Figure 1: World's most Innovative Pressure Electrolyser (PME) Demonstrator; 2,2 m^2 Cell Area.

Low-cost, high-capacity PME Electrolyser for the energy hydrogen market

HYSTRUC

Objectives

New energy markets require efficient, low cost, small size electrolysers in the MW power range for the macro storage of mainly renewable electric energy, for load management and frequency control of the power grid, the build up of a hydrogen infrastructure for hydrogen fuelled vehicles and for the supply of synfuel production plants with renewable-H_2. Within the program an innovative 30 bar pressure electrolyser in the MW power range, the so-called Pressure Module Electrolyser (PME), will be developed and tested.

Features of the PME:

- **high efficiency, low energy demand**
- **price below 500 €/kW installed**
- **small foot print**
- **load variable within 10% up to 120% of nominal load**
- **unattended, reliable operation**
- **separate lye streams**
- **high purity of product gases**
- **high safety**

Patents have been applied for the PME Concept.

The challenge

Pressure electrolysers at present are complicated, require much operational energy, and are expensive and susceptible to failure. The development of the PME will result in a new generation of pressure electrolyser.

The central innovation of the concept is that all pressure -carrying components are placed within one single pressure vessel. The gas lift pumping effect within the cells makes the lye pump obsolete. The separation of the lye streams improves gas purity and safety. The technical simplicity makes energy consuming auxiliary components obsolete, improves operational safety and reduces costs. The load variable 30 bar PME electrolyser is meant to become a stand alone unit for on site hydrogen production and a variable and disposable load to stabilize the electric power grid (frequency control, load/power management), especially for grids to which a large fraction of renewable energy (RE) production facilities are connected like wind, solar generators etc.

Technical targets

Targets to be achieved at the end of project:

- 0,8 m^2, 500 kW PME demonstrator successfully operated
- 2 m^2, 500 kW PME pre production unit successfully operated
- no lye pump required
- separation of anolyte and catholyte possible
- load variations of 10% to 120% of nominal load possible
- very high gas purity
- very high efficiency at 8000 A/m^2
- reliable stand alone operation possible
- costs for mass production, about 500 €/kW installed

Project structure

The project consortium consists of MTU Friedrichshafen GmbH, the project co-ordinator and responsible for the development of the cell stack, namely for the functional unit within the pressure vessel and for the qualification of oxygen resistant material or of design solutions to prevent exposure to oxygen. They are also responsible for the design and building of the 2,2 m^2 real size operational verifier model and for the joint operation with NHEL of the 30 bar, 0,8m^2 demonstrator and the 30 bar, 2 m^2 pre-production unit. This will be done probably within the premises of MTU or Norsk Hydro.

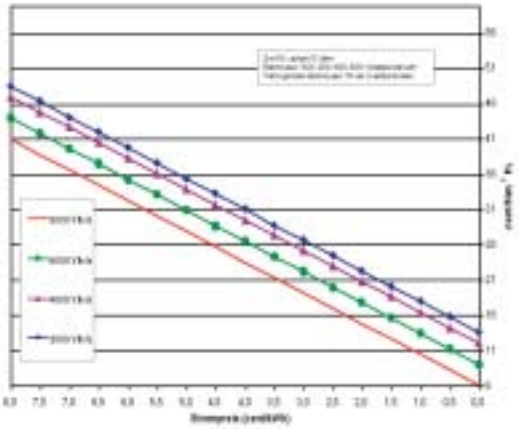
Prime Membrane Technology (PMT), Belgium, associate contractor to MTU, will erect an enlarged and improved diaphragm production facility.

The second principal contractor within the project, Norsk Hydro Electrolysers AS (NHEL), Norway, will be responsible for the design and for the production of the pressure vessel as well as for the balance of plant, including the auxiliary supply units for the 30 bar PME verifier and for the 30 bar PME pre-production unit. NHEL will also be responsible for the preparation of the site for the test operation, including the power supply for the two 500 kW test units and will participate in the operation of the plants.

The project it based on the extensive experience of all the project partners.

Figure 2: 500 kW, 30 bar PME Test Unit, 0,8m^2 cell area.

Figure 3: Cost per Nm^3 of PME Hydrogen, depending on the cost of electricity and the operating hours of the PME electrolyser at rated power.



Expected impact and exploitation

The results of the project will have strategic impact on energy markets, namely those of renewable energies, of fuel cell markets for stationary and mobile applications and the synfuel market. Establishment of a hydrogen infrastructure for FC vehicles and for synfuel production facilities will move closer towards realisation by developing the ability to produce cost efficient electrolytic hydrogen, directly where H_2 is required. For the transport of the electric energy the existing power grid is used. One of the great advantages of electrolytic hydrogen fuel production is, that the very same installations are equally suited for operation with conventionally produced electric energy, for RE's and for a blend of both, enabling an economic and smooth transition to a sustainable, increasingly non-fossil fuel energy supply structure. In that way, the project opens up enormous market opportunities for the EU and the chance to reduce emissions of greenhouse gases noticeably without an unacceptable economic burden for society.

The intellectual property will be exploited by MTU and NHEL, within joint projects and within activities where each partner has a market share.

Progress to date

The functioning of the PME concept has been proven by computer simulations and by the operation of the 2,2 m^2 demonstrator. All the performance targets have been met so far. The status of the material qualification allowed the building of the first 500 kW, 08m^2 test unit, whose design has been concluded. Most of the materials and components have been ordered; production of components and sub-components has started. It is intended to start operation of the 500 kW, 0,8m^2 test unit by August 2003.

INFORMATION

References: NNE5-2001-00525

Programme:
FP5 - Energy, Environment and Sustainable Development

Title:
Demonstration and Testing of an Innovative 30 bar, Low Cost, Small Size Pressure Electrolyser (PME), in the MW Power Range, for the Cost Efficient Production of Electrolytic Hydrogen. (HYSTRUC)

Duration: 42 months

Partners:
- MTU Friedrichshafen (D)
- Norsk Hydro Electrolysers (NO)
- Prime Membrane Technology (B)

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