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Shaping Energy for a Sustainable Future

TECHNICAL SPECIFICATIONS FOR THE CONTRACTING OF THE SUPPLY AND INSTALLATION OF A TEST BENCH REVERSIBLE ELECTROLYZER AND FUEL CELL OR "SOFC/SOEC TESTBENCH" FOR THE FUNDACIÓ INSTITUT DE RECERCA EN ENERGIA DE CATALUNYA (IREC)

CASE NO. 25-0042

1. OBJECT

The purpose of this document is to define the minimum technical and functional characteristics for the contracting of the supply of a reversible electrolyser and fuel cell test bench or " sofc / soec" testbench » (hereinafter the SOFC/SOEC test bench) for the Foundation Institut de Recerca en Energia de Catalunya (hereinafter, IREC). This equipment must allow, without the need for additional or auxiliary elements to those described in this specification, the operation and electrochemical characterisation of solid oxide fuel cells at high temperatures in a power range of up to 3 kW in fuel cell mode (SOFC) and up to 10 kW in electrolysis mode (SOEC), expandable in the future up to 10/25 kW SOFC/SOEC, for long periods (up to 1000 h).

The SOFC/SOEC testbed is required to carry out the tasks of work packages 3, 4, and 5 of the H2SHIFT project (HORIZON, project ID: 101137953) consisting of the implementation of a characterisation service for SOFC/SOEC technology stacks up to a power of 3/10 kW respectively, produced by startups and SMEs to assist them in the development of efficient solutions for hydrogen production. The chosen power range allows the testing of individual stacks and of sets of stacks with a capacity suitable to enter the hydrogen production market. The testbeds available at IREC do not allow the power to exceed 5 kW in SOEC mode, being too small to reach the technology maturity levels defined in the project (TRL 5-8). Given this evidence, the acquisition of a 3/10 kW SOFC/SOEC reversible test bench, expandable in the future up to 10/25 kW SOFC/SOEC, has become a necessity to achieve the objectives of the H2SHIFT project.

The equipment is part of the H2SHIFT Project (Services for Hydrogen Innovation Facilitation and Testing), which is funded by HORIZON, EU (GA No. 101137953).

2. SUPPLY COMPONENTS

- Supply and installation of the SOFC/SOEC test bench, with the minimum characteristics required in this specification.
- Supply and installation of the equipment control system and software.
- Delivery of documentation.
- Training.

3. MINIMUM TECHNICAL REQUIREMENTS FOR THE SOFC/SOEC TEST BENCH

This section describes the minimum technical requirements for the SOFC/SOEC test bench that the successful tenderer will supply.

3.1. Hot zone

- High-temperature electric furnace with a minimum volume of 50x50x50 cm^3, capable of reaching a maximum temperature of 950 ºC. The furnace must be adapted to accommodate the SOFC/SOEC stack with electrical and gas connections. Its opening must allow a comfortable installation of the stack and its components. The furnace will be equipped with a controller capable of establishing a heating and cooling ramp with a speed as low as 1 ºC min^{-1}.
- A preheating system is required to preheat the inlet gases of each electrode to a minimum of 700 ºC.
- A compression system will be coupled to the furnace to precisely apply and control a uniform vertical compression force at the stack coupling area (in the hot zone).
- To accommodate the stack inside the oven, a metallic base plate (minimum size 100x100x20 mm3) is required where the fuel and air inlet and outlet pipes will be welded. The type of metal used must be able to work at high temperatures (AISI310, AISI410, AISI4301, Crofer22APU, Crofer22H, ZMG, etc.).

3.2. Gas circulation system

- Two gas pipes for the inlet (fuel electrode inlet gas and air electrode inlet gas) and two gas pipes for the outlet (fuel electrode outlet gas and air electrode outlet gas) shall enter and exit the furnace.
- Gas lines for the fuel electrode: H_2 (up to minimum 30 NL min^{-1}), N_2 (up to 100 NL min^{-1}) and an additional line if the installation needs to be expanded during the equipment's useful life. The gas lines must be merged with the generated steam line (see next point) into a single inlet for the stack.
- A steam generator is required to generate superheated steam to a minimum of 200 ºC, allowing precise control (maximum 1% of full scale) of the steam flow rate, up to 6 kg h^{-1}. It must be connected to the distilled water line to allow continuous and long-term operation.
- Gas for air electrode: air (up to min. 250 NL min^{-1}).
- Gas lines must include any elements necessary for proper functioning, e.g. solenoid valve, particle filter, non-return valves, and flow controllers.
- All gas lines through which steam will circulate must be heated to a minimum of 200 ºC to prevent steam condensation.
- At both electrode outlets, there will be access for extracting gas samples for chromatography.

3.3. Power supply to the stacks

- A reversible power supply capable of reaching 10 kW will be included. The voltage must reach a minimum of 100 V and the current 100 A.

3.4. Structure

- All equipment will be gathered in one or two closed cabinets with full access through doors.
- The maximum size must be 3x4 m^2 and 3.5 m in height (**but packages must not exceed 1.68x1.98x3.10 m^3 at the time of shipment to fit inside the IREC forklift**).
- The cabinet will be sectorised (electronics, gases, oven, etc.).
- Access to the oven will be guaranteed to facilitate the installation and removal of the stacks.
- An Uninterruptible Power Supply (UPS) will be present to allow the controlled shutdown of the equipment in the event of a building power outage.
- A cabinet ventilation system is required.

