

Tender Notification for Procurement

Interdisciplinary Centre for Energy Research

Indian Institute of Science, Bangalore 560012

Quotations are invited for the procurement of a fuel cell/stack test station towards exhaustive parametric analysis of the fuel cell/stack. The requirement is towards investigating the performance of a PEM fuel cell/stack fuelled with in-situ generated bio-Hydrogen. The test station should basically permit exhaustive and intricate tests with precise control over a range of parameters (like temperature, pressure, humidity etc) to enable analysis of the fuel cell/stack performance with bio-Hydrogen. The requirement is for a project sanctioned by the Department of Science and Technology. The quotation should clearly indicate the terms and conditions of delivery, delivery schedule, entry tax, payment terms, warranty coverage etc. The quotation should be submitted in two parts: Part I (Technical bid) and Part II (Commercial bid).

In light of the prevailing situation, all meetings shall be scheduled online through Microsoft Teams / other suitable online meeting platforms.

Important dates

| Sl.No | Item | Date |
|--------------|---|------------------|
| 1 | <p>Two bid tenders last date</p> <p>The tenderer should submit Technical and Financial Bid separately in sealed envelope super scribing the envelope as 'Technical Bid' and 'Financial Bid'. Both these envelopes should again be put in a single envelope.</p> <p>The documents should reach;</p> <p>Chairman; ICER; Indian Institute of Science; Bengaluru 560 012. Attention: Prof S Dasappa</p> | 20th August 2020 |

Background

Proton exchange membrane (PEM) fuel cells are tipped / expected to displace conventional internal combustion engines as the principle energy conversion devices. While fuel cells have fundamental advantage of delivering nearly double the energy conversion efficiency and virtually no tailpipe emissions, they are limited on the fuelling part with ability to handle only Hydrogen in the electrochemical redox reaction. With conventional Hydrogen generation approaches overwhelmingly dependent on fossilized hydro carbon based resources, the need for decarbonizing the energy sector requires adoption of alternative approaches. It is interesting to note that there are only two naturally occurring compounds containing Hydrogen: Water – H₂O and Biomass – C_{1.0}H_{1.4}O_{0.6}. An IISc patented thermo-chemical reactor adapted to operate with steam and oxygen as the gaseous media can generate almost 100 g of Hydrogen per kg of Biomass. The biomass so

developed qualifies as green / renewable Hydrogen. In the current proposal efforts are towards fuelling a PEM fuel cell/stack using bio-Hydrogen to establish green Hydrogen fuelled PEM fuel cell system as a high efficiency green energy conversion system. While PEM fuel cell/stack operation with ultra-pure Hydrogen is well established, fuelling the system with bio-Hydrogen is challenged by the presence of a range of condensable higher hydrocarbons and also carbon monoxide, the key energy contributing gas generated during gasification. While gasifier unit down-stream elements are being designed and put in place to generate pure Hydrogen as per ISO 14687:2019 specifications, it is also critical to explore operating condition tuning to enable the fuel cell/stack to take higher levels of contaminants, thereby reducing the cost of gas conditioning process. Towards realizing the identified deliverables, a state of the art, fuel cell/stack test station which will permit carrying out exhaustive parametric analysis of the fuel cell/stack fuelled with in-situ generated bio-Hydrogen is a preliminary requirement. The test station should basically permit exhaustive and intricate tests with precise control over a range of parameters (like temperature, pressure, humidity etc) to enable analysis of the fuel cell/stack performance with bio-Hydrogen. In line with identified objectives and deliverables in the proposal, following specifications are identified for the fuel cell test station.

Fuel cell/stack test station specifications.

1. A modular test bench frame with basic frame, safety installations and functions, power supply, general features
2. Reliable design through precise engineering with three-stage high level safety standards.
3. Suitable for testing different PEM fuel cell technologies (low temperature to high temperature) and for different cell/stack geometries
4. Test Station expandable as per the customer requirement with more functionalities.
5. Test station with ability to draw up-to about 1 kWe peak power.
6. Electronic load box for loading in the range 0 to 5 V DC and 0 to 150 Ampere with control accuracy of $\pm 0.05\%$, 0.5% and 0.3% for current/voltage, power and resistance respectively.
7. Load operation modes: Constant current, Constant voltage, Constant resistance, Constant power.
8. Fully automatic active Load box control and Load box operation has to be fully integrated and under control of the test automation
9. Module for Anode gas supply: mass flow controllers with Anode Hydrogen flowrate: 0.05 to 3 NL/min; Anode Nitrogen flowrate: 0.1 to 10 NL/min.
10. Module for Cathode gas supply: mass flow controllers with Cathode Oxygen flowrate: 0.05 to 3 NL/min; Cathode Air flowrate: 0.2 to 15 NL/min; Cathode Nitrogen flowrate: 0.1 to 10 NL/min.
11. On-board inert gas storage with capacity atleast in excess of 5 Litres at 4 bar purge pressure and auto system cut off feature in the event of non-availability of inter gas (in terms of flow / pressure)
12. Fuel and air pressure in the range 1 to 1.5 bar absolute.
13. Anode and cathode gas temperature control up to 200 deg C
14. Electrochemical workstation with impedance 100 $\mu\Omega$ to 1.5 Ω and frequency 100 μHz to 100 kHz
15. Reliable and approved software and GUI for screen oriented manual operation and user defined test automation
16. Additional interface enabling the creation of customer designed LabView GUIs
17. Test bench software has to provide interfaces and links for the suitable integration with HIL simulation tools with the purpose to simulate fuel cells in stationary and also various automotive applications.

