RUBY

ROBUST AND RELIABLE GENERAL MANAGEMENT TOOL FOR PERFORMANCE AND DURABILITY IMPROVEMENT OF FUEL CELL STATIONARY UNITS

Project ID	875047
PRR 2024	Pillar 4 – H_2 end uses: stationary application
Call topic	FCH-02-8-2019: Enhancement of durability and reliability of stationary PEM and SOFC systems by implementation and integration of advanced diagnostic and control tools
Project total cost	EUR 2 999 715.00
Clean H_2 JU max. contribution	EUR 2 999 715.00
Project period	1.1.2020–31.12.2024
Coordinator	Università degli Studi di Salerno, Italy
Beneficiaries	Ballard Power Systems Europe AS, Bitron SpA, Commissariat à l'Énergie Atomique et aux Énergies Alternatives, Université Bourgogne-Franche-Comté, École polytechnique fédérale de Lausanne, Europäisches Institut für Energieforschung EDF KIT EWIV, Fondazione Bruno Kessler, Institut 'Jožef Stefan', Solidpower SpA, Sunfire Fuel Cells GmbH, Teknologian Tutkimuskeskus VTT Oy, Université de Franche-Comté

https://www.rubyproject.eu/

PROJECT AND GENERAL OBJECTIVES

The RUBY project aims to exploit electrochemical impedance spectroscopy (EIS) for developing, integrating, engineering and testing a comprehensive and generalised monitoring, diagnostic, prognostic and control (MDPC) tool. Thanks to EIS's features, RUBY will improve the efficiency, reliability and durability of solid oxide fuel cells (SOFCs) and polymer electrolyte fuel cell systems for stationary applications. The tool relies on advanced techniques and dedicated hardware, and will be embedded in the fuel cell systems for online validation in relevant operational environments.

NON-QUANTITATIVE OBJECTIVES

The MDPC tool performs monitoring, diagnosis, prognosis control and mitigation of the stack and balance of plant for polymer electrolyte fuel cell systems in back-up applications and for SOFCs for micro combined heat and power applications.

PROGRESS AND MAIN ACHIEVEMENTS

- Tests on polymer electrolyte membrane stacks and systems have been performed in nominal conditions.
- Tests on SOFC stacks have been commissioned.
- Preliminary tests on SOFC systems have been performed in nominal conditions.
- Preliminary versions of monitoring, diagnostics and prognostic algorithms have been developed and tested.
- Hardware (HW) for the MDPC tool has been designed, manufactured and tested.
- The concept and preliminary design of HW for EIS perturbation stimuli have been determined.

FUTURE STEPS AND PLANS

- The project will acquire conventional and advanced signals. The tool measures conventional signals from the balance of plant and stack (voltage, current, temperature, etc.) and the EIS for the stack.
- RUBY will advance the MDPC tool's activities. The tool monitors the state of health of the stacks and the systems, detects faults at the stack and balance-of-plant levels, estimates the stacks' lifetimes, applies advanced control actions and proposes mitigation strategies at the system level.
- Tests will be conducted on the polymer electrolyte membrane stacks and systems in faulty conditions.
- Tests will be performed on SOFC stacks in nominal and faulty conditions.
- Tests will be carried out on the SOFC system in faulty conditions.
- MDPC tool algorithms will be integrated into the HW.
- HW will be commissioned for EIS perturbation stimuli.
- The MDPC tool will be implemented and tested.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Achieved to date by the project	Target achieved?	SOA result achieved (by others)	Year in which SOA result was reported
Project's own objectives	Lifetime of back-up applications (PEM)	years of operation	15	12		12	2020
	Electrical efficiency of back-up applications (PEM)	% (LHV)	45	45		45	
	Reliability of back-up applications (PEM)	BX–Y	B10–15	B25–12		B25–12	
	Lifetime of micro-CHP applications (SOFC)	years of operation	12	10		10	
	Maintenance costs of back-up applications (PEM)	€/year	452	617		617	
	Availability of micro-CHP applications (SOFC)	%	99	97		97	
	Availability of back-up applications (PEM)	%	99 999	99.99		99.99	
	Electrical efficiency of micro-CHP applications (SOFC)	% (LHV)	39	35		35	
	Stack durability of micro-CHP applications (SOFC)	hours	40 000	30 000		30 000	

Clean Hydrogen Partnership
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