



**UIMP.** Almacenamiento eléctrico: El eslabón perdido de la sostenibilidad energética.

**Proyecto ALMACENA** 

15 de marzo de 2016

### **ALMACENA Project. Context**



Red Eléctrica is the Spanish Transmission System Operator (TSO)



- Red Eléctrica was the first company in the world dedicated exclusively to power transmission and the operation of electrical systems.
- A pioneer in its field, the company occupies a position of leadership today in these activities.



### **ALMACENA Project. Context**



Spanish Transmission System Operator (TSO) functions



- To ensure the security and continuity of power supply, keeping the instantaneous balance between generation and demand.
- To design, develop and maintain transport network.



#### **ALMACENA Project. Context**

**ALMACENA** Project



**Electricity is not storable** and instantaneous balance between production and demand is needed





**ALMACENA Project. Opportunity for storage** 



Storage as opportunity to integrate renewable energy, to improve flexibility, security and efficiency of electric system

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#### **ALMACENA Project. Opportunity for storage**





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#### **ALMACENA Project. Applications**





#### ALMACENA Project. Non conventional storage



Non conventional Storage	
1 FLYWHEEL	2 ELECTROCHEMICAL STORAGE



**FLYWHEEL** 

 Device that storages energy as movement (kinetic energy)

#### • Applications:

Frequency stabilizationVoltage stabilization



#### • Lanzarote Project:

Power: 1,65 MW Time: 12 seconds



#### ALMACENA Project. Non conventional storage



Non conventional Storage	
1 FLYWHEEL	<sup>2</sup> ELECTROCHEMICAL STORAGE

#### 2 ELECTROCHEMICAL STORAGE



#### RED ELÉCTRICA DE ESPAÑA



# Device that storages energy as electrochemical potential (battery)

#### • Applications:

- ✓ Power-Frequency control
- ✓ Voltage control
- ✓ System flexibility

#### ALMACENA Proyect (Carmona)

Power: 1 MW

Time: 3 hours

#### ALMACENA Project.



## **ALMACENA PROJECT**







#### **ALMACENA** Project



ALMACENA is an innovation project led by REE(the Spanish TSO) and with A1223 Energy Solutions (now NEC ES) as technology provider. The ALMACENA Project consists of a 1MW, 3MWh grid battery system (GBS), includes a Power Conversion System (PCS) and is connected to the Spanish Transmission Grid in Carmona Substation (Sevilla)







### **ALMACENA Project. Initial Targets**



ALMACENA project's main target is to analyze challenges and features of electrochemical storage systems connected to the grid











To especify and to define the energy storage system

To test technical capabilities (flexibility) for system operation

To get valuable experience and key aspects in O&M





### ALMACENA Project. The "LEGO"

ALMACENA system is highly modular

Container with 32 Racks





**Every Rack contains 22 modules** 





#### ALMACENA Project. Online diagram





### **ALMACENA Project. Functionalities**

3 simultaneous control modes ...





### **ALMACENA Project. Functionalities**

... that can be mixed in real operation

- 1. LS + PF
- 2. LS + PF + VR
- 3. LS + PF + RR
- 4. LS + VR
- 5. LS + RR
- 6. PF + VR
- 7. PF + RR

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Fijar Modo: Operationa	al 💌
Configuración	
м	
LS	
PF	8
RR	
VR	•
P_PF (%)	10
fref (.01 Hz)	5000
f1 (mHz)	100
f2 (mHz)	500
P_LS (%)	90
SocMaxRef (%)	90
SocMinRef (%)	10
P_manual_cmd (kW)	0
Q_manual_cmd (kvar)	0
Vref (V)	480
V1 (1000pu)	20
k1	-30
K2	-40
Kv	-10





### **ALMACENA Project. Control system**

Control systema allows to manage the system both, locally and remotelly

#### Local control inside de container

Modo de Op	eración		Control de Grup	o de Potenc	ia
Modo Actual:		Apagado	Mantenimiento		
<ul> <li>Secuencia de Inicio</li> </ul>	3	Detenido	Apagar		
Bateria Cone	ectada		Abudan	Presionando	Local/Remoto
Inversor Cor	nectado		Control Local	solicitará el r	einicio del sist
Union Auton	natica de Bastidore	es de			
Baterias			Control Domoto		
Datos del Med	lidor Detallados				
Estado Actua	lidor Detallados al AC		Q	DC	
Estado Actua kW Demanda:	idor Detallados al AC	0	Corriente (A):	DC	0.0
Estado Actua kW Demanda: kW: bvar Demanda:	idor Detallados Al	0.0	Corriente (A): Voltaje (V):	DC	0.0
batos del Med Estado Actua kW Demanda: kWar Demanda: kvar:	iidor Detallados al AC	0 0.0 0.0	Corriente (A): Voltaje (V): kW: EDC (%):	DC	0.0 0.0 0.0 0.0
Estado Actua KW Demanda: kW: kvar Demanda: kvar: Corriente (A):	idor Detallados al AC	0 0.0 0.0 0.0 0.0	Corriente (A): Voltaje (V): kW: EDC (%): Energia Almacenada (kWh):	DC 0	0.0 0.0 0.0 0.0 3000
Datos del Med Estado Actua kW Demanda: kW: kvar Demanda: kvar: Corriente (A): Voltaje (V):	al AC	0 0.0 0.0 0.0 0.0	Corriente (A): Voltaje (V): kW: EDC (%): Energia Almacenada (kWh): Capacidad de Carga:	DC 0	0.0 0.0 0.0 3000 1000.0
Datos del Med Estado Actua kW: Demanda: kvar Demanda: kvar: Corriente (A): Voltaje (V): Frecuencia (Hz):	al AC	0 0.0 0.0 0.0 0.0 0.0 0.00	Corriente (A): Voltaje (V): kW: EDC (%): Energia Almacenada (kWh): Capacidad de Carga: Capacidad de Desarga:	DC 0	0.0 0.0 0.0 3000 1000.0 1000.0
Datos del Med Estado Actua kW Demanda: kVar Demanda: kvar: Corriente (A): Voltaje (V): Frecuencia (H2):	al AC	0 0.0 0.0 0.0 0.0 0.0 0.0	Corriente (A): Voltaje (V): KW: EDC (%): Energia Almacenada (kWh): Capacidad de Carga: Capacidad de Carga: Capacidad de Carga:	DC a: 0	0.0 0.0 0.0 3000 1000.0 1000.0 0/32

## Remote control from any desk in REE







### **ALMACENA Project. Control system**

Control software for monitoring and control, adapted to REE needs



### ALMACENA Project. Where we are?



Standar O&M after NEC purchasing by NEC ES

2

3

4

1

**Gathering leassons learned** 

Analysing performance – Colaboration with Sevilla's University

Colaboration with EPRI – International benchmarking



Substation Scale Energy Storage Demonstration Initiative



### ALMACENA Project. Where do we go?



1

Learning on Maintenance

2

Developing operation tools (long/ short term)

3

4

Modeling aging (key element for business models)

Going on with EPRI's colaboration



Substation Scale Energy Storage Demonstration Initiative





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#### Gracias por su atención

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Proyecto Almacena: http://www.ree.es/es/red21/idi/proyectos-idi/proyecto-almacena