 2nd Nov, 2019 and must be sent in a sealed envelope super scribed with the reference number & the due date given above.
5. The quotations must be send via speed post or registered post only.
6. The address on the envelop should read:
   The Head, Electromagnetic Applications & Instrumentation Division,
   RCnD Bldg., North Site
   BARC, Trombay,
   Mumbai - 400 085.
   (Kind Attn: Shri Udai Giri Pratap Singh Sachan)
7. Necessary inspection facilities should be provided to our engineer during fabrication at bidder’s premises.
8. The bidder shall deliver the finished components after approval by our engineer within 12 weeks from the date of firm work order issued to the bidder. The finished components along with the left over material shall be delivered by the bidder at Electromagnetic Applications & Instrumentation Division, BARC, Trombay, Mumbai - 400 085.
9. Head, Electromagnetic Applications & Instrumentation Division reserves the rights to accept/ reject any or all quotations without assigning any reason.
10. Delivery charges if any must be clearly mentioned in the offer.
11. Quotation must also indicate the validity of offer.
12. Quotation must also indicate the GST no and PAN no of the party.
13. The quotation has to be signed by authorized person along with company seal.

Encl.: Specification Sheet no.- VV/SC/UG/19/01 dated 16/09/2019

(Udai Giri Pratap Singh Sachan)
SO/D, EmA&ID

Copy to:
1. BARC website for uploading
Annexure-C

<table>
<thead>
<tr>
<th>Tender Specification no.</th>
<th>Revision no.</th>
<th>Date of Issue</th>
<th>No of pages</th>
</tr>
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<tbody>
<tr>
<td>VV/SC/UG/19/01</td>
<td>01</td>
<td>16/09/2019</td>
<td>4</td>
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Supply, fabrication, integration, testing of vacuum vessel & thermal shields along with vertical superconducting magnet

1.0 Scope

Tender is invited for Supply, fabrication, integration, testing of vacuum vessel & thermal shields along with vertical superconducting magnet as per the technical specification document No: VV/SC/UG/19/01. In this specification the seller shall be referred to as the “Supplier” and Bhabha Atomic Research Centre shall be referred to as the “Buyer”.

Supplier shall arrange required raw material, facilities, infrastructure for manufacturing, welding of the vacuum vessel, support structure, leak detection testing etc. The description of the vacuum vessel along with thermal shield are mentioned in Para 4.0 of this tender specification. The fabrication shall be carried out strictly based on the drawings and specifications provided in this tender specification. Any modifications, if required, during the fabrication shall be approved by the buyer before fabrication.

Supplier shall quote lump sum for the above mentioned job. No Free Issue Material (FIM) is involved in this job. Only overall cost will be compared.

The brief description of contents of the tender specification document is as described below.

Para 2.0 gives the details of deliverables.
Para 3.0 gives statement of purpose.
Para 4.0 gives the general description and technical requirements.
Para 5.0 gives the raw material requirements.
Para 6.0 gives the welding specification and requirements.
Para 7.0 gives the testing and factory acceptance requirements.
Para 8.0 gives the quality assurance requirements.
Para 9.0 gives the price and delivery schedule requirements.

2.0 Details of deliverables

<table>
<thead>
<tr>
<th>S.No</th>
<th>Component</th>
<th>Nos</th>
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<tbody>
<tr>
<td>1</td>
<td>Supply, fabrication, integration, testing of vacuum vessel &amp; thermal shields along with vertical superconducting magnet</td>
<td>01 set</td>
</tr>
</tbody>
</table>

3.0 Statement of purpose

Helmholtz configuration based 3.65 Tesla superconducting magnet shall be cooled by two stage G-M cry cooler. The superconducting magnet shall be used for Gyrotron applications. It is a vertical superconducting magnet housed inside a vacuum vessel. To reduce the radiation losses, intermediate thermal shields are required. The magnet shall have a warm bore of 65 mm and which is accessible from both the sides. The job involves fabrication, machining, assembly, integration & leak testing of vacuum vessel.
4.0 General description and technical requirements

4.1 Helmholtz configuration based 3.65 Tesla superconducting magnet is required for Gyrotron applications. The magnet is a split coil magnet for better field uniformity. The field uniformity achieved is 0.5 %. The length of the magnet is approximately 200 mm. The magnet is vertically supported by low thermal conductivity G-10 rods.

4.2 The magnet is cooled by second stage (4.2 K) of two stage GM cryocooler. During cool down thermal contractions take place. Suitable extensions of OFHC copper have to be designed for these thermal contractions.

4.3 The thermal losses on the magnet is reduced by installing an intermediate thermal shields at 50 K. These shields are connected to first stage of cryocooler. The first stage shall be connected to thermal shields with the help of ETP copper extenders.

4.4 Provisions for mounting 4 Cernox sensors on superconducting magnet top and bottom flange shall be provided. In the same way 4 silicon diode sensors shall be mounted on the thermal shields.

4.5 Thermal shields shall be made into 4 parts as shown in the conceptual drawings. To reduce radiation losses Multi-Layer Insulation (MLI) shall be wrapped on the magnet cold mass & thermal shields.

