



Fuel cells systems – clean energy conversion

FCTEST

Challenges/Problems addressed

FC systems offer a clean and highly efficient way to convert energy carriers (e.g. hydrogen, natural gas...) into electricity. President Prodi, Vice-president Mrs. De Palacio and Commissioner Busquin have recently acknowledged this at the highest political level of the Commission during the launch of the High Level group on Hydrogen and FC in October 2002. According to the summary of President Prodi "This is an important choice for Europe, Hydrogen technology will not only reduce our energy dependency and gas emissions; in the long run it will also change considerably our socio- economic model and create new opportunities for developing countries".

However, the technology is not yet mature and needs to be further developed. Significant technological challenges still need to be addressed. For the rating of improvements in FC technology, commonly agreed measures for system efficiency such as power density, dynamic behaviour and durability are indispensable. This requires the definition of harmonised testing procedures both for entire FC systems and for system components. To be successful, a large variety of boundary conditions need to be tracked (e.g. different applications, different stack technologies, various types of fuel, fuel quality, etc). To date, no standardised test procedures for FC systems, stacks and cells are available. Similarly, no standardised test procedures exist for the assessment of FC systems against user requirements for stationary, portable and transport applications (e.g. homologation testing of FC vehicles). In practice many laboratories have developed their own test protocols to meet the needs of their own or national R&D programmes. In spite of the fact that FC are still in pre-

commercialisation phase, the issue of harmonisation of testing procedures and measurement methods needs to be addressed now to ensure a smooth introduction of the technology.

Project structure

Structure

The FCTEST action of the Clean Energies Unit of the JRC-IE is centred on the following three major pillars:

- Creation of the Fuel Cell Testing Facility.
- Technical contribution to the European Network on FC Testing and Standardisation (FCTESTNET).
- Scientific insight of the performance of FC systems by means of mathematical modelling.

Approach

Within the **action**, technology mapping of FC testing competencies in Europe (according to ERA principles) will be realised. Generally accepted and harmonised testing procedures to qualify fuel cells, stacks and systems will be defined and developed further. Additionally, it is the purpose of **the action** to contribute to a harmonisation of quality standards, evaluation methods and test procedures for fuel cell based industrial products, for global common markets. Later on, these harmonised test procedures will be used in a comparison and benchmarking of different products and systems, to obtain information with respect to the progress in, and applicability of different FC technologies.

Mathematical modelling of transport phenomena taking place within a single fuel cell to better understand FC systems performance characteristics will be carried out as a support to the testing activities.

Objectives

Fuel Cells (FC) are expected to play a major role in the future energy supply and may in the long-term replace a large part of the current combustion systems in all end use sectors. In combination with conventional fuels such as natural gas, they have, in the medium and long-term, a large potential for energy savings and for strong reductions in CO₂ and pollutant emissions.

The Fuel Cells Performance Testing and Standardisation (FCTEST) action of the JRC-Institute for Energy is focusing on the following major objectives:

- To complete the creation of the FC Testing Facility.
- To define, harmonise, validate and standardise test procedures for operational performance, environmental compliance, and safety of single cells, FC stacks and FC systems.
- To provide direct comparisons of competing FC technologies in terms of performance, operational characteristics, efficiency, safety and environmental compliance.
- To initiate the European Reference System for FC Testing through the co-ordination of the European Network on FC Testing and Standardisation, FCTESTNET.
- To provide scientific insight of the performance of FC systems by means of mathematical modelling of the complicated physical laws pertinent to FC.

Expected impact and exploitation

The main goal of the action is to initiate a European Reference System for FC Testing, starting with the operation of the FCTESTNET, and in addition, supporting the creation of a European Virtual FC Testing Laboratory. In that sense, progress towards integrating European research activities in testing and standardisation in the field will be achieved. It will result in short and medium term developments that can be delivered to the industry, but that will benefit policy development as well. JRC through the FCTESTNET Network will develop a platform to be the European counterpart in global harmonisation and standardisation in collaboration with US, Japan and Canada. Testing and Standardisation are main issues to make FC technology acceptable. FC is a key component of the JRC Strategy for Sustainable Energy. To be in line with the JRC's mission statement, i.e. to support EU policies simultaneously enforcing the subsidiary principle, and to be in line with the other energy actions of the Institute for Energy under Environment and Sustainability, the involvement in the area of FC makes it possible to give real "integrated" S&T support to EU policies over the full range of hydrogen based energy technology.

Progress to date

The FCTEST action started at the beginning of 2003.

FC Testing Facility

The facility planning has been finished and main part of the equipment has been purchased.

Scientific insight of the performance of FC systems

A Specific Targeted Research Project proposal has been submitted for evaluation. JRC-IE is the scientific co-ordinator of a consortium focused on the detailed mathematical modelling and numerical simulation of the physico-chemical phenomena taking place **within** single cells and **FC** stacks. The long-term target is the integration of the complete FC stack model to FC systems. Three major FC technologies, namely **Polymeric Electrolyte Membrane FC** (PEMFC), Direct Methanol **FC** (DMFC) and Solid Oxide **FC** (SOFC) will be examined.



INFORMATION

References: Action 2322

Programme:
Joint Research Centre 2003 – 2006 Multi-Annual Work Programme

Title:
Fuel Cells Performance Testing and Standardisation (FCTEST)

Duration: 48 months

Partners:
- not applicable (JRC institutional activity)

EC Scientific Officer:
Georgios Tsotridis
Tel: +31-224565122
Fax: +31-224565625
Tsotridis@jrc.nl

Status: Ongoing