

Overcoming Intermittency in Renewable Energy through Storage Systems

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Keywords : Renewable intermittency, storage system, grid integration, storage economics

Abstract

Energy Storage Systems represent a key factor in order to increase the hosting capacity of the electricity distribution grids coupled to unpredictable renewable energy power plants (i.e. wind and solar).

Recent development of energy storage and power electronic technologies, either at commercial or demonstration level, are providing new opportunities to use energy storage in applications that span the entire grid continuum, from power plants to customer site.

In order to assess actual technical suitability of the most promising batteries technologies for energy storage applications, Enel Research department designed and built up a specific test facility able to fully characterize their performances under the different operating conditions.

The batteries installed on the test rig are Vanadium Redox Flow battery (VRB), sodium nickel-chloride high-temperature battery (ZEBRA) and lithium-based battery (LiFePO₄).

Testing activity can be carried out by means of an electric load, which simulates charge and discharge requirements of different applications, as well as by connecting the batteries to a PV system placed on the facility building, in order to assess dynamic coupling with renewable plants.

The storage systems are remotely operated by an Energy Management System, based on the following three criteria:

- A planning level which uses forecasted electricity prices for the day ahead to determine the optimal set points to maximize the profit objective through energy trading;
- A real-time management level which uses real-time measurements to calculate instructions to be sent to the BMS to overcome renewable intermittency;
- A real-time control level which focuses on optimizing component life and equipment safety

Endesa is collaborating to the testing activity and is carrying on a demonstration project in the Canary Island that will evaluate how large battery energy storage may provide significant dynamic operation benefits for the frequency regulation and potential overload of isolated grid.

The presentation describes the main results obtained in Enel Group projects and proposes a preliminary guideline required in order to maximise the benefits for renewable plant operators and storage system economics.