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Dr. Piyush Shakya
Project Coordinator

Ref: MEE/MDS/380/1/2018
Dated: 04.01.2018

Limited Tender No: MEE/MDS/380/1/2018

Due Date: 01.02.2018, 1.00 pm

Pre-Bid meeting: - The bidders are requested to attend the pre-Bid meeting scheduled on 11.01.2018 at 3 pm Conference room, Machine Design Section, IIT Madras.

Technical Bid opening meeting on 01.02.2018, 4.00 pm

Dear Sir/Madam,

On behalf of the Indian Institute of Technology Madras, offers are invited for the supply of “**AUTOMATED ACCELERATED LIFE TEST RIG**” conforming to the specifications given in (Annexure-I):

Instructions to the Bidder

- (i) **Preparation of Bids:** - The Limited tenders should be submitted under two-bid system (i.e.) Technical bid and Financial bid.
- (ii) **Delivery of the tender:** - The tender shall be sent to the below-mentioned addresses either by post or by courier so as to reach the following address before the due date and time specified in our Schedule:

Dr. Piyush Shakya
Assistant Professor, Room No.405, Machine Design Section, Department of Mechanical Engineering, IIT Madras, Chennai 600036, India

- (iii) **Opening of the tender:** - The offer/Bids will be opened by a committee duly constituted for this purpose. The technical bids will be opened first and it will be examined by a technical committee which will decide the suitability of the bid as per our specifications and requirements. The bidders will be invited for opening of Technical bids. In respect of opening of financial bid, those bidders who are technically qualified only will be called for.

- (iv) **Prices:** - The price should be quoted in net per unit (after breakup) and must include all packing and delivery charges to Machine Design Section, **Department of Mechanical Engineering**. The offer/bid should be exclusive of taxes and duties, which will be paid by the purchaser as applicable. However, the percentage of tax & duties should be clearly indicated.

The price should be quoted without custom duty and excise duty, since I.I.T. Madras is exempt from payment of excise duty, and the custom duty will be paid at concessional rate against duty exemption certificate. In case of import supply, the price should be quoted on EX-WORKS and CIP basis indicating the mode of shipment.

- (v) **Agency Commission:** - Agency commission, if any, will be paid to the Indian agents in Rupees on receipt of the equipment and after satisfactory installation. Agency Commission will not be paid in foreign currency under any circumstances. The details should be explicitly shown in Tender even in the case of 'Nil' commission. The tenderer should indicate the percentage of agency commission to be paid to the Indian agent. The foreign Principal should indicate about the percentage of payment and it should be included in the originally quoted basic price, if any.
- (vi) **Terms of Delivery:** - The item should be supplied to our Departments as per Purchase Order. In case of import supply, the item should be delivered at the cost of the supplier to our Institution. The Installation/Commissioning should be completed as specified in our important conditions.
- (vii) **Technical Bid Opening:** The technical bid will be opened on **01.02.2018, 4:00 pm** at the Conference room, Machine Design Section, Department of Mechanical Engineering, **IIT Madras** and the financial bids of those tenders who are technically qualified will be opened at a later date.
- (viii) IIT Madras reserves the full right to accept / reject any tender at stage without assigning any reason.

SCHEDULE

Important Conditions of the tender

1. The due date for the submission of the tender is **01.02.2018, 1 pm**.

The offers / bids should be submitted in two bids systems (i.e.) Technical bid and Financial bid. The Technical bid should consist of all technical details / specifications only. The Financial bid should indicate item-wise price for each item and it should contain all Commercial Terms and Conditions including Taxes, transportation, packing & forwarding, installation, guarantee, payment terms, pricing terms etc. The Technical bid and financial bid should be put in separate covers and sealed. Both the sealed covers should be put in a bigger cover. The Limited Tender

for supply of “**AUTOMATED ACCELERATED LIFE TEST RIG**” should be written on the left side of the Outer bigger cover and sealed.

2. **Performance Security:-** The successful bidder should submit Performance Security for an amount of 5% of the value of the contract/supply. The Performance Security may be furnished in the form of an Account Payee DD, FD Receipt from the commercial bank, Bank Guarantee from any nationalized bank of India will be an acceptable.

Only after submission of Performance Security, Purchase Order/Work Order will be released / L.C will be opened.

Performance Security in the form of Bank Guarantee:- In case the successful bidder wishes to submit Performance Security in the form of Bank Guarantee, the Bank Guarantee should be routed through the Beneficiary Bank to the end user bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee from a Nationalized Bank of India.

The Bank Guarantee should remain valid for a period of sixty days beyond the date of completion of all contractual obligations of the supplier including the warranty obligations.