Other generic terms of reference are as identified below;

1. Multi-Level Safety Monitoring

A tool for multi-level safety monitoring is required to ensure the optimal safety of operator, unit under test and test bed in all operating states.

2. Services to be supplied on various aspects related to the installation:

i. Electrical Engineering:

- Electrical integration of all test system components at IISc test cell environment.
- The electrical engineering has to be carried out according to EN-60204-1 - Safety of machinery.

ii. Mechanical Engineering:

Mechanical / physical integration of the test system components at IISc test cell environment comprising of the following but not limited to:

- Creation of a 3D layout of the test cell, the operator area and –if applicable – the technical area. Note: Drawings of the concerned part of the building will be provided in a suitable digital format by IISc.
- Detailed Engineering and specification of specific components and subsystems as specified in the technical specifications.
- Arrangement of the equipment / components / devices to be supplied and incorporation of them into the 2D-layout.
- Design drawings are to be delivered.
- Fuel storage guidelines must be clearly specified for a variety of gaseous fuels along with safety aspects.

iii. Mechanical Installation and Commissioning:

Ensuring correct erection of the mechanical parts of the system (according to the scope of supply) and to guarantee compliance to installation specifications prior to test system commissioning and productive operation.

- Positioning and mounting of all equipment in cooperation (if necessary with local subcontractor)
- Removal of protection coatings and transport locking device(s)
- Alignment of equipment at designated location
- Commissioning of mechanical system elements

iv. Commissioning:

Well trained, qualified and certified engineers shall perform all required steps to get the single equipment and complete test system ready for the acceptance test as defined in the particular agreement. Following activities are to be included:

- Check of power & media supply, data, measurement and sampling connections.
- Installation, configuration and parameterization of all software.
- Allocation and verification of used I/O and measurement channels according to engineering.
- Interfacing of peripheral equipment based on scope of supply.
- Commissioning work is carried out with one fully functional single cylinder research engine.
- Controller set-up and basic tuning for the given UUT/Load System combination as a preparation for the Final Acceptance Test.

3. Documentation:

Includes a compilation of following documents (digital format); user manuals included typically:

- Operating manual.
- Maintenance instructions and schedules.
- Spare and wear parts lists as well as a list of consumables, safety instructions and a troubleshooting guide.
- Emergency measures according to the safety matrix.
- Documentation of third party products (language as available).
- System engineering drawings.
- Description of the test bed layout and functionality.
- Trouble shooting and emergency measures.

The documentation shall be provided in English language.

4. Other Items

- The vendor must submit a signed compliance document mentioning whether their equipment meets each and every specification detailed above.
- The award of the tender will be decided by the institute as per price of the complete system. All insurance charges shall be borne by the vendor.
- Technical and financial bids should be submitted separately.
- All prices of the fuel cell/stack test station and accessories should be quoted in currency of respective country of origin of the equipment.
- The specifications mentioned shall be understood to be the minimum required. Additional technical and research features suitable to our requirements shall be given due reference.
- Vendors that submit qualifying technical and financial bids are required to send competent representatives from the sales and technical divisions for further negotiations.

All the communication in this regard should be addressed to:

The Chairman
ICER,
Indian Institute of Science
Bangalore 560 012
India

With attention to Prof. S Dasappa.

The email communication should be to dasappa@iisc.ac.in.

SPECIFIC TERMS AND CONDITIONS

The following requirements should be specifically adhered to by the vendor, and express indication should be given regarding adherence.

1. GUARANTEE PERIOD

- The equipment should be guaranteed for a period of 12 months from the date of handing over the fully functional unit to the Institute, against manufacturing defects of material and workmanship.
- Separate list of spares desirable for an R and D lab along with costs to be provided separately with individual costs.

2. POST GUARANTEE ANNUAL MAINTENANCE CONTRACT(AMC)

Annual maintenance contract (AMC) for the complete system will be start after expiry of the warranty period as per agreed terms and conditions. The contract will also include the recommissioning of the system for what so ever reasons.