3.5. Control and monitoring

- The SOFC/SOEC test bench operation shall be carried out using dedicated software that unites all the equipment, solenoid valves and sensors. This software shall allow individual control of each equipment as well as its automated operation (oven, mass flow controllers, heaters, power supply, electronic load).
- It must be able to connect to a computer for system control.
- The control and monitoring software must allow users defined by IREC to:
  a) Access to the data obtained by the SOFC/SOEC test bench, which will be stored at least locally on the control equipment to be supplied by the successful bidder.
  b) Remote control of SOFC/SOEC test bench by users through control equipment.
- The successful tenderer will provide the proposed control and monitoring software development services for minor adjustments in the form of a time pool, within one year from the date of provisional receipt of the equipment. The time pool must include a minimum of 20 hours for this one year. This number of hours may be subject to improvement by the successful tenderer by the provisions of Annex 3 of the Particular Administrative Clauses Document.
- To ensure accurate monitoring of the test bench and stacks, the necessary sensors will be included to evaluate, as a minimum:
  - gas line pressure,
  - the temperature of the gases,
  - The temperature of the stacks at different points (minimum of 8 temperatures inside the oven),
  - the voltage of the stacks and individual cells (minimum 20 voltages with an accuracy of +/- 0.05 V),
  - the force applied by the compression system,
  - The temperature and voltage measurement capabilities must be expandable.

3.6. Security

- Safety protocols and alarms must be implemented within the software to cut off gases, furnace power, or power and load supply in different emergency scenarios.
- Gas sensors will be installed to detect possible leaks, especially of H_2 and CO.

- As mentioned above, a cabinet ventilation system and a UPS for controlled shutdown are required for a building power outage.

4. VALIDATION, TRANSPORT, LOCATION AND INSTALLATION

4.1. Validation

The successful bidder and IREC will agree on a validation plan before the end of the equipment manufacture. Once the manufacture has been completed and prior to the transport of the equipment, the successful bidder will need to send IREC the manufacturing report and the test report following what has been agreed in the validation plan.

4.2. Transport and location

The transport of the goods to be supplied will be carried out following INCOTERM DPU.

The supply and installation of the equipment must be carried out within the maximum periods established in section D of the Table of Characteristics of the Particular Administrative Clauses Document, starting from the day after the formalisation of the contract. The bidders may improve this maximum period in accordance with the award criteria provided for in the Particular Administrative Clauses Document.

The test bench will be delivered to the ground floor of the IREC headquarters, located at Jardins de les Dones de Negre, 1, 08930 Sant Adrià del Besòs, Barcelona, Spain, by flatbed truck with appropriate auxiliary elements (e.g., pallets) to allow its transport by manual forklift (provided by IREC). The test bench will be located on the second floor of the building, accessible by a 1.68x1.98x3.10 m^3 forklift.

4.3. Facility

The supplied system must include parts, accessories or components necessary for a correct installation. The successful bidder will install the test bench with its control system and software within one month from receipt of the equipment, with delivery of the documents or later. The date and time of the installation will be agreed between the person responsible for the contract by IREC and the person responsible for the installation of the successful bidder. The successful bidder will provide technical support to guarantee a fully operational system.

Minutes of provisional and definitive acceptance

Once the installation of the equipment and the completion of the training have been completed, the person responsible for the contract on behalf of the successful bidder will inform the person responsible for the contract on behalf of IREC of this circumstance, with the IREC contracting body preparing the provisional acceptance certificate for the supplies made. From the date of signature by both parties of this document, the successful bidder may issue the corresponding invoice following the provisions of the Particular Administrative Clauses Document.

Once the guarantee period has ended, the IREC contracting body will prepare the final acceptance certificate for the supplies made.

5. DOCUMENTATION

Once the equipment has been supplied and installed and verified to be fully operational, the successful bidder will provide all the documentation, technical manuals for maintenance, and user manuals for all the system components installed on computer media. These manuals must also describe the operating software and all its operating modes.

6. TRAINING

Once the equipment has been supplied and installed and verified to be fully operational, the successful bidder will provide a training course for a team of approximately 4 or 5 people appointed by IREC. The objective of the training will be to sufficiently train IREC staff in the handling of the system and all its components and the complete maintenance of the equipment.
Training will be provided at the time of the equipment's installation or within 3 business days after installation.

7. WARRANTY

The test bench must be guaranteed for at least 12 months (starting the day after the provisional acceptance certificate for the supplied and installed system is signed). The guarantee must cover any defect or malfunction of the system or any of its components (including hidden defects). This guarantee will be comprehensive, excluding defects due to misuse of the equipment by IREC. The tenderers may improve this guarantee in accordance with the award criteria provided for in the Special Administrative Clauses Document.

8. BILLING

The amounts will be invoiced according to the following billing plan, applying the percentages on the amounts offered by the successful bidder based on the fulfilment of the verifiable milestones throughout the execution of the contract:

- 30% of the contract amount upon formalisation of the contract.
- 30% of the contract amount when the equipment has been validated by the successful bidder, tested in the successful bidder's workshop, and is ready for shipment. The manufacturing report and test report must be sent to IREC by the person responsible for the successful bidder.
- 40% of the contract amount when the equipment is installed, with the documentation delivered and the training carried out.

Before making the indicated payments, the person responsible for the IREC contract must first accept them. The person may require additional supporting documentation to verify compliance with the milestones.

In addition, the successful tenderer must allow IREC personnel access to its facilities to inspect the equipment's manufacturing status at any time during the contract's execution when requested by the IREC contract manager.

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