= iSTORMY =

EUROPEAN COMMISSION

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Interoperable, modular and Smart hybrid energy STORage systeM for stationarY applications

GRANT AGREEMENT No. 963527

Deliverable Report

D5.2 – Report on system integration into EDF Concept grid

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Publishable summary

The iSTORMY project aims to developpe an interoperable and modular Hybrid Energy Storage System (HEES) and demonstrates, through various use-cases, its operation in provision of multiple grid services.

As planned in WP5, the hybrid energy storage system prototype has been integrated into the EDF Concept Grid testing facility for the demonstration.

This document gives an overview of the integration process, electrical connections with the testing facility, and the communication interface with the EDF energy management system (EMS).

Contents

Table of Figures

1 Introduction

The main goal of the validation phase of iSTORMY in WP5 is to demonstrate the operation of the battery on a real grid (EDF smart grid platform) through three use-cases defined in the project (WP1). To that end, the project-developed Hybrid Battery Energy Storage System (HBESS) is installed at the EDF Concept Grid experimental platform and connected to the other grid assets such as PV production and EV fast charging station.

2 On-site integration and electrical connections

The HBESS arrived at EDF on the 12th of February 2024 in the morning. Connection of the grid interface, auxiliary cables and the ethernet communication followed the physical installation of the container shown in Figure 1.

Figure 1. Installation of the iSTORMY container at the Concept Grid laboratory

As shown in Figure 2, the HBESS is connected to a 20kV/400V and 400kVA substation. It can be operated either in the grid connected mode or islanded mode (with controllable voltage source). The battery is also connected to a load (EV fast charging station of 350kW maximal power) and PV production (120kWmaximal power). The last two assets will mainly be used for the use-cases two and three.

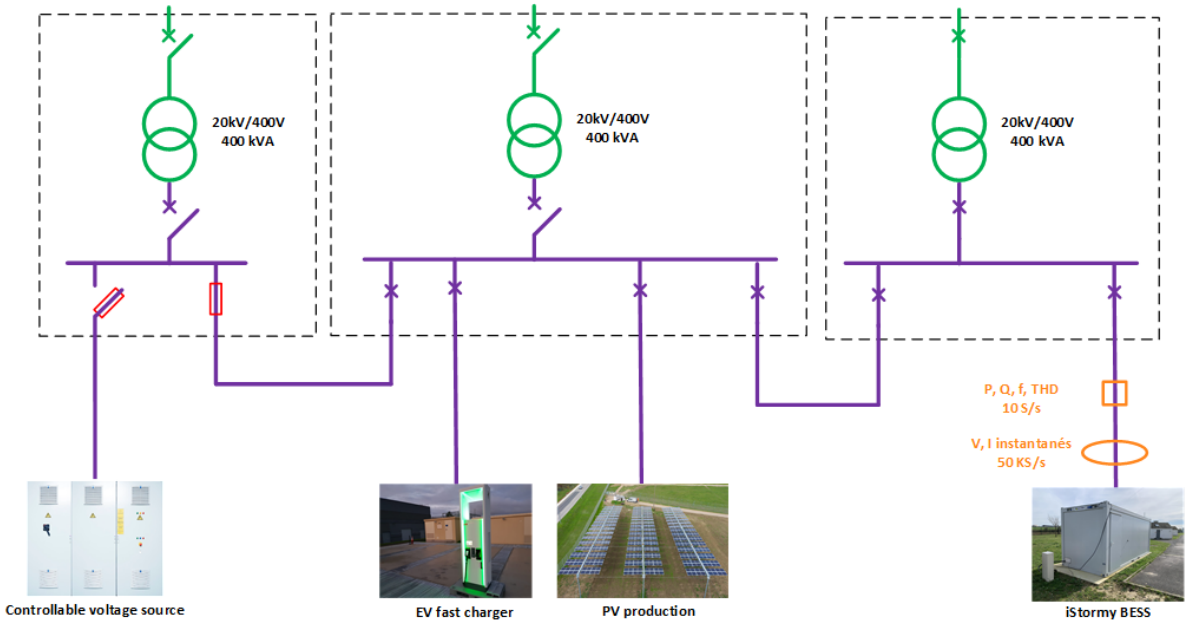

Figure 2. Scheme of the grid configuration

The mains cables (three phases, neutral and earth) are connected at the back of the container (Figure 3 on the left) and to the main circuit breaker (Figure 3 on the right). An auxiliary supply cable is connected at the top of the container (Figure 3 on the left).

