

# Application Prospect of Large-scale Energy Storage Technology in Current Power System

Gao Xueqian

North China Electric Power University (Baoding), Institute of international education, Baoding, Hebei, 071003, China

gaoxueqian@126.com

**Keywords:** power system, large scale, energy storage technology, application prospect.

**Abstract:** At present, in the power system, large scale energy storage technology has gradually become the norm, but, some technical shackles in the development and application lead to power system disturbances, or even normal operation. This paper mainly discusses the current development of power system, energy storage technology and the role and position of all kinds of energy storage technologies and cost. The application prospect of this technology in power system is also analyzed, in order to improve the market competitiveness of power supply, and environmental quality for to achieve sustainable development.

## 1. Introduction

Enterprises, units, or individuals, in the daily work, in the life process, are inclined to make the smart grid or new energy power generation as the first choice. This just highlights the value and role of energy storage technology, and its application in the power system is becoming more and more extensive. At present, there are various kinds of energy storage technology. There are many kinds of energy storage technology. There are more or less differences between different categories of energy storage technology in terms of function and characteristics. In China, large-scale energy storage technology still has great development and application space. Combined with the actual situation and needs of power system, we should make reasonable and effective application of the technology.

## 2. Current development of power system

### 2.1 Energy structure characteristics of power system

Different power systems, their energy planning and energy storage technology demand is also different. At present, our country is dominated by thermal power generation, and the proportion of our country is over 70%. Among them, most of the coal is coal. The developed countries are different from our country, which mainly uses oil, gas and nuclear power to generate electricity. As far as Spain is concerned, the ratio of wind power in the country is close to 20%. In the process of wind power generation, it is difficult to determine the wind's back regulation or effectiveness, so it increases the power system's peak shaving difficulty unless it is equipped with suitable backup capacity and peak load power.

Our country, whether it is the total electricity consumption, or system installed capacity is larger than the developed countries such as the United States and other developed countries, the same load. Still in Spain, for example, the installed redundancy as high as 125%, while China is far lower than this value, which shows that only by setting a lot of peak shaving and reserve power, in order to ensure the safety of wind power and in the process of maintenance, to achieve large-scale peak power, and the failure to timely solve [1].

## **2.2 Renewable energy development and planning**

Both developed and developing countries are trying to generate electricity with the help of renewable energy, and the corresponding planning and layout have been carried out. China is also gradually inclined to use wind, water, solar energy and other new clean energy to generate electricity, which helps to reduce energy consumption and is very environmentally friendly. Developed countries such as the United States, Britain and other developed countries are also very popular with renewable energy. If we use large scale wind power or solar energy to generate electricity in power system, we will have a serious impact on the original power grid, resulting in its difficult operation.

The application of large scale energy storage technology can not only make the power grid more flexible in the process of operation in the power grid, but also can improve the ability of consumptive area power grid wind power and photovoltaic power generation. At the same time, the technology has the obvious advantages of automaticity, adjustable and so on, and the reactivity is sensitive, which makes the power grid speed control more convenient. The energy storage system contains a lot of capacity space, because it can control and regulate the power generation of cycle energy flexibly, to a great extent, it improves the capacity of the power grid. In the next few years, large-scale energy storage technology will develop space [2] with the application of renewable energy.

## **3. Location and function of energy storage technology**

In recent years, the application of new energy to the power system has gradually become a trend, and its power generation scale is gradually expanding. In traditional power systems, both transmission and distribution, or electricity dispatching, are considered according to the demand for electricity. The application of new energy, such as wind and solar energy, in the power system, needs to consider many factors and is not stable enough, so it is difficult to reasonably control and regulate it. If it is applied to the large-scale grid operation, it is easy to increase the operation failure of the power grid and make it difficult to ensure the security and stability. The advanced nature of energy storage technology lies in that it can overcome all kinds of unstable factors in the process of new energy power generation, provide wide application space for clean energy, and ensure its economy and environmental protection.

The traditional power grid is based on the demand for electricity. This characteristic determines that the power grid is in the balance of supply and demand, whether it is in the planning, operation, or control. In the current social development process, its shortcomings are becoming increasingly prominent, increasing the difficulty of power grid scheduling and control, and the management process is more complex [3].

More and more peak loads have appeared in the power grid with the increase of the daily demand for electricity. In order to coincide with the peak load capacity requirements, Power Grid Corp has invested a lot in transmission and distribution equipment, reducing