To,

Subject: Minor fabrication and supply of coaxial RF coupler

Dear Sir,
Please let us have your competitive rate for Minor fabrication and supply of coaxial RF coupler as per following details:

1. The scope of work involves:
   - Fabrication and supply of the coaxial RF coupler as per the technical specifications, detailed scope of work and acceptance criteria given in Annexure I and drawings given in Annexure II.
   - Safe packaging and transport to the Purchasers site.

2. The supplier shall prepare the detailed fabrication drawings and must submit the drawings to undersigned for approval before starting the fabrication. Digital copies of the 3D model and drawings shall be provided to the indenter, along with hard copy of the drawings.

3. The bidder should have supplied various similar precisely fabricated RF coupler or their components or any other accelerator related projects to any government research unit like BARC/RRCAT/DRDO/ISRO at least on one previous occasion. All the copies of earlier work orders or purchase orders that demonstrate the required experience should be attached with the quotations. **If the supplier is unable to demonstrate suitable experience indicated above, the offer is liable to be rejected.**

4. The bidder has to quote for all the components together. Incomplete/partial quotations will not be accepted.

5. Pan no., VAT no., Tin no. of the bidder should be mentioned clearly on the quotation.

**Rights and Privileges:**
Indenter reserves the right to inspect any machinery or material or equipment furnished or used by vendor or to reject any, which is found defective in workmanship, quality, and design or otherwise unsuitable for use which is not in accordance with the specification.
Note: In case any further clarification is required, the bidders may contact the undersigned at phone no. 022-2559-1475, email: sonal@barc.gov.in

Your quotation duly filled in the prescribed format, addressed to “Head, IADD, Van-de-Graff Bldg, BARC, Trombay, Mumbai – 400085” in a sealed envelope quoting tender number and due date, must reach on or before 10/11/2020 date by 3 PM through speed post only. On top of envelop it must also be written “kind attention to Sonal Sharma, IADD”.

Sonal Sharma
SO/E, IADD

Enclosures:
Specifications (Annexure I)
Drawings (Annexure II)
Annexure I

Technical specifications

1. **Technical requirement:**

This specification describes the requirements for fabrication and supply of coaxial RF coupler as per enclosed sketches (refer Annexure II). The fabricated components will be used to couple power to accelerators being developed at BARC. Precise machining of all the components is important.

2. **Overview of Requirements:**

1. The scope of work involves fabrication and delivery of four numbers of Coaxial RF couplers.
2. The supplier has to deliver items as per details mentioned in table 1.
3. The supplier has to prepare final manufacturing drawings as per preliminary drawings of Annexure II and send it for approval in soft and hard copy format. Approval of drawings does not relieve supplier from responsibility of meeting factory acceptance test.
4. The supplier will procure all the raw materials and will send all its test reports for approval.
5. After manufacturing of components as per approved drawings, the supplier will prepare dimensional inspection report of all manufactured components.
6. The coaxial coupler parts will be joined together by vacuum brazing. The SS316 LN flanges will be joined by vacuum brazing or electron beam welding.
7. The manufacturer should have previous experience in successfully fabricating OFE copper components for use in ultra-high vacuum (UHV) applications. Also, the manufacturer should have good experience of vacuum furnace brazing technology. All the copies of earlier work orders or purchase orders that demonstrate the required experience should be attached with the quotations. If the supplier is unable to demonstrate suitable experience indicated above, the offer is liable to be rejected.
8. The components to be supplied shall be free from surface cracks, porosity and other internal flaws.
9. Knife edges and sealing surfaces should not have any scratch/dent mark.
10. The surface finish of all the components should be less than 0.3 microns.
11. All surfaces should be chemically clean, free of dirt, grease, oil and chips and look aesthetically good. Surfaces shall be visibly inspected and wiped down with a white cloth. In order to be considered free of contamination, no discoloration should appear on the white cloth.
12. Detailed manufacturing plan and QC plan should be submitted to indenter and approval taken, before starting the fabrication.
13. For technical compliance, supplier shall fill in the attached compliance table as per table A3. All entries of the table should be filled. Quotations where the compliance table is not completely filled are liable to be rejected.
14. Packaging and shipment should be such that final component does not undergo shocks, deformations, surface damages, moisture or anything having negative effects on its design and operation intent.