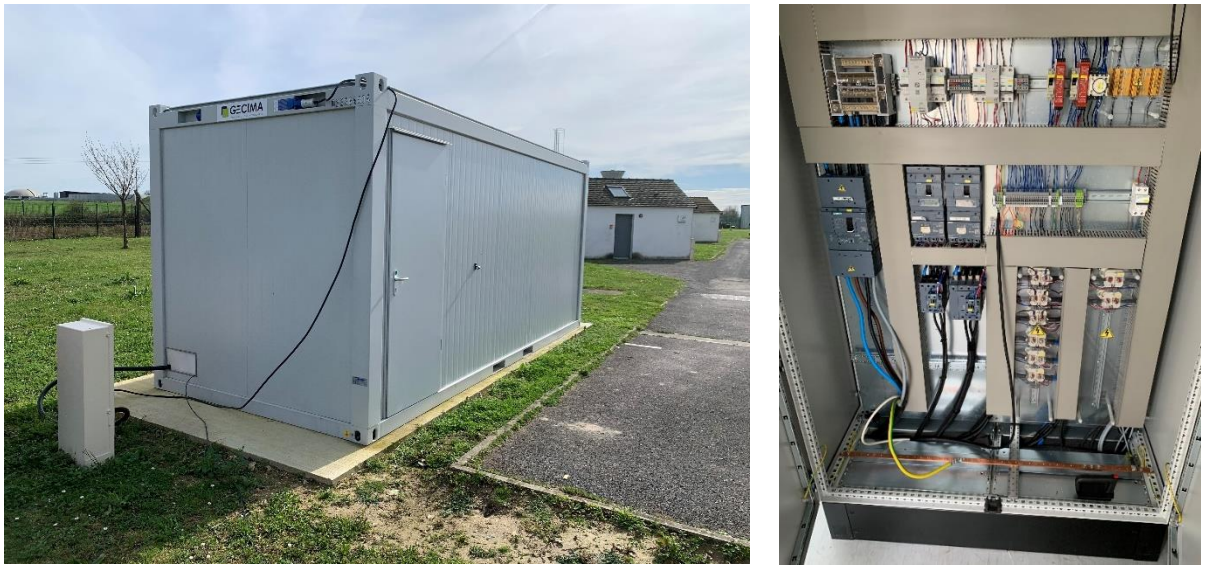

Figure 3. Electrical and communication connections

3 Communication interface with the EDF EMS

The communication structure among the components is illustrated in Figure 4. The EMS acts as a Modbus master device. All connected devices use the following IP address range: 192/168.1.X/24.

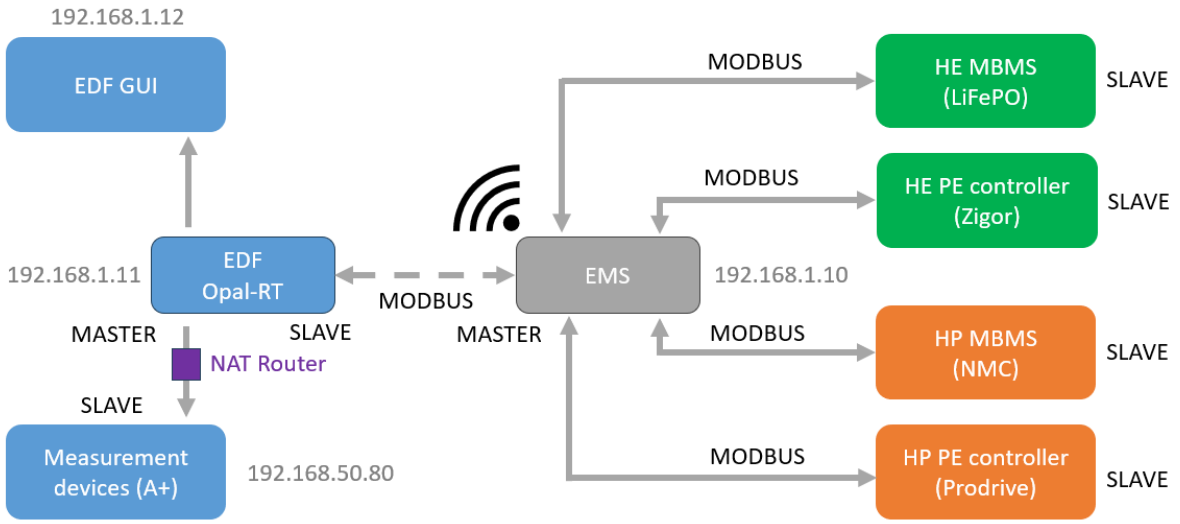

Figure 4. Communication structure of the HBESS and EDF EMS

The EDF controller is implemented on a real-time simulator from OPAL-RT. This simulator uses MATLAB/Simulink development environment.

To exchange data and setpoints between the EMS and the EDF controller, the signal map, with data types, is defined in Table 1. The EDF and HBESS controllers exchange values periodically according to the signal map. All values are coded as signed integer (INT16) and a corresponding decimation factor is defined. A simple graphical user interface (GUI), developed to test the communication interface, is shown in Figure 5.

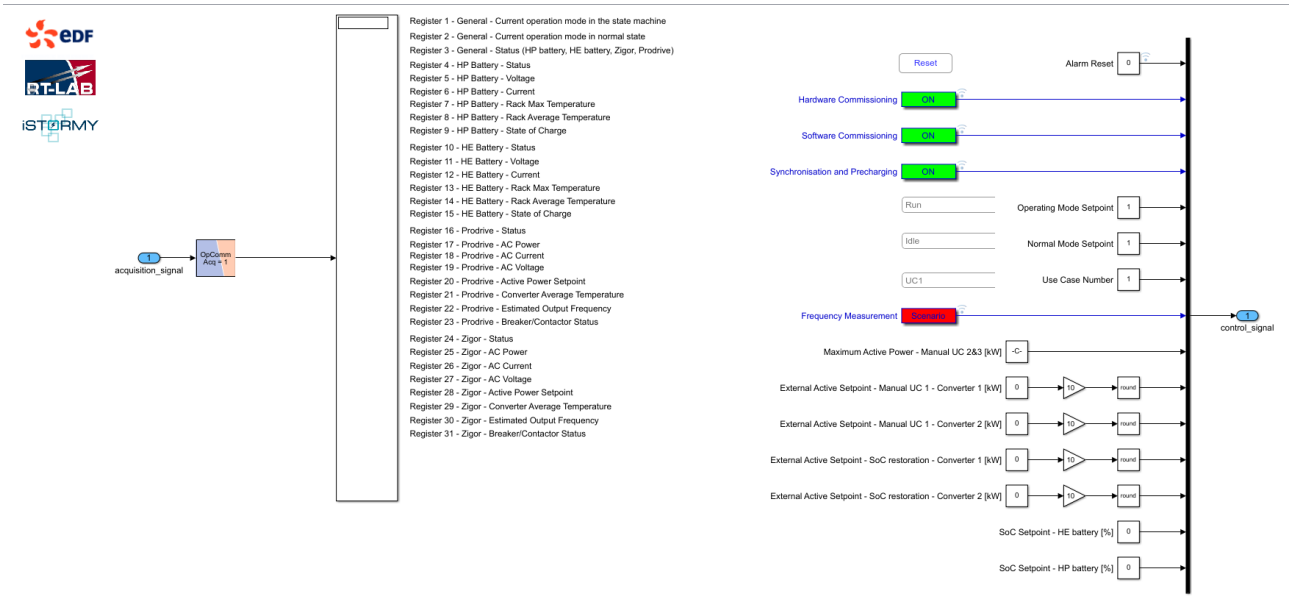

Figure 5. Preliminary user interface for the commissioning

Table 1 : iSTORMY signal map of signals exchange between the EMS and EDF controller

Sender	Receiver	Item		Register ID	Type	Byte	Unit	Decimation	Comments
EMS	Concept Grid GUI	General info	Current mode of operation in the state machine	001	INT 16	2			EMS mode of operation in the state machine
			Current mode of operation in the normal state	002	INT 16	2			
			Status word for alarm information	003	INT 16	2			HP[1] battery alarm, HE[2] battery alarm, ZIG converter alarm, PT converter alarm
		HP Battery info	HP module status	004	INT 16	2			
			Voltage of HP module	005	INT 16	2	V	x10	
			Current of HP module	006	INT 16	2	A	x10	
			Max temperature in HP rack	007	INT 16	2	ºC	x10	
			Average Temperature of HP module	008	INT 16	2	ºC	x10	
			State of Charge of the HP module	009	INT 16	2	%	1	
		HE Battery info	HE module status	010	INT 16	2			
			Voltage of HE module	011	INT 16	2	V	x10	
			Current of HE module	012	INT 16	2	A	x10	
			Max temperature in HE rack	013	INT 16	2	ºC	x10	
			Average Temperature of HE module	014	INT 16	2	ºC	x10	
			State of Charge of the HE module	015	INT 16	2	%	1	
		Prodrive Info	Converter status	016	INT 16	2			On/Off/Error
			AC side power measurement	017	INT 16	2	kW	x10	15678 W -> Sent value will be 156 -> At CG divide by 10 to get 15.6 kW

[1] High-power.

[2] High-energy.

			AC side current measurement	018	INT 16	2	A	x10	
			AC side voltage measurement	019	INT 16	2	V	x10	
			Active Power setpoint	020	INT 16	2	kW	x10	
			Average converter temperature	021	INT 16	2	ºC	x10	
			Estimated output frequency	022	INT 16	2	Hz	x10	
			Status word for breaker/contactor status	023	INT 16	2			
		Zigor Info	Converter status	024	INT 16	2			On/Off/Error
		Zigor Info	AC side power measurement	025	INT 16	2	kW	x10	
		Zigor Info	AC side current measurement	026	INT 16	2	A	x10	
		Zigor Info	AC side voltage measurement	027	INT 16	2	V	x10	
		Zigor Info	Active Power setpoint	028	INT 16	2	kW	x10	
		Zigor Info	Average converter temperature	029	INT 16	2	ºC	x10	
		Zigor Info	Estimated output frequency	030	INT 16	2	Hz	x10	
		Zigor Info	Status word for breaker/contactor status	031	INT 16	2			
Concept Grid GUI	EMS		Alarm reset	001	INT 16	2			
Concept Grid GUI	EMS		Hardware commissioning done	002	INT 16	2			Hardware commissioning finished and validated
Concept Grid GUI	EMS		Software commissioning done	003	INT 16	2			Software commissioning finished and validated
Concept Grid GUI	EMS		Precharge and sync. commissioning done	004	INT 16	2			Precharge and synchronization commissioning finished and validated
Concept Grid GUI	EMS		Operating mode setpoint	005	INT 16	2			1 = Run (From Ready to Normal) 2 = Stop the system 3 = Reconnect (From Stop to Comm)
Concept Grid GUI	EMS		Normal mode setpoint	006	INT 16	2			1 = Idle (From providing power to Idle) 2 = Standard EMS 3 = Self-Healing EMS

								4 = SoC Restoration 5 = Online Diagnostic 6 = Manual
		Use case number	007	INT 16	2			1 = Use Case 1 2 = Use Case 2 3 = Use Case 3
		Frequency measurement or simulation for Use case 1	008	INT 16	2	Hz	x10	Frequency setpoint during Use Case 1
		External active power setpoint for Use cases 2 and 3	009	INT 16	2	kW	x10	Power setpoint (power profile for the use case)
		External active power setpoint for converter 1 in "Manual Mode"	010	INT 16	2	kW	x10	
		External active power setpoint for converter 2 in "Manual Mode"	011	INT 16	2	kW	x10	
		Active power setpoint for SoC restoration in converter 1	012	INT 16	2	kW	x10	
		Active power setpoint for SoC restoration in converter 2	013	INT 16	2	kW	x10	
		SoC setpoint for HE battery	014	INT 16	2	%	1	
		SoC setpoint for HP battery	015	INT 16	2	%	1	

4 Conclusions

The HBESS container has been properly installed and integrated at EDF Concept Grid, with groundwork for installation, electrical connections and communications interfaces. The main functionalities of the HBESS have been tested; final alignment with ZIG power electronics interface will take place shortly before full system demonstration in T5.3.

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Project partners:

#	Partner short name	Partner Full Name
1	VUB	VRIJE UNIVERSITEIT BRUSSEL
2	CEG	CEGASA ENERGIA S.L.U.
3	PWD	POWERDALE (terminated)
4	CEA	COMMISSARIAT A L'ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES
5	MGEP	MONDRAGON GOI ESKOLA POLITEKNIKOA JOSE MARIA ARIZMENDIARRIETA S COOP
6	ZIG	ZIGOR RESEARCH & DEVELOPMENT AIE
7	EDF	ELECTRICITE DE FRANCE
8	TNO	NEDERLANDSE ORGANISATIE VOOR TOEGEPAST NATUURWETENSCHAPPELIJK ONDERZOEK TNO
9	PT	PRODRIVE TECHNOLOGIES BV
10	GW	GREENWAY INFRASTRUCTURE SRO
11	AIT	AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH
12	UNR	UNIRESEARCH BV

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