3. If an Indian agent is involved, the following documents must be enclosed:
Foreign principal's proforma invoice indicating the commission payable to the Indian Agent and nature of after-sales service to be rendered by the Indian Agent.
 - ✓ Copy of the agency agreement with the foreign principal and the precise relationship between them and their mutual interest in the business.
 - ✓ The enlistment of the Indian agent with Director General of Supplies & Disposals under the Compulsory Registration Scheme of Ministry of Finance.
4. The tenderer must have experience in designing, building and commissioning similar state of art instrumented test rigs to reputed customers (industries/research institutions) in India or abroad. The tenderer should also have exposure of integrating instrumentation with data acquisition (preferably on N.I. platform). A list of customers in India and abroad with details must accompany the quotations. Experience of having built bearing fatigue test rig for reputed bearing OEM will be highly desirable.
5. Original catalogue (not any photocopy) of the quoted model duly signed by the principals must accompany the quotation in the Technical bid. No prices should ever be included in the Technical bid.
6. Documentary proof for the claimed position and repetition accuracies must be obtained from the principals and submitted along with the relevant pages of the standards.

7. Compliance or Confirmation report with reference to the specifications and other terms & conditions should also be obtained from the principal.
8. **Validity:** Validity of Quotation not less than 90 days from the due date of tender.
9. **Delivery Schedule:-** The tenderer should indicate clearly the time required for delivery of the item. In case there is any deviation in the delivery schedule, liquidated damages clause will be enforced or penalty for the delayed supply period will be levied.
10. **Risk Purchase Clause:-** In the event of failure of supply of the item/equipment within the stipulated delivery schedule, the purchaser has all the right to purchase the item/equipment from other sources on the total risk of the supplier under risk purchase clause.
11. **Payment:-** No Advance payment will be made for Indigenous purchase. However 90% Payment against Delivery and 10% after installation are agreed to wherever the installation is involved. In case of import supplies the payment will be made only through 100% Letter of Credit i.e. (90% payment will be released against shipping documents and 10% after successful installation wherever the installation is being done).
12. **Advance Payment:-** No advance payment is generally admissible. In case of specific percentage of advance payment is required, the Foreign Vendor has to submit a Bank Guarantee equal to the amount of advance payment and it should be routed through the Beneficiary Bank to the end user Bank. Otherwise, the Indian Agent of the foreign vendor has to submit a Bank Guarantee through a Nationalized Bank of India.
13. **On-site Installation:** - The equipment or machinery has to be installed or commissioned by the successful bidder within 15 to 20 days from the date of receipt of the item at site of IIT Madras.
14. **Warranty/Guarantee:** - The offer should clearly specify the warranty or guarantee period for the machinery/equipment. Any extended warranty offered for the same has to be mentioned separately. (For more details, please refer our Technical Specifications).
15. **Late offer:** - The offers received after the due date and time will not be considered. The Institute shall not be responsible for the late receipt of Tender on account of Postal, Courier or any other delay.
16. **Acceptance and Rejection:** - I.I.T. Madras has the right to accept the whole or any part of the Tender or portion of the quantity offered or reject it in full without assigning any reason.
17. **Do not quote the optional items or additional items unless otherwise mentioned in the Tender documents / Specifications.**
18. **Disputes and Jurisdiction:** -

- a. **Settlement of Disputes:** Any dispute, controversy or claim arising out of or in connection with this PO including any question regarding its existence, validity, breach or termination, shall in the first instance be attempted to be resolved amicably by both the Parties. If attempts for such amicable resolution fails or no decision is reached within 30 days whichever is earlier, then such disputes shall be settled by arbitration in accordance with the Arbitration and Conciliation Act, 1996. Unless the Parties agree on a sole arbitrator, within 30 days from the receipt of a written request by one Party from the other Party to so agree, the arbitral panel shall comprise of three arbitrators. In that event, the supplier will nominate one arbitrator and the Project Coordinator of IITM shall nominate one arbitrator. The Dean IC&SR will nominate the Presiding Arbitrator of the arbitral tribunal. The arbitration proceedings shall be carried out in English language. The cost of arbitration and fees of the arbitrator(s) shall be shared equally by the Parties. The seat of arbitration shall be at IC&SR IIT Madras, Chennai..
- b. **The Applicable Law:** This Purchase Order shall be construed, interpreted and governed by the Laws of India, Court at Chennai shall have exclusive jurisdiction subject to the arbitration clause.
- c. Any legal disputes arising out of any breach of contract pertaining to this tender shall be settled in the court of competent jurisdiction located within the city of Chennai in Tamil Nadu.

19. All Amendments, time extension, clarifications etc., will be uploaded on the website only and will not be published in newspapers. Bidders should regularly visit the above website to keep themselves updated. No extension in the bid due date/ time shall be considered on account of delay in receipt of any document by mail.

