# APPLICATIONS OF ELECTRICAL STORAGE SYSTEMS-A REVIEW

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**ABSTRACT:**

***This article focuses on the applications of Energy Storage Systems apart from the support that EES technology provides for mobile devices, automotive, space applications, and other autonomous or isolated systems, EES has seen increasing interest in power quality management, bridging power and energy management applications in recent years. Other applications offer time-shifts ranging from hours to days and even months to facilitate energy management and temporarily decouple electrical energy production and consumption . There are already several applications that provide network support and management, and more will be added in the future.***

**Keywords :** ***Energy Storage Systems,Power Quality Management,***

## 1. Introduction

Power quality is the degree to which the power supply is reliable and maintains a rated voltage, power factor , rated frequency (50Hz or 60Hz, depending on national standards), and a pure sine wave with no harmonics or transients. Points to [2]. Power quality regulation services work the fastest and can be operated in seconds to minutes. Next are bridging power services that can operate in minutes to an hour, bridging the limited power generation capacity of energy sources and volatile power demand, and ensuring continuity when switching from one power source to another. [2, 4]. Energy Storage Technology has been applied in a variety of areas, including portable electronics, automotive and fixed systems, traction and propulsion provision, ubiquitous automotive startup, lighting and ignition, standby power, and remote power [1]. Improvements in both renewable energy and storage technologies are constantly needed to accommodate the ever-growing source of fluctuations in the grid. However, energy storage for non-renewable energy can also be essential to the transition to sustainable energy production in order to promote penetration. In recent years, EES has increased interest in power grid applications that provide regulatory, contingency, and management reserves. A detailed description of each application is discussed further in this article.

## 2. Fluctuation suppression

Rapid power fluctuations from renewable energy sources can occur on a time scale of up to 1 minute due to changing weather. Such fluctuations can be fatal to some power electronics, information and communication systems in the grid. To mitigate the effects of this iteration, you can apply a fast response EES that can provide a high ramp rate and cycle time. Plants can be charged / discharged in seconds to minutes to facilitate power generation from intermittent renewable energy sources

## 3. Oscillation damping

Until to some extent, the integration of renewable energy into the power mix can be managed by existing sources of flexibility. As it becomes more widespread, the resilience of the system to disruption can be compromised, especially in weak and isolated networks. Therefore, fast response and high ramps within a 1 minute time frame to avoid system instability and consequent voltage drops or power outages by absorbing an d discharging energy during sudden power drops due to transient fluctuations. You need an EES that can avoid system instability and consequent blackout.

## 4 Frequency regulation

Frequency tuning is necessary to maintain a balanced system. There are daily, weekly, and seasonal models, but power consumption cannot be accurately predicted, leading to an imbalance between power generation and demand or deviation from rated frequency, May cause voltage drop and power failure.. The systems can be used in such applications that require long life and fast response speeds combined with excellent link speeds. The energy stored in these applications must increase or decrease its output in less than a few seconds to maintain the frequency permanently within the standard range of the electrical network.

## 5 Reactive support

The power converter used to facilitate RES integration introduces some unwanted harmonics into the system. On the other hand, some types of wind power generators consume a large amount of reactive power, which also affects the voltage drop and synchronization with current. devices that can compensate for phase differences are devices that provide reactive support and include generators, loads, and energy storage devices. The EES used in such applications offers both the important advantage of being available in the absence of power generation and the high ramp speeds sufficient for short-term support. controls can be implemented mechanically or via auto-generated controls. It is worth noting that the converter system used plays an important role in both cases, as both active and reactive power from the storage system must be compensated.

## 6 Low voltage ride-through

Low voltage coupling, also known as Fault Coupling, determines the ability of a generating set to remain connected to the grid during short voltage drops or entire system failures. It's important for the power system to keep the supply online, to avoid a possible string case where the voltage could drop far enough to force another generator to work, etc. The integration of the EES system, with its high power capacity and instantaneous response, at the point of connection to the external grid, allows continuous connection of the power plant and reduces the risk of grid collapse [1,6].

## 7 Voltage regulation

Besides frequency, a stable voltage must be maintained within technical limits throughout the value chain of the power system. Voltage is usually controlled by transformer taps, but for modern systems to withstand dynamic changes of active and reactive power, EES technology can be implemented. Fast response EES located at the end of heavy load lines can improve voltage drop and drop by tapping or pumping respectively

## 8. Uninterruptible power supply

Uninterruptible Power Supply (UPS) acts as a time-delay converter during interruptions, voltage spikes, or flickering and has become important to some residential and commercial consumers, who Owners of security and fire protection systems, computers, server databases and other automation systems need to protect or permanently retain stored data in memory. Since these devices require uninterruptible power, instantaneous response EES systems can be deployed to improve power quality and provide backup power in the event of a power failure. This application adds great value in cases of power quality problems and frequent power outages.

## 9 Load following

Maintaining and optimizing production involves precisely matching power output to changing demand. Depending on the required flexibility, generating sets are currently being deployed at the request of network managers. However, as the penetration of renewables increases, there is a need for well-scalable alternative sources to meet the production-consumption mismatch and shape the energy profile [3,5]. . This is commonly known as load tracking and includes storage devices capable of delivering power over a time frame of a few minutes to an hour. A suitable EES system for this purpose can provide ramp speeds of 0.3 to 1 MW/s and sufficient power and electrical capacity in reserve.

## 10 Black start

Many power plants need electrical power from the grid to perform start-up operations, form a reference frequency for synchronization, and help other units restart [3]. This service is an integral part of the power system and has been achieved by using diesel generators or hydroelectric units to provide the initial energy needed to restart the grid after a power outage. . Without power from the grid, EES units must remain fully charged and discharge when black-start capability is required to enable other installations to start up and synchronize with the grid [4].

## 11 Emergency Back-up

energy storage units can provide backup power allowing customers to weather outages and resume normal operations [1]. It functions as an alternative to emergency diesel generators, commonly installed and modified to support large users including healthcare facilities, telecommunications services, commercial and industrial customers. For increased reliability, emergency backup storage requires a relatively long instantaneous response time and discharge time [2]. The output power and rated energy capacity of these applications depend on whether they are deployed to shut off power until a conventional standby generator can start or whether they are fully self-mitigated [3].

## 12 Peak shaving

If cheap energy is stored during periods of low demand at night and fed into the grid during peak electricity demand of during the day, the economics of a power plant will improve significantly. The Service must be able to operate within 1 to 10 hours, to meet daily peak demand and thus, to be able to shut down expensive peak generating plants

## 13 Energy arbitrage

Electricity prices are highly volatile, but tend to follow a pattern of daily low prices during off-peak hours at night and high daytime prices during peak times. Energy arbitrage involves operating storage in such a way that it consumes energy when market prices are low and releases energy when market prices are higher. Thus, mass energy storage is advantageous in that it can cover both power generation and load, making it possible to arbitrate two-period power generation prices and improve the system load of the power generation process.

## 14. Conclusion

From the above review it is clear that a energy storage System plays a vital role in power applications . A wide The techno- logical progress, performance and economic aspects of different EES applications were discussed and evaluated .Variety of EES technologies and concepts are available, while others are expected to emerge in the future.

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