3. **Deliverables**

- Overall coupler is divided into two parts: cold vacuum part and warm air part.
- **Four** such couplers have to be delivered.
- Overall coupler drawing is given in fig 1. Cold part vacuum end is given in fig 2. Warm part vacuum end is given in fig 3.
- These components have to be joined together by either welding or brazing or other method as per details given in their drawings.
- 20 nos of alumina discs are required to be supplied.
- Extra two nos of inner zirconium copper sleeves and two nos of outer copper sleeves will be required for brazing trials of two alumina discs. Details are given in section 4 under heading “materials”.
- For any further technical query to reach at the estimated price, the Vendor may contact the indenter: Sonal Sharma, IADD, BARC
  Ph: 022 25591475
  Email: sonal@barc.gov.in

4. **Materials**
- Material used for coaxial coupler inner and outer conductors should be OFE Copper.
- Other material includes SS 316L tubes, connectors, antenna, brass connectors, PTFE discs for support.
- Metallized ceramic Alumina discs (99.8% purity) of 7 mm thickness, 100.98mm diameter (20 nos) are required. Please see the note below for these discs.
- The material for Flanges should be SS316 LN
- For waveguides shown in the air part of coupler the material used in aluminium AL6061-T6.
- The bellows will be SS with electroplating of copper as per details given in section 5.
- Vendor will provide test certificates like chemical test, eddy current test for all OFE Copper and SS316 LN material to be used for manufacturing the coupler.

*Note:*
1. Initially all the non-metallized alumina discs have to be given to BARC for test and approval.
2. After approval BARC will give the non-metallized discs back to vendor. Then all the discs can be metallized.
3. Among these, 2 of the approved metallized discs can be brazed with inner and outer zirconium copper sleeves (details will be provided).
4. The two metallized brazed discs have to be send back to BARC for vacuum leak test and inspection. These will be prototypes.
5. After final approval four other discs can be brazed and used for final couplers.

5. **Alumina discs:**

Metallized ceramic Alumina discs (99.8% purity) of 7 mm thickness, 100.98mm diameter (20 nos) are required. Details specifications are given below:

<table>
<thead>
<tr>
<th>Quantity: 20 nos</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Material</td>
</tr>
</tbody>
</table>
2. Purity ≥ 99.7%
3. Metallization Inner & outer diameter surfaces
4. Mo-Mn thickness 10 μm-38 μm
5. Nickel Thickness 2 μm -10 μm
6. Chamfering ≤0.5 mm
7. Dimensional tolerances ±0.10 mm
8. Outer diameter Ø100.98 mm
9. Inner diameter Ø25.4 mm
10. Thickness 7 mm
11. Surface finish better than 0.8 micron
12. Dielectric Loss Ac-kv/mm (3.18mm) 1.0 x e-4
13. Dielectric Constant (25°C@1MHz) 8.7

6. Bellows:
The bellows will be SS with electroplating of copper. For plating following are the important points:
1. Plating needs to be of the highest quality in order to remain intact (e.g., no delaminating or flaking) at temperatures that range from 4 °K to 450 °K.
2. The adhesion between the copper plating and base material should be checked by bend test and peel test as per ASTM B571.
3. All the copper plated parts should be Vacuum baked at 400° C for 2 hours in clean vacuum oven.
4. Allowable values for RRR of plating electrical conductivity are in the 10-100 range.
5. The copper plating is to have a surface roughness of Ra < 1.6μm

7. Joining Processes and Joint Detail
- Brazing should be done in vacuum furnaces.
- Joining process (e.g. welded v. brazed), methodology (e.g. vacuum v. induction brazing), and filler material are to be selected by the vendor and approved by the indenter.
- Joints shall meet leak tightness specification with a leakage rate lower than 10⁻⁹ mbar l/s, and be free from visible (with 10X magnifiers) surface irregularities, and be free of vacuum ‘virtual leaks’.
- Ceramic surfaces must be protected during brazing to prevent accidental surface coating due to
sublimation or other mechanism.

