

# EUROPEAN COMMISSION

SEVENTH FRAMEWORK PROGRAMME  
FUEL CELLS AND HYDROGEN JOINT UNDERTAKING (FCH JU)  
THEME SP1-JTI-FCH.2013.3.5

Field demonstration of large scale stationary power and CHP fuel cell system

GA No. 621256



**Demonstration of a combined heat and power 2MWe PEM fuel cell generator and integration into an existing chlorine production plant**

|                     |  |              |
|---------------------|--|--------------|
| Deliverable No.     | DEMCOPEM-2MW D3.2  |              |
| Deliverable Title   | Report on the computer model of the PEM unit, comprising flow diagrams and results of various simulations to optimize the design of the unit |              |
| Dissemination level | Public/Confidential/Restricted   | Confidential |
| Written By          | Stefano Campanari, Giulio Guandalini, Stefano Foresti (POLIMI)   | 28-10-2015   |
| Checked by          | Stefano Campanari (Politecnico di Milano)  |              |
| Approved by         | Nick Miesen (Akzonobel)  |              |
| Issue date          | 29-10-2015   |              |

## Publishable summary

This report is dedicated to the extension and application of the simulation model developed for the DEMCOPEM-2MW PEM plant. The model is developed within Work package 3 of the project, dedicated essentially to modelling of the process taking place in the 2 MW PEM plant as well as to measurements evaluation and validation. Within WP3, this report D3.2 is dedicated to tasks 3 and 4 which are “Process simulation of the PEM generator with a computer code” and “Computations with the computer model”.

The model calculates the mass and energy balance for the plant considered in this project, including the PEM and its main balance of plant components (heat exchangers, blowers, pumps). The model has been developed with ASPEN Plus®, with particular attention to modelling PEMFC performances through a specific custom model depending on the operating and stream conditions (temperature, pressure and composition of inlet streams, current density).

Within D3.1, the simulation was validated based on the layout and performances of the PEM plants of Solvay in Lillo (1 MW plant) and of the Akzonobel in Delfzijl (70 kW plant), using information on plant layout and cell behavior (voltage, temperatures, reactant flow rates and compositions) provided by NFCT and based on information about the 2 MW plant expected layout provided by MTSA.

Within D3.2, the simulation model is further refined according to the actual specifications of the 2 MW plant, both referring to the PEM performances (refinement of V-I curve prediction) and to plant components (saturator, heat exchangers, air blower, hydrogen recycle compressor). Moreover, a new section of the model is setup for the simulation of pressure losses in the pipeline network connecting the saturators and the fuel cells (air and hydrogen loop) as well as for the cooling water loop.

Then several simulations are performed to predict the plant performances when the plant moves from BOL (beginning of life) operating conditions of the fuel cells to mid and EOL (end of life) conditions, investigating the effects of different set point options for air and fuel utilization as well as the effects of a different plant arrangement where unused hydrogen exiting the fuel cell is burned in a combustor to generate additional export heat. Results show possible operating strategies to keep the plant power output close to the nominal value during lifetime, while minimizing efficiency losses.

## Acknowledgement

This project is co-funded by the 7th FP (Seventh Framework Programme) – Fuel Cells and Hydrogen Joint Undertaking

<http://www.fch-ju.eu/>

<http://ec.europa.eu>



### Disclaimer

The FP7 project has been made possible by a financial contribution by the European Commission under Framework Programme 7. The Publication as provided reflects only the author's view.

Every effort has been made to ensure complete and accurate information concerning this document. However, the author(s) and members of the consortium cannot be held legally responsible for any mistake in printing or faulty instructions. The authors and consortium members retrieve the right not to be responsible for the topicality, correctness, completeness or quality of the information provided. Liability claims regarding damage caused by the use of any information provided, including any kind of information that is incomplete or incorrect, will therefore be rejected. The information contained on this website is based on author's experience and on information received from the project partners.