- Costs for the post-guarantee 3 years of annual maintenance contract for the complete system which includes all the accessories supplied during the installation. One annual visit by relevant subject expert(s) must be scheduled during the period of AMC.
- The amount due every year on account of the AMC will be paid at the beginning of theyear to the vendor.

3. WARRANTY

- The complete system is to be under warranty period of 36 months including free supply of spare parts, and labour from the date of functional installation, commissioning and acceptance.
- During the period of warranty the supplier is required to take full responsibility to recommissionthe system in the event of failure whatsoever reasons.

4. DOCUMENTATION

- Two sets of operational/service/application manuals are to be provided along with the Equipment in English.
- Detailed documentation on various sequences, application software and evaluation software etc. are to be provided and the same must be updated regularly for next 10 years as and when these are released.
- Supplier is required to ensure mailing of product/research newsletters released from their R&D sites to the our site on a regular basis. This is to keep this centre abreast of the latest developments taking place in system technology and research techniques.
- The vendor is to provide a tender compliance sheet by giving all the necessary specifications, which should be supported by printed documentation sheets and certification of each item. In the absence of such documentation, a letter from the principals of the company should be provided.
- The vendor must provide at least one USER SATISFACTION CERTIFICATE for equivalent / similar kind of supply and installations.

5. SOFTWARE UPGRADATION

Software upgrades for the core system and all related applications for next 10 years to be provided free by the firm as a matter of routine as and when these are released, inclusive of minor hardware changes.

6. RESEARCH COOPERATION (Optional)

- The vendor is required to provide work in progress packages to us for research trial as for their other research sites. The firm should provide an exhaustive list of performance of various engines which will help the research and cooperation.
- The vendor should extend demonstrated cooperation regarding design and implementation of novel hardware and software inputs as required by the user, such as newer analysis techniques, emissions standards, post-processing, synthesis of data.
- Specific proposal regarding research collaboration will be submitted subsequently for consent and counter signatures of the principals on the research proposal.

7. DELIVERY, INSTALLATION & COMMISSIONING OF THE SYSTEM

The facility should be built and the test station should be delivered, installed and functionally commissioned within 3 months from the date of receipt of confirmed supply order. The supply of the items will be considered as effected only on satisfactory commissioning and inspection of the system by the institute. After successful installation and inspection, the date of taking over of the complete running of the test station by the institute shall be taken as the start of the warranty period.

8. CUSTOM CLEARANCE

The Institute will furnish the necessary papers for the import of items into India, necessary custom duty exemption certificate and other supporting documents to facilitate the import of the items.

Note: Institute has got into an agreement with M/S FEI Cargo for custom clearance of all imported equipments to the Institute.

9. TRAINING

The supplier, at their expense, will arrange for an application specialist, immediately after the installation and commissioning of the fuel cell test station, to demonstrate the capabilities/features of the system and also to impart training to staff members. The supplier, at their expense, shall provide initial specialized training at our site by a research scientist and a research engineer from the supplier's international R&D Centre or from an internationally renowned centre; the training shall cover the state of art research application, together with system operation and first line maintenance of the system, system and application software, along with developmental aspects for modifications and development of user defined sequences, for various application purposes, etc. The travel, boarding and lodging expenses of the above personnel, scientist and engineer shall be borne by the vendor and this training should be completed before handing over the system to the institute.

10. MODE OF SHIPMENT

The consignment must be air-lifted, insured and transported to the installation site by the supplier.

11. PAYMENT TERMS

A confirmed irrevocable and divisible letter of credit will be opened with the bank designated by the vendor with 80% of the total cost payable against confirmed proof of dispatch and the remaining 20% balance on successful installation against a bank guarantee of 10% of the total cost for the 3 years warranty period.

TERMS AND CONDITIONS FOR SUBMISSION OF BIDS

Both the Technical and Commercial bid should be put in separate sealed envelopes and both the envelopes should be put in another cover subscribing “**Fuel Cell Test Station**” and should reach “*The Chairman, Interdisciplinary centre for Energy Research, IISc, Bangalore-560012*” on or before **20th August 2020.**

The Technical bid must include all the details of technical specifications of the equipment, compliance certificate along with commercial terms and conditions, **however, without the price component.** The bill of materials, printed technical brochure and any other documents to help the technical evaluation of the bid may be enclosed.

1. The commercial bid must include the price of the item(s) in Indian/Foreign currency indicating the breakup of

a) For Goods manufactured within India

- (i) The price of the goods quoted Ex-works including taxes already paid.
- (ii) GST and other taxes like excise duty, entry tax and other applicable taxes which will be payable on the goods if the contract is awarded.
- (iii) The charges for inland transportation, insurance and other local services required for delivering the goods to IISc, Bangalore.
- (iv) The installation, commissioning and training charges including any incidental services, if any with applicable service taxes.