- Before brazing, the dust on systems used should be removed with dry nitrogen.

8. Vacuum Leak Tightness

- All parts, brazed and welded joints, and CF-style and diamond seal flanges shall be helium leak tested during sub-assemblies – where required and after final assembly as specified. No O-ring use on CF-style flanges is allowed during the helium leak check. The leak check needs to be done with copper seals.
- All required subassemblies have to be leak tight to helium with a leakage rate lower than $10^{-9}$ mbar l/s. All brazing and welding joints or various joints will be tested with a helium leak detector with sensitivity better than $10^{-10}$ mbar l/s, during the validation phase of the methods or during the manufacturing of the couplers.
- The leak checking vacuum system shall be designed to eliminate any risk of hydrocarbon contamination of the parts being tested.
- The vendor shall design and fabricate any mating hardware required to perform leak tests.
- The vendor shall supply a report of the vacuum leak tests to the indenter.

9. Cleanliness and Handling

a. All parts and assemblies shall be free of cutting fluid, flux, atmospheric dust, and visible contaminants.

b. Any parts before furnace treatment (vacuum firing, brazing) or welding need to be cleaned. General cleaning procedure is as follow:
   - i. KPC820 or equivalent, 3% solution, 30 minutes in ultrasonic tank
   - ii. DI water rinse
   - iii. 99.9% pure Isopropyl alcohol rinse
   - iv. Blow dry with cryogenic nitrogen
   - v. Micro90 or equivalent, 2% solution, 30 minutes
   - vi. DI water rinse
   - vii. 99.9% pure Isopropyl alcohol rinse
   - viii. Blow dry with boiled off nitrogen gas
   - ix. Citronex or equivalent, 2% solution, 5 minutes
   - x. DI water rinse
   - xi. 99.9% pure Isopropyl alcohol rinse
   - xii. Blow dry with boiled off nitrogen gas

10. Packaging

- Sub-assemblies shall be secured and stabilized for safe shipping.
- Design and fabrication of any hardware required for shipping is the responsibility of the vendor.
- Use of aluminum foil is not permitted.
- Knife edges of the Conflat flanges have to be protected from any scratches or nicks during the fabrication and shipping.

11. Pre-dispatch inspection:

- Pre-dispatch inspection will be carried out at supplier’s place by the purchaser or its representative.
• Supplier will keep all test certificates, dimensional inspection reports, instruments etc. and packaging ready at the time of PDI.

12. **Acceptance Criteria:**

• The supplier will send final manufacturing drawings for approval. After getting these drawings approved, the supplier will commence manufacturing.
• The chemical composition test certificates and ultrasonic test certificates as per ASTM standard of all raw materials should be submitted by the supplier for approval before commencement of manufacturing. The test certificate should be issued of government of India certified laboratory.
• In case of Original manufacturer’s mill test certificate, the batch number on mill test certificate shall be traceable on each pieces of the manufactured component.
• Material found to satisfy and qualify the relevant ASTM standard shall be accepted. Clearance for manufacturing will be issued after marking/stamping of the accepted lot.
• The supplier has to start manufacturing after clearance of raw material and its accepted lot from purchaser.
• After completion of manufacturing, the supplier should provide CMM dimensional inspection report for approval.
• Vacuum leak rate test (better than 1e-10 Torr li/sec) report to be provided.
• Surface finish report of internal parts has to be approved by indenter.
• Bellows copper plating quality details has to be approved by indenter.
• Purchaser may reject offers which do not offer manufacturer’s certificates. All such testing will be on account of the supplier and the test samples/ coupons shall be prepared from material of same lot, as intended to be supplied here. Purchaser reserves right for inspection for all above tests, to confirm results specified in mill test certificate.
13. MANDATORY TECHNICAL QUESTIONNAIRE AND COMPLIANCE TABLE

(TO BE FILLED IN BY THE BIDDER & SUBMITTED ALONGWITH THE OFFER)

Instruction-1 *Table A.1, Table A.2 and A.3*: The rightmost column should be filled in by the Bidder.

