HIGREEW WORKSHOP

The installation of a commercial-scale flow battery in the Son Orlandis photovoltaic plant

Victoria, 17 Mayo, 2023



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INTERNAL

BESS projects Map Operation+execution

EGP Storage Business footprint



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Baleares – Innovation DEMO

Need

Problems to be solved (TECHNOLOGY):

- Storage with long duration (> 4 hours)
- Simultaneous multiple applications: long duration energy shifting plus power intensive services
- Deep discharge applications.

Today, Li-lon batteries seem to be not competitive, in terms of costs, for long duration storage. In addition, deep discharge cycles affect the life of lithium batteries.

Source: Siemens Corporate Technologies 2018

Baleare

Need (BUSINESS OPPORTUNITY):

Baleares Islands Tender: request for 5-hour-storage integration in PV power plants (1 PV project, ≈3 MWp, COD 2023).





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Innovative proposal and BESS sizing



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Innovative electrochemical solutions for Spanish Islands



"Innovation window" for innovative BESS chemistries testing

- PV + BESS Baleares and Canary Islands tenders: 5 hours storage not mandatory but gives additional competitiveness to PV projects (i.e. additional scoring)
- No "strong" constrains on performances: ideal environment to assess innovative-but-mature-enough BESS!



- Site: Son Orlandis (Baleare
 Tech: Vanadium Flow
- Size: 1.1 MW / 5.5 MWh



- ✓ No fire risk
- ✓ High recyclability
- No critical raw materials
- Long life (>20 yrs)
- Low LCoS for > 5-6 hours

COD: Sep 2023

Redox Flow Batteries

Technology features

PRINCIPLE

- The RFBs generally contain 2 electrolyte solution in 2 separate tanks, circulated through 2 independent loops
- The chemical composition of the electrolyte solution define the sub-categories; the most important and common being Vanadium RFB (VRB).
- A VRB uses the same metal in both half-cells (grey) that are separated by an ion-exchange membrane (red). The negative half-cell uses the V(III)/V(II) redox couple whereas the positive half-cell uses the V(IV)/V(V) redox couple. As the battery performs electrical work, the ionic balance is maintained by protons (H+) migrating across the ion-exchange membrane.

MAIN FEATURES

- RFBs are flexible and expandable by design and can store energy simply by adding additional tanks of electrolyte.
- Power range: 1÷100 MW
- Ideal fit for many storage applications requiring long duration discharge (>4 hours)
- Relatively low efficiency RTE DC-DC 70÷80% avg; response time < secs</p>
- No fire safety hazard. Vanadium and zinc-bromine electrolyte are slightly corrosive. Recyclable (>90%)
- Emerging technologies on the market: vanadium, iron-based, zinc bromine electrolytes. The main components of a RFBs are mature products and abundant raw materials.



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Baleares – Innovation DEMOs

Storage business case and main value streams



Flow Batteries Vs Li-ion – Large Scale Plant



LCOS Comparison

Business case assumptions: 20 MW – 80 MWh – 1 cycle/day – 8% discount rate



Business case assumptions: 1.1 MW – 5.5 MWh – 1 cycle/day – 8% discount rate LCOS for 1.1 MW BESS [\$/MWh] 250 200 150 4h 5h 8h 10h 11h 12h . 6h 7h 4 **Discharge time**

No evidence of Lithium/Flow LCOS break even for 4 to 12h discharge time

Electrochemical technologies: KPI comparison







Innovative electrochemical solutions for Spanish Islands Erection and BESS manufacturing





Innovative electrochemical solutions for Spanish Islands



Electrical diagram



Innovative electrochemical solutions for Spanish Islands Plant completed





Innovative electrochemical solutions for Spanish Islands Next steps



COMMISSIONING

- Start of operations scheduled on June 2023
- Hot commissioning to be completed by September 2023
- Grid connection of **first battery hybridized with a PV plant** under new TSO grid code in Spain.

O&M HAND OVER

- Maintenance contract to be signed with LARGO
- Definition of dispatch control signal for the battery from ENDESA control center (electricity pool price forecasting algorithm)
- Operational monitoring tool of main KPIs (PI)