4.6 The complete magnet shall be supported from the top flange with the help of G-10 tie rods. The support rods shall be intercepted at 50 mm from the top to support the thermal shield and will be thermalized at 50 K.

4.7 The thermal shield thickness shall be taken as 3 mm and shall be made of ETP copper only. Diameter of thermal shield is 610 mm and the length of shield shall be 780 mm.

4.8 Connections to the magnet shall me made of OFHC copper only. The thickness of extender shall not be less than 10 mm.

4.9 Vacuum vessel shall be made into four parts. Top and bottom flange, cylindrical vessel and vacuum vessel inner bore.

4.10 Vacuum vessel top flange shall be minimum 20 mm thick and it shall have DN-160 KF port for mounting RDK-415 cryocooler. Two instrumentation ports of DN-63 shall be there for carrying out temperature sensor connections. Two CF-40 ports for carrying out power connections and a central hole such that clear bore of 120 mm at center may be made.

4.11 Bottom flange shall have provision of integrating vacuum vessel bore of 74 mm diameter.

4.12 Cylindrical Vessel shall have following ports: Port-A is DN-160 mm port for mounting Turbo Molecular Pump, Port-B & Port-C is CF-40 for mounting vacuum pressure gauges.

5.0 Raw Material requirements

5.1 Stainless steel 304L sheet thickness 8 mm as per ASTM A240 / ASME SA-204M, preferably 2B rolled sheet shall be used for cylindrical vacuum vessel construction.

5.2 Stainless steel 304L plate thickness 20 mm as per ASTM A240 / ASME SA-204M, preferably 2B rolled sheet shall be used for top and bottom flange construction.

5.3 ETP copper 3mm for thermal shield, thermal shield flanges, thermal shield inner bore construction.

5.4 OFHC copper for 4.2 K extensions and cryocooler connections.

6.0 Welding specification and requirements

6.1 All the joints shall be TIG welded by purging 99.9% pure Argon gas.

6.2 The fillet material used shall be SS-304 L only.
6.3 The welding shall be fillet welding as shown in the drawings and the welding beads shall be grounded after welding.

7.0 Testing and factory acceptance requirements

7.1 After fabrication of vacuum vessel & thermal shields following acceptance test shall be carried out:
   a) Leak detection of the vacuum vessel upto $10^{-10}$ Torr.L/sec.
   b) After fabrication assembly and integration of the vacuum vessel shall be carried out and visual inspection shall be carried out.

8.0 Quality assurance requirements

8.1 The supplier shall maintain a documented quality assurance program that will insure that each item offered for acceptance or approval conforms to the requirements.

8.2 Quality surveillance and expediting, relating to all the aspects of the contract will be carried out by the buyer or his authorized representative for which purpose the supplier and his subcontractor shall

   8.2.1 Allow access at all reasonable times during manufacture, assembly and testing to the premises in which the work is being carried out.

   8.2.2 Furnish the latest drawings and/or tooling, gauges, instruments, testing equipment etc. required for inspecting the jobs. Prints of all the latest required drawings and approved procedures shall be made available for inspection and retention, if so desired.

   8.2.3 Produce an inspection plan to the buyer’s satisfaction and notify when checkpoints on the plan are imminent so that the buyer’s representative may be present, if it is so desired.

   8.2.4 Obtain acceptance of the components in the form of a shipping release from the buyer’s representative before the shipment.

8.3 The supplier shall be responsible for the inspection of the components that is subcontracted by him.

8.4 Waiving of quality surveillance by the buyer’s or acceptance of the items by the buyer or his authorized agent, shall not relieve the supplier from the responsibility for supplying the items in accordance with specification requirements of this document and purchase order.

9.0 Price and delivery schedule requirements

9.1 The supplier shall furnish workmanship guarantee certificate valid for one year.

9.2 The delivery of the vacuum vessel with its relevant technical documentation is expected within 3 months from date of placement of work order.

9.3 The supplier shall give detailed break up cost with delivery schedule. However only overall cost will be compared.
**Annexure-D**

**Document to be filled and provided by the supplier for technical evaluation**

The below content shall be printed in the company letter head. All the enclosure requested in this table has to be provided. **Otherwise the offer will be out rightly rejected.**

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes/No</th>
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<tbody>
<tr>
<td>Does the supplier have previous experience in carrying out similar such electronic systems development for BARC, IGCAR any recognized government research Labs and has the supplier enclosed copy /proof of the purchase orders and photo copies of the developed systems</td>
<td></td>
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<tr>
<td>Has the supplier enclosed the list of employees, design engineers, assistants, CAD/EDA software, CMM, CNC facilities, available with them to carry out the present job?</td>
<td></td>
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<tr>
<td>Does the supplier agree to carry out acceptance testing for the system to be developed?</td>
<td></td>
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<tr>
<td>Has the supplier sub-contracted the part of job? If yes, they should also produce the list of sub-contractors and their infrastructures and facilities.</td>
<td></td>
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Schematic for Vertical Bore Conduction Cooled Cryostat

Dt: 28.8.19