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Energy storage systems for wind power application

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Extended Abstract

The importance of wind power generation has increased significantly in the last three decades. Nowadays, it is one of the most expanded renewable sources. However, there is still a need for a larger participation of these means of generation based on natural resources, in order to satisfy the ever-growing energy consumption in a less environmentally hazardous manner. Nevertheless, a few drawbacks limit wind power expansion. These shortcomings must be overcome to improve its energetic performance.

Energy storage systems solve some of the problems found in network connected or isolated wind farms. Since it is not possible to control or to forecast with perfect accuracy wind random fluctuation, storage systems are able to accumulate energy when the resource is available, and release energy when required, thus decoupling generation and consumption processes. Nowadays, there exist many different storage technologies. Some of the most important are dealt in this study.

Electrochemical batteries store energy by direct and inverse chemical reactions. Several types exist since different compounds are used in all of them. Flow batteries and sodium sulphur batteries follow similar principles as well. However, their remarkable importance deserves individualised study.

Other devices, such as flywheels, supercapacitors or SMES systems, are able to store energy in a rotating mass, or using electric and magnetic fields respectively. When necessary, electricity flows out of these devices, thus providing energetic supply.

Hydrogen technology aims to be widely used for large-scale electricity. Since no pollutant is produced, it is considered one of the best long-lasting supply alternatives.

According to the power and energy requirements, three different operation modes for the storage devices appear; these are the following: power quality, bridging power and energy management. Depending on the application, a certain device will be preferable among the others due to its particular characteristics.

The lead-acid battery is currently the leading technology either for power or energy applications. However, as seen in this paper, some of the devices considered have better performance under the same working conditions. Moreover, as soon as the different technologies develop, lead-acid batteries will be replaced with more efficient systems.

A few conclusions are stated after reviewing the references. In general terms, the most recently developed technologies still need to reduce costs in order to be economically competitive. In addition, since all of them have several advantages and disadvantages, efforts must be done to enhance their benefits and reduce their weaknesses. Therefore, invests in R&D are required, as well as increasing fieldwork in order to test the performance of these technologies in actual applications.