

## A) General Information

**Acronym:**

**Title of the User-Project:**

**TA Call:**

**Host Research Infrastructure:**

**Starting Date:**

**End Date:**

**Lead User :**

**Additional Users:**

**W&S\_IC – 20100930-05**

Wind power and Storage  
modelling and Integrated Control  
in electric distribution systems

2<sup>nd</sup> CALL - 30-09-2010

RISØ DTU (Syslab)

01-05-2011

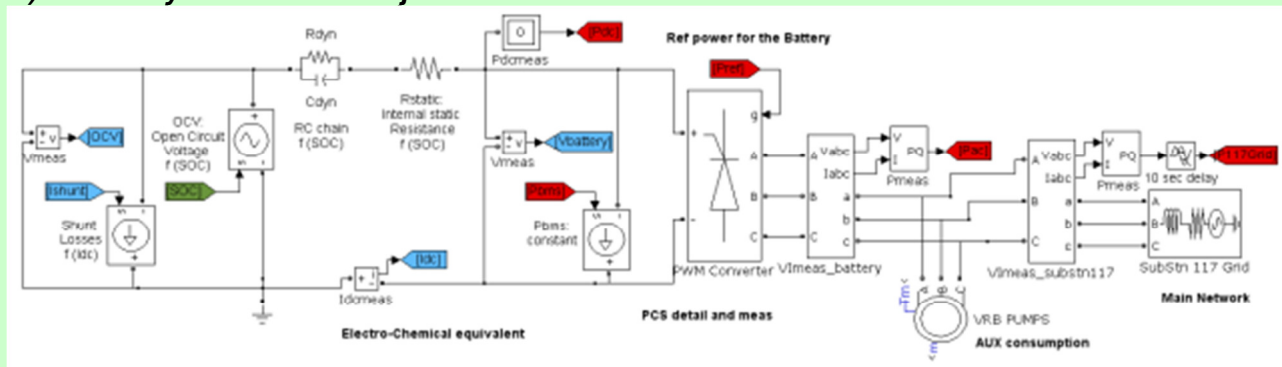
13-05-2011

Federico Silvestro - University of Genova – IEES  
(Intelligent Electrical Energy Systems) laboratory

Mattia Marinelli – Francesco Baccino - University of  
Genova



## B) Summary of the User-Project

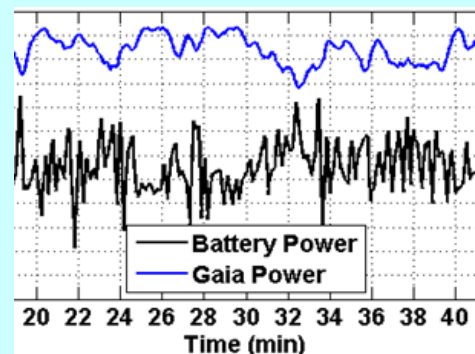


*The Vanadium Redox Flow battery model*

Characterization of the dynamic and static parameters of Vanadium Redox battery has been used to tune a battery model of the State of Charge, the electrochemical and the thermal behaviour, realized in Matlab-Simulink. The idea is to control the battery charging and discharging in order to control the whole system output. Two controller typologies are studied: the first one that provides the control of the power output, the second one related to the control of the energy output in a given time window.

## C) Main Achievements

The battery internal DC roundtrip efficiency resulted to be quite good (between 71% and 80%), but the huge amount of energy required by the auxiliary system resulted very high, reducing thus the overall roundtrip efficiency (between 48% and 36%). The battery proved to be a very fast respondent battery, since the only limits are due to the communication delays and to the inverter ramping rate, however the great delay in the feedback of the PCC measure had the effect to destabilize the Power Control. Concerning the Energy Control, the tests have proved the effectiveness of this slow type control even with some bounds on the power ramp rate of the battery.



*Control of battery power wind power (Gaia).*

## D) Dissemination of the Results

F. Baccino, O. M. Forero Camacho, F. R. Isleifsson, M. Marinelli, P. B. Nørgård, F. Silvestro: "Experimental validation of control strategies for a microgrid test facility including a storage system and renewable generation sets", CIRED Workshop, pp. 1-4, Lisbon, 29-30 May 2012

F. Baccino, M. Marinelli, S. Massucco and F. Silvestro: "Low Voltage Microgrid under Islanded Operation: Control Strategies and Experimental Tests", full paper submitted to IEEE MedPower 2012, pp. 1-7, Cagliari, Oct. 2012

F. Baccino, M. Marinelli, S. Massucco and F. Silvestro: "Vanadium Redox Flow Battery Dynamic Modelling and Experimental Validation", Energy Storage, full chapter submitted, pp. 1-24, ISBN: 979-953-307-768-9, InTech Edition, expected publishing date Sep 2012

### ***E) Use of the Resources***

|                               |           |
|-------------------------------|-----------|
| <b>Nr. of Users involved:</b> | <b>3</b>  |
| <b>Access Days:</b>           | <b>10</b> |
| <b>Stay Days:</b>             | <b>30</b> |