Instruction-2 *Failure to submit a fully completed, duly signed and stamped questionnaire will result in the rejection of the offer.*

Instruction-3 *Wherever, the response is Yes/No, please strike out the inapplicable response*

**Table-A.1: General Information**

<table>
<thead>
<tr>
<th>Qualification of the vendor</th>
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<tbody>
<tr>
<td>A.1.1. Name of the vendor</td>
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<tr>
<td>A.1.2. Contact details of the vendor (Give full address, email, phone and fax numbers.)</td>
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<tr>
<td>A.1.3. Does the vendor have his own corporate office in India? (Give full address, email, phone and fax numbers.)</td>
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<td>A.1.4. Do you have ISO 9001 or equivalent certification?</td>
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**Table-A.2: Technical Information**

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Question</th>
<th>Response</th>
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<tbody>
<tr>
<td>A.2.1.</td>
<td>Have you offered fully fabricated RF coupler or any component for RF coupler or any accelerator related projects to BARC?</td>
<td>Yes/No</td>
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<td>A.2.2.</td>
<td>Whether you will provide test certificate issued by an approved lab?</td>
<td>Yes/No</td>
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<tr>
<td>A.2.3.</td>
<td>Do you have testing facility required for testing material as specified in the specifications? If not where do you propose to do these tests?</td>
<td>Yes/No</td>
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<tr>
<td>A.2.4.</td>
<td>Will you provide certificates for Chemical, Mechanical properties, Ultrasonic Examination and Intergranular corrosion test?</td>
<td>Yes/No</td>
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<tr>
<td>S. No</td>
<td>Requirement</td>
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<td>1</td>
<td>Demonstrated experience in high precision machining of OFE copper components, SS components, aluminium components etc (micron). Copies of earlier work orders or purchase orders should be attached.</td>
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<td>2</td>
<td>Demonstrated experience in UHV applications (ultimate vacuum of 1e-8 Torr or better). Copies of earlier work orders or purchase orders should be attached.</td>
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<td>3</td>
<td>Demonstrated experience in vacuum furnace brazing of OFE copper components. Copies of earlier work orders or purchase orders should be attached.</td>
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<tr>
<td>4</td>
<td>Demonstrated experience in vacuum furnace brazing of OFE copper to high purity alumina joints. Copies of earlier work orders or purchase orders should be attached.</td>
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<td>5</td>
<td>Demonstrated experience in electron beam welding of joints for UHV applications. Copies of earlier work orders or purchase orders should be attached.</td>
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<td>6</td>
<td>Surface finish of all internal surfaces should be better than 0.8 micron. Surface finish should be achieved only by machining. <em>Grinding, buffing, etc. are not permitted</em></td>
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<td>7</td>
<td>Vendor should provide the required test reports using only coordinate Measurement Machine (CMM). <em>Inspection reports with Vernier will not be accepted.</em></td>
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<td>8</td>
<td>Vacuum leak of 1 e-10 torr lit/sec or better should be demonstrated by the vendor at its works/site to the indenter. Helium leak rate detector should be used for vacuum leak rate measurements.</td>
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<td>9</td>
<td>Packing at factory will involve blanking off the flanges and pressurizing with inert gas Provision for the same needs to be made on the flange.</td>
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<th>Compliance (Write YES or NO Only)</th>
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Annexure II

Drawing of the full coupler assembly (air side and vacuum end combined): Quantity 04 nos

Fig 1. Full assembly of coupler
Part Assembly: coupler vacuum end (quantity 04 nos) (item 2 of fig 1)

Fig 2: vacuum part of coupler
Part assembly: 650 coupler air side (quantity 04 nos) (item 3 of fig 1)

Fig 3: air part of coupler