Acknowledgement:- It is hereby acknowledged that the tenderer has gone through all the conditions mentioned above and agrees to abide by them.

SIGNATURE OF TENDERER

ALONG WITH SEAL OF THE

COMPANY WITH DATE

**Department of Mechanical Engineering
Indian Institute of Technology Madras**

4th January 2018

Quotations are invited for an **AUTOMATED ACCELERATED LIFE TEST RIG** with the following details:

A) Technical Requirements:

An automated accelerated life test rig is required for conducting bearing life tests. The principal components of the test rig are shaft supported by test bearings, motor, load bearings, and loading arrangements. The test rig will also have the capability of acquiring data from data acquisition sensors in addition to recording operating conditions (load, speed, the temperature of the test/load bearings etc.). Various specifications of the accelerated life test rig are discussed below:

i) Rig setup:

The test rig should consist of a shaft supported by two test bearings on each side of the shaft and two load bearings at the centre of the shaft.

a) Shaft Specifications and requirements: (stepped shaft)

- 1) The rotor should behave like a rigid rotor.
- 2) The maximum load applied at the center of the shaft is 8000 N. The load induced in each bearing should be measured within 1% accuracy using load cell or a similar device.
- 3) The maximum rotation speed of the shaft is 5000 rpm. The speed should be controllable at the exact set speed within +/-10 rpm or better.
- 4) The shaft should be designed such that stresses induced in the shaft while operating under maximum load and speed conditions are lesser than the allowable stress of the shaft.
- 5) The shaft should not bend and buckle under loading.

b) Bearing specifications:

- 1) Inner diameter of test bearing is 25 mm, outer diameter is 52 mm and width is 15 mm (**SKF Bearings**) **BB1B420205**
- 2) The diameter of the load bearing should be chosen such that its basic dynamic load capacity is at least thrice of basic dynamic load capacity of the test bearing.
- 3) The load bearings should also be from **BB1B** series (easily removable cage)

c) Bearings replacement:

The rig should have an easy arrangement for replacing the bearings without damage. The arrangement should be detailed in the technical bid.

d) Bearing dust prevention:

The rig should provide for an explicit sealing arrangement for the bearings to prevent contamination from dust.

ii) Floor area:

The overall floor area of test rig (excluding the floor area for the hydraulic tank for loading) should be less than 0.6m x 1m.

iii) Motor drive:

The motor should connect to the shaft directly through couplings (V belt/timer belt should not be used). The speed of the motor should be increased stepwise. For example, to reach a speed final operating speed of 2000 rpm, the motor should run in the steps of 200 rpm (fixed speed step) and should wait at each intermediate rpm stage for the temperature to stabilize and then move to the next step.

iv) Speed Control and data acquisition:

The motor should have the capability of operating at different speeds that may be achieved by attaching a variable frequency drive to the motor or any other means possible. The variable frequency drive may be operated with the help of a National Instrument (NI) card. This card should monitor the speed of the test rig and uses the feedback loop to correct the speed, if deviated. The NI card should acquire the speed of the test rig, display it on a screen and also write in a log file. In case of any other equipment, all the above-mentioned requirements must be satisfied. (Speed sensor: any laser-based sensor).

v) Loading arrangement:

The test bearing in the test rig may be loaded by applying loads on the load bearings. Loads should be applied by a hydraulic or pneumatic loading arrangement. A load cell connected to an NI card should be used to acquire/display the applied load. Similar to the speed, the applied load also should be controlled using a feedback loop. The NI card attached will also ensure that the applied load is not sudden and is in the steps of smaller steps. For example, a sudden application of 1000 Kg load may damage the bearing. However, application of 1000 Kg in the steps of 50 Kg (fixed step) may not damage the bearing. Load cell maximum load capacity is 1000 kg.

vi) Power cut handling arrangement:

The test rig is required to run for long durations without any stoppages. However, frequent power cuts may harm the experiments. In the event of a power cut (irrespective of the duration of the power cut, less than a few seconds or for a very long time), the load applied should always go to zero and machine should stop. The automatic restart (once the power comes back) should not be provided (only manual restart for both hydraulic system and machine).

vii) Cooling Mechanism:

The bearing operating temperature should not cross 70° (industry guidelines), for a continuous running of 48 hours (under max load & speed condition). A cooling mechanism should be provided to delay the time taken by the machine to reach 70° and to bring it back within the limit as early as possible. However, when the operating temperature crosses 70° (after 48 hours of the uninterrupted run), the operating software should stop the machine.

viii) Noise reduction arrangement:

The test rig should not cross the noise limit of 75 dB (for continuous operation under max load and speed conditions).

ix) Resonance frequency:

The rig should be rigid enough so that no structural resonance is setup in the operating speed range. This aspect should be proven by the bidder through scientific means.

x) Sensors for data acquisition:

The sensors for data acquisition (accelerometers, pressure microphone, PU probe, Acoustic emission sensor, proximity pickups etc.) for the data acquisition will be provided by IIT Madras and hence not to be included in the pricing. The rig design should ensure easy sensor replacement. The information regarding the number of sensors and the sizes may be obtained from the undersigned.

xi) Sensors for control and operation:

It may be noted that all other sensors (load, speed, temperature sensors and/or any other sensor) are within the scope of the vendor. The supplier should provide a full list of the make of all the parts.

xii) Data acquisition system and control cards:

The integration of all sensors (mentioned both in points **x** and **xi**), acquisition card, and data processing hardware/software will be the responsibility of the rig manufacturer in consultation with IIT Madras. The DAQ integration should be done using LabVIEW and NI based hardware. The cost of data acquisition system and NI based control cards **may not be included in the price bid** and will be separately budgeted.

xiii) Operating software:

The operating software (LabVIEW based) for the test rig is required to set the operating conditions such as load, speed, incremental load steps, temperature threshold, etc. The software should be able to control all the NI cards, assist in data acquisition, display, and recording the key parameters in a log file. The software should also compute basic features (details may be obtained from undersigned) from the vibration data and display those as trending parameter.

Operating software requirements:

1. Control software should be such that both manual and automatic operation of the bearing test rig is possible.
2. Both Load and speed control is needed to be provided, with a feedback control. In case of any deviation from the actual values, the software should initiate action to bring the load and speed values back within the defined control limits.
3. During the power failures, the load applied on the spindle assembly should go back to zero and manually start again from zero.
4. Temperature tripping facility (machine stops if temperature crosses a particular threshold) should be inbuilt in the software.
5. Load application should be in the steps of 50 kg (maximum), with the initial load applied being 50 kg.
6. The difference in the applied load and actual load on the spindle should be within $\pm 1\%$ of the load applied.
7. In case, multiple cylinders are used for load application, the difference between in actual load between different cylinders should be within $\pm 5\text{Kg}$.
8. Loads, speed of the spindle, and temperature at the outer race of the test and load bearings (4 places) are to be displayed.
9. The output of the load, speed, and temperature should be in a specific format, provided by IIT Madras.
10. Source files (.vi files) of the software are to be provided to IIT Madras, so that any future changes in the software may be accommodated.
11. As the development of the control software is of interactive nature, several minor adjustments/modifications are required for the appropriate functioning of the operation.

Many of these small modifications may not be predicted beforehand and may be known only at the time of installation and testing. Therefore, any problems detected in the software for within 6 months of the delivery should be corrected free of cost.

12. A document explaining salient features of the software and steps to be taken for troubleshooting of the control should be provided along with software.

xiv) Safety and Emergency Stop:

The rig should have adequate safety devices and controls including an emergency stop to allow unattended safe running of test setup almost 24x7. All the rotating parts should have some cover so that any loose part doesn't hit the operator or any other visitor nearby. The emergency stop should be provided at a distance from the machine so that machine could be stopped without going near to the machine.

xv) Drawing approval:

Drawings for the rig should be submitted to IIT Madras for approval prior to manufacturing. The requirement of machining tolerances for various mating parts such as spindle, housing, spacer etc. for such test rig and should be discussed with IIT Madras. There will be preassembly check of tolerances on the components, in particular of shafting and related parts for compliance. The rig manufacturer should allow an IIT Madras representative or an authorized person deputed by IIT Madras to carry out compliance check regarding tolerances.

xvi) Electrical connection details:

The details of the required electrical supply for the installation of the rig should be mentioned by the rig manufacturer in the technical bid.

B) Other Terms and conditions:

- 1) The financial bid should have item wise details under the following (modules).
 - i) Software development cost
 - ii) Panels, and integration cost for all NI components, sensors.
 - iii) Design & development & fabrication cost (containing cost of all the hardware, sensors, motors, etc.)
 - iv) Loading mechanism hydraulic/pneumatic power pack cost
- 2) The order may contain different modules based on the availability of the budget/funds.
- 3) Minimum 1 years warranty/guarantee period.
- 4) Maintenance for 3 years (inclusive warranty/guarantee period).
- 5) A detailed manual describing all the parts of the machines, their dismantling/assembly procedures, operating procedures should be provided.
- 6) A machine operating demo should be provided by the rig manufacturer.
- 7) Delivery of the machine should be within 4 months of the release of P.O.
- 8) Quick after sales support and technical help within 24Hrs of call during the experimentation is highly desirable and mechanism for it be explicitly stated in the technical bid.

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