(b) For Goods manufactured abroad

- (i) The price of the goods should be quoted on CIF/DAP Bangalore, India basis.
- (ii) The charges for insurance and transportation of the goods by Air/Sea up to Bangalore India.
- (iii) The agency commission charges, if any.
- (iv) The installation, commissioning and training charges including any incidental services, if any.

2. The invoice to be billed at applicable GST and for concessional GST rates, GST concession certificate(s) shall be provided.

3. Please indicate the import code of the items.

4. Goods found to be defective by the committee during installation and warranty have to be replaced / rectified. Items found not acceptable or missing have to be replaced / rectified. Replacement of parts to be at the cost of the supplier (including all incidental charges), within 15 days from the date of receipt of written communication from us. If there is any delay in replacement / rectification, the warranty period should be correspondingly extended.

5. The terms FOB, FCA, CIF, CIP, etc., shall be governed by the rules prescribed in the current edition of the Incoterms published by the International Chambers of Commerce, Paris.
6. The purchases made by the purchaser for scientific purpose are exempt from excise duty and Custom Duty at a concessional rate is leviable.
7. Conditional tenders shall not be accepted.
8. Bids shall remain valid for minimum of 90 days after the date of bid opening prescribed by the Purchaser.
9. The Purchaser reserves the right to accept or reject any bid, and to annul the bidding process and reject all bids at any time prior to award of Contract, without thereby incurring any liability to the affected Bidder or Bidders.
10. The bidder should have established track record of Design, Manufacturing and supply of Rotor Balancing Machines.
11. Technical support for 3 years must be provided.
12. Onsite inspection of the machine will be done by IISc before the dispatch at IISc cost.

Annexure-I

Note: Compliance Certificate to be enclosed with the technical bid

| Description | Comply | Non-comply | Deviation from specifications | Remarks |
|--|--------|------------|-------------------------------|---------|
| <ol style="list-style-type: none"> 1. Upto 1 kWe of power loading capacity 2. Electrochemical workstation with impedance 100 $\mu\Omega$ to 1.5 Ω and frequency 100 μHz to 100 kHz 3. Provision for testing <ol style="list-style-type: none"> a. Low temperature fuel cells/stacks b. High temperature fuel cells/stacks c. Multiple geometry fuel cells/stacks 4. Electronic load box with range 0 to 5 V DC and 0 to 150 Ampere current with control accuracy of $\pm 0.05\%$, 0.5% and 0.3% for current/voltage, power and resistance respectively 5. Modes of loading the cell/stacks <ol style="list-style-type: none"> a. Constant current b. Constant voltage c. Constant resistance d. Constant power 6. Automatic load box integrated and under control of the test automation 7. Anode gas supply module; <ol style="list-style-type: none"> a. Hydrogen flowrate: 0.05 to 3 NL/min; b. Nitrogen flowrate: 0.1 to 10 NL/min. 8. Cathode gas supply module; <ol style="list-style-type: none"> c. Oxygen flowrate: 0.05 to 3 NL/min; d. Air flowrate: 0.2 to 15 NL/min. e. Nitrogen flowrate: 0.1 to 10 NL/min. 9. Fuel and air pressure in the range 1 to 1.5 bar absolute. 10. Anode and cathode gas temperature control up to 200 deg C 11. On-board inert gas storage with capacity atleast in excess of 5 Litres at 4 bar purge pressure and auto system cut off feature in the event of non-availability of inter gas (in terms of flow / pressure) | | | | |

Annexure-II

MANUFACTURERS' AUTHORIZATION FORM

[The bidder shall require the manufacturer to fill in this form in accordance with the instructions indicated. This letter of authorization should be on the letterhead of the Manufacturer and should be signed by the person with the proper authority to sign documents that are binding on the Manufacturer.]

Date: [insert date (as day, month and year) of Bid Submission]

Tender No.: [insert number from Invitation for Bids]

To: **The Chairman, Interdisciplinary Centre for Energy Research, IISc, Bangalore-560012.**

WHEREAS

We [insert complete name of Manufacturer], who are official manufacturers of [insert full address of Manufacture's factories], do hereby authorize [insert complete name of Bidder] to submit a bid the purpose of which is to provide the following Goods, manufactured by us [insert name and or brief description of the Goods], and to subsequently negotiate and sign the Contract.

We hereby extend our full guarantee and warranty with respect to the Goods offered by the above firm.

Signed: [insert signature(s) of authorized representative(s) of the Manufacturer]

Name: [insert complete name(s) of authorized representative(s) of the Manufacturer]

Title: [insert title]

Duly authorized to sign this authorization on behalf of: [insert complete name of Bidder]