TECHNICAL SPECIFICATION for supply of Test station for Proton Exchange Membrane (PEM) Fuel Cell

The due date for receiving the proposals against the EoI is 10th April 2021 (Saturday).

Rev 00	Approved Amrish Gupta		
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Specification for Test station for Proton Exchange Membrane (PEM) Fuel Cell

Quantity: 1 No.

Sl.#	Item description	BHEL specifications
Item Specifications		
1	Fuel Cell Test Station	Fuel Cell Test Station is required for testing Low Temperature Proton Exchange Membrane (LTPEM) based Single Cells. It should have an integrated PLC/equivalent functional system to provide highly accurate, noiseless, reliable data acquisition, precise, real time control loop operation and 3-level alarm management for maximum operational safety. It should have a humidification system including flexible hose trace heating. Fully reliable and programmable, automated operation in hydrogen safe area. It should also have a provision for integrated impedance analyzer.
2	Detailed specifications	The detailed technical specifications : Typical test items : Single cells active area ranging from 200 to 500 cm2 . Maximum power rating : 1200 Watt. Ambient Temperature Range: 20 to 40 Deg C. a. Electronic load details • Voltage : 0- 5 VDC • Accuracy : ± 0.1 % of the selected value over the range • Current : 0-700 A • Accuracy : ± 0.1% of the selected value over the range • Load box should be capable of drawing current up to 700 A at 0.1 VDC (True zero voltage mode) • Provision for operating under three modes o Constant current o Constant voltage o Constant resistance b. Gas flow : • Anode gas flow range : 0.5 to 15 Nl/min for hydrogen with check valve, gas filter, MFC and solenoid valve. • Cathode gas flow range : 0.5 to 75 Nl/min for Air with check valve, gas filter, MFC and solenoid valve. • Nitrogen gas flow range: 0.5 to 25 Nl/min provided with check valve, gas filter, MFC and solenoid valve. Provision to be enabled to mix N2 in either of existing line of anode or cathode for dilution of live pure gases of Hydrogen or Air. c. Mass Flow Controller accuracy : ± 0.2 % FS ± 0.8 % of actual value. d. Onboard N2 storage: Test station should comprise SS tank of volume capacity 5 lts or higher for automatic filling of Nitrogen gas from supply line provided with 3-5 bar pressure. e. N2 Purging: • Nitrogen gas should be circulated through anode and cathode gas supply lines of inlet to exit during shut down • Provision to supply required quantity of N2 gas into either of the anode or cathode gas supply line during testing.

3	Humidification	• Saturated gases of anode and cathode should be free of water droplets • All the humidifier lines provided with heating arrangement to control humidifier exit gases at required set temperatures • Provision for automatic refilling of DI water from overhead DI water tank (atmosphere pressure) to the respective humidifiers of anode and cathode • Dew-point control range : Ambient to 90 Deg.C • Dew-point control accuracy : ± 1 Deg.C (steady state, ± 2 Deg.C under difficult conditions) • Dry Gases : Provision for dry gases through by-pass • Trace heating : Heating hoses from humidifier until test item to avoid condensation and to achieve highly precise gas temperature control accuracy. a. Temperature control : • Precise temperature control of anode and cathode gas flow and test item temperature with Pt 100 temperature sensors • Thermocouples OD size of 1.5 mm or lower tip diameter, minimum of 60 mm probe length and 1 meter cable length • Total thermocouples required - 8 Nos. (5Nos. thermocouples required for monitoring the local temperatures and 3 Nos. for feedback application along with temperature controllers. • 3 nos. of onboard temperature controllers with power supply of 220 VAC and 250 W receptacle for blower / heater (250W/220 VAC) for cooling / heating the test cell to maintain set temperature • Gas temperature control range : Ambient to 130 Deg.C for maximum gas flow rates as mentioned in the mass flow specifications • Maximum heated hose temperature : 180 Deg.C max gas temp • Gas temperature control accuracy : ± 1 Deg.C (steady state) b. Back Pressure control and Display : o Onboard front and back pressure local displays for anode and cathode sides o Monitoring differential pressures between anode and cathodes inlets and outlet respectively via programmable software o Manual back pressure control range at cathode and anode : 1.1 to 2.5 bar o Control and measurement points : Anode and cathode outlets o Accuracy in pressure displays: ±20 mbar of the measured value o Accuracy in pressure control: ± 25 mbar (steady state) c. Safety : • PLC/ equivalent functional system : Onboard Hydrogen leak detector with 3-level alarm management system for safe and unattended 24/7 operation, dry relay input for external LEL sensor, dry relay input for laboratory alarm, laboratory ventilation system alarm, external shut-down of test station. • Piping Material : SS316 or PTFE for all wetted parts. • CE Conformity according the product safety directives 2001/95/EC • Confirm to Risk assessment ISO13849 and 12100

4	Programming requirements	The programmable test station should have the following provisions for testing the cell performance characteristics. a. Continuous test cycle: Test cell life time testing under constant load and variable load profiles. of ramp, step and random at various intervals of time. b. ON/OFF test cycles : It has to be programmed such that the electronic load, humidifiers, reactant preheaters etc. have to be active (ON) once the cell temperature meets the specified value. c. Provision for feeding minimum of 4 load profiles for testing at different time scales when the load is ON /active. d. Cell has to be turned OFF after completion of load profiles and has to be cooled back to room temperature and cell has to be heated back to specified temperature. e. Items b & d is considered as one cycle, such cycles have to be repeated for specified number of cycles with an inbuilt program as input. f. Save and recall facility of load profiles. g. Should have separate functional program call for ON/ and life time testing. h. Dynamic efficiency: GUI should be enable with cell efficiency in % based on actual power out against the lower heating value (LHV) of H2 combustion i. Overall efficiency: GUI to be enabled with overall cycle efficiency in % based on the actual cumulative power out (kWh) against the lower heating value (LHV) of total H2 consumption
5 (a)	Impedance Analyzer	• Impedance range: 200 µOhm to 1.5 Ohm • Cell/Stack Max. Input conditions : DC Current : 700 A; DC Voltage : 5 V • Frequency range: 100 µHz to 100 kHz. • Amplifier Modulation Range : Current ± 100A; Voltage ± 5V • Accuracy: ± 0.5 % of reading value. Completely integrated system, measurement under electronic load test conditions to give full Nyquist plot over a range of frequency band.
5 (b)	Extension of EIA for Cyclic voltammetry/ Linear sweep experiments	Configuration of electrodes: 3 Nos (Working, reference and counter electrode) Voltage range: 0-3V Current: +/- 100A for test cell of active area 225 cm2 Sampling time: 10ms to 100 ms Voltage scanning rate :10mV/s to 100mV/s
5 (c)	Any external device or an integrated analyzer to fulfil the functions of 5a and 5b can be allowed, price may be quoted separately mentioning the model details.	
6	Generation of Test profiles	Generation of cell performance/efficiency curves for a given test profiles : Cell performance evaluation in terms of I-V characterization curves for the following operating conditions. o Constant curent mode o Constant voltage mode o Constant power mode

7	PDI	Continuous operation of fuel cell test station with test sample cell for a minimum period of 100 Hrs. as part of PDI in the presence of BHEL executives at the manufactures site. Training of BHEL executives at the manufactures site on Fuel Cell Test Station operation skills.
8	Manufacturer's test Certificate :	Manufacturer's test Certificate for 1000 hours of continuous operation has to be provided.
9	Data logging & Display :	Display monitor not less than 32" or higher size and compatible software to be provided by the vendor to supervise the variables of interest and to monitor the complete process and to store the data of key process parameters (storage capacity not less than 1 tb, RAM : 4 GB; processor: IntelR i5 – 3.1 GHZ)
10	Accessories	Offer shall include all the accessories required for trouble free operation of equipment at BHEL R&D. Only proto type 3 cell stack would be provided by BHEL while commissioning of test system at BHEL
General Specifications		
1	General Specifications :	The vendor should intimate to BHEL R&D regarding electrical power source rating and civil foundation requirements along with drawings well in advance.
2	Pre dispatch Inspection at OEM site :	Supplier should intimate the readiness of equipment before PDI. PDI of equipment will be carried out at supplier's works by two BHEL engineers. The Vendor shall give minimum of 45 days notice for PDI. Time frame for PDI has to be intimated. Travel and hospitality for two BHEL engineers will be to BHEL account.
3	Training :	Training has to be provided by the installation engineers for all modes of equipment along with accessories at site of installation (BHEL, R&D, Hyderabad). Training should also be provided on safety features, task to be performed in case of emergency, etc. Detailed scope/ daily schedule and duration of training has to be indicated. The training charges, if any, have to be quoted separately.
4	Erection & Commissioning (E & C) :	Supplier is responsible for erection & commissioning of the entire system at BHEL R&D premises with BHEL proto 3 cells PEM fuel cell stack. E & C charges shall be quoted separately.
5	Warranty of Equipment :	The equipment should be under warranty for a period of 1 year from the date of commissioning or 18 months from dispatch, whichever is earlier. During warranty period, if there is any repair to be carried out at the supplier's works, transportation cost of equipment/component besides repair / replacement charges, if any, should be borne by the supplier.
6	Annual Maintainance Contract (AMC) :	After completion of standard warranty period, OEM/Authorized Indian Agent should provide AMC for a period of 3 years. BHEL reserves the right to release separate AMC order after completion of standard warranty period as per the charges quoted in this bid.
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