

Application 2060



Environmental characterization and Safety Tests of an Hybrid Power Source combining a LT-PEMFC and a Lithium Ion Battery Energy Storage embedded into a passive cooling shelter for off-grid Residential, Telecom and Agriculture applications.

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The aim of the project is conduct environmental, functional and safety test on an innovative hybrid power system designed and realized by Genport. Within this project a set of functional tests with different combination of electrical loads and RES configurations will be conducted in order to characterize the behavior of the system in wide temperature range from 5 C to 40 C.

Additionally safety tests will be executed in order to evaluate the fail-safe behavior of the hybrid power source components as well as from the safety point of view, the interaction of the different sub-system (Fuel Cell Stack, Balance of Plant, ion lithium cells) will be investigated. A final task will be the analysis of the framework of norms among the existing in order to identify the most suitable set for the next CE certification.

The project will be structured into four main activities: Definition of the test specification, Setup of the test equipment's, execution of the experiments and analysis of the result.

The Hybrid Power Source Technology

A key issue of RES, such as wind and solar resources, is intermittent. RES are not dispatch-able, they exhibit large fluctuations, and are uncertain. Wind turbine and solar panel are cost effective way to generate energy in off-grid contest; however a drawback of RES is the variability; wind tends to run intermittently and solar power is only available during the daytime. The intermittency of RES can be absorbed by the combination of different RES (PV and Wind) and distributed resources such as energy storage, programmable loads and smart appliances. The choice of different RES as well as storage devices (hydrogen, batteries) depends on the location, the hybrid energy system's operational mode (stand-alone vs. grid-connected) and its size. In order to realize such a system's full benefit, resources have to be coordinated to efficiently and reliably provide services (e.g. power, hydrogen storage size) in the face of uncertainty that arises from renewable and consumers.

Genport has developed and realized reliable off-grid auxiliary clean power system designed to extend runtime of primary renewable energy sources (RES) 24h/7 days . G300-6200 HPS integrates a lithium battery pack of 6,2 kWh capacity with a backup LT-PEMFC. Hydrogen is produced on site with a PEM electrolyzer. G300-6200 HPS can to be easily installed into a ventilated area of the telecom shelter and it is ready to power instantaneously TLC equipments.

The Ion Lithium Battery Energy Storage System is an instantaneous buffer of energy that dynamically smooths fluctuation of energy between RES and the load. The PEM fuel cell unit fulfills the needs of electric energy when RES and lithium batteries are out of works for long time. Power electronics has been designed to operate safely as well as to provide the highest efficiency. Several control features have been implemented to improve lifetime and reliability; for the Battery Energy Storage system a redundant and independent safety features at cell level is foreseen for the (Current Interrupt Device, twofold vents); at module level a logic fuse, voltage, current, temperature and balancing is foreseen and at system level, fuses, current sensor and disconnect switch are embedded.

For the Fuel Cell System: an hydrogen Sensor Detection, safety procedure to connect/disconnect stack; a short circuit and overload current protection, a stack over voltage protection and a battery under voltage protection, stack and battery soft start procedures embedded. The auxiliary hybrid power source, provides continuously the energy requested by the the load as being grid-connected detects dynamically the state of health of the renewable energy sources, the hydrogen powered fuel cell, the lithium-ion battery systems, the electrical loads, predicts and communicates remotely latent failures and an optimization algorithm take these inputs and it dispatches efficiently electricity among the components of the isolated micro-grid.

Company Overview

Genport srl, is an Italian spin-off of Politecnico di Milano, designer and manufacturer of advanced, power sources for extreme environments in marine, electro-medical, defense, emergency, telecommunication, industrial applications. The company has the headquarters in Italy at the Vimercate Technology Park and its US subsidiary, Genport North America Corp. is located at the Purdue Research Park in West Lafayette (IN). Genport has acquired extensive experience in designing and manufacturing high end lithium ion smart battery systems from portable to stationary storage units. The combination of fuel cells, lithium batteries and solid H₂ enables us to design reliable, high energy density and zero impact hybrid power solutions to extend runtime of the electronics.

Previous References

The team of GENPORT has a long-term experience in the field of Lithium Ion Batteries and Fuel Cell/Hydrogen technologies from research to the industrial solution with a strong international scientific activity (100 scientific publications and 8 patents); 15 years in international and national programs focused on improving durability, performance of fuel cells. This expertise is complemented by a solid industrial capability which lead us to provide an outstanding product platform: G300 HFC a 400W hybrid fuel cell, patented CE market-certified portable fuel cell system; GenPV a modular PV system integrated with a Lithium-ion Battery Pack, embedding a sophisticated microprocessor-based solar charger; GboxH₂ is a rechargeable solid hydrogen system; GenFuel is a solid hydrogen fuel concept based on sodium borohydride; G300 HPS is a fuel independent power source integrating PV with a fuel cell; GenH₂ is a portable PEM electrolyzer; GENIOL is a precision-engineered rechargeable Lithium-ion Battery Pack embedding our own Smart Battery Management Electronics. Participation at National and EWP7-EU research funding programs: FISR – ENEA, 2008. Call Topic: Development of PEMFC stack embedding novel Gas Diffusion Electrodes; Bando Innovazione, 2008 (Camera di Commercio Como). Call Topic: Development of a Hybrid Fuel Cell System Technology; Energy Efficiency, 2009 (National FESR project funded by Lombardy Region): Developments of Prototypes based on Hybrid Fuel Cell System; WP7-DERRY Project, 2012: Cold start up procedures and test for portable fuel cell, WP7- PEM BEYOND Project 2014 : PEMFC system and low-grade bioethanol processor unit development for back-up and off-grid power applications.

Key people that will be involved:

Paolo Fracas: co-founder and CEO of Genport srl and Genport North America. Electrical Engineer with a postgraduate certificate in international management at MIT, 25 year of professional experience in multinational companies Italy and US. He developed innovative fuel cells materials. He is author of 10 patents and publications. He was acting at the Advisory Board of UK PEMFLOW Project, in the Board of the Hydrogen and Fuel Cell Italian Association (H2IT), Plasmatech of WP5, Mesh (WP6). He coordinated several regional research projects.

Walter Castagna. B.Sc. in Electronics Engineering, M.Sc. in Control Engineering, is the CTO in Genport. He has 23 years experience as senior power electronics and control systems design engineer in multinational companies in Italy and Ireland.

Stefano Limonta. M.Sc. in Electrical Engineering with Laude is the Lead System Engineer of the PEM Fuel Cells Team. He has led the development of the G300 PEM Fuel Cell. He is now in the end phase of development of the G300-6200 HPS and is team leader of the 5kW Hybrid Fuel Cell System under the EU-FCH-JTI Pembeyond project.

Diego Croci. M.Sc. in Energy Engineering with Laude is the Fuel Cell System Engineer. He leads the design simulation and development the hybrid power sources and a and the 5kW Hybrid Fuel Cell System.

Paolo Barile., M.Sc. in Electronics Engineering with Laude, is the Lead Engineer of the Lithium Ion Battery Pack Development Team. He has specific experience in HW and FW design and he is now developing the new generation of GENIOL microprocessor-based BMS for building large modular storage systems.