



HEALTH-CODE

Real operation PEM fuel cells HEALTH-state monitoring and diagnosis based on dc-dc COnverter embeddeD Eis

Panel 4 – Research activities for stationary applications

Acronym:	HEALTH-CODE
Project ID:	671486
Title:	Real operation PEM fuel cells HEALTH-state monitoring and diagnosis based on dc-dc COnverter embeddeD Eis
Call Topic:	FCH-02.3-2014
Project total costs (€):	€ 2,3 million
FCH JU maximum contribution (€):	€ 2,3 million
Project start/end:	01 Sep 2015 - 31 Dec 2018
Coordinator:	Uni. Salerno, Italy
Beneficiaries:	Bitron, Ballard Power Systems Europe, Electro Power Systems Manufacturing, Uni. Technol. Belfort Montbeliard, Uni. Franche-Comte, Aalborg Uni., Torino E-District Consorzio, Eifer Europaisches Inst. fur Energieforschung, Absiskey
Website:	http://pemfc.health-code.eu/

Project and objectives

HEALTH-CODE aims at improving and validating in emulated real operations an advanced monitoring and diagnostic tool capable of evaluating the state-of-health and extrapolating lifetime of Polymer Electrolyte Membrane Fuel Cell systems (PEMFCs). The focus of the project is related to μ -Combined Heat and Power and backup applications. The tool is based on the use of suitable data derived from Electrochemical Impedance Spectroscopy (EIS) measurements performed during systems operation. HEALTH-CODE also aims at reducing experimental campaign time and costs by means of innovative scaling-up methodology.

Major project achievements

- ▶ Completion of the first experimental campaign on both stack technologies with the measurements of about 1200 EIS spectra in normal and faulty states
- ▶ Design and preliminary testing of the Second Generation of the EIS board and the Low Voltage DC/DC converter
- ▶ Design and preliminary testing on project data of the different algorithms accounted for the Monitoring and Diagnostic Tool

Future steps

- ▶ Completion of the Second Experimental Campaign on both stack technologies and with respect to the remaining faults to be tested
- ▶ Delivery of High Voltage DC/DC converter and testing its functionalities as well as communication and performance with EIS board
- ▶ Improvement of diagnostic algorithms on new data from the project and thorough assessment of performances
- ▶ Testing of Scaling-up algorithm on whole project data for final performance assessment and validation
- ▶ Integration of designed power electronics, EIS board and diagnostic algorithm on systems and validation tests

Non-quantitative objectives and status

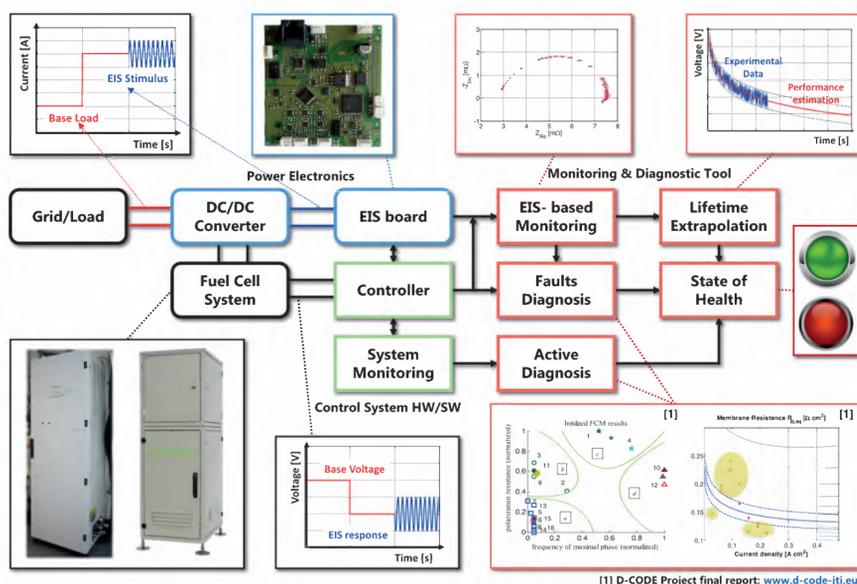
- ▶ Enhanced Monitoring and Diagnostic Tool for PEMFC systems Activities on time; first results achieved on data acquired in the project; further tests are ongoing upon availability of new data from the project
- ▶ EIS board cost <3% of the overall system manufacturing cost The final design of the EIS board fulfilled the requirement of cost being under the 3% of the overall cost of both residential and backup systems
- ▶ Backup system designed to be coupled with electrolyser The tests on O₂-fed backup system has been performed with respect to all the faults accounted in the project
- ▶ EIS to estimate features at cell level to monitor their time evolution Methodologies for State-of-Health and lifetime assessment have been designed and preliminary tested upon available project data

Relevant to FCH JU overarching objectives

- ▶ Increase the electrical efficiency and the durability of the different fuel cells used for power production to levels which can compete with conventional technologies, while reducing costs

Quantitative targets and status

Target Source	Parameter	Unit	Starting point	Target for project	Achieved to date in project	Best est. of final project result	Target: status on May 1 st 2017	Description
MAWP 2014-2020	Efficiency	%	32	36	32	36	Due later	Proper fault diagnosis will reduce voltage decay over the working time.
MAWP 2014-2020	Durability	years	1.71	2.28	1.71	2.28	Due later	Proper fault diagnosis will reduce voltage decay over the working time.
MAWP 2014-2020	Availability	%	98	99	98	99	Due later	Increase in the mean time between failures



EPS short stack @ UFC



EIS spectra acquired so far: Around **1200** of which **25% in nominal conditions** and **75% in faulty operations**

BPSE stack @ AAU



BPSE stack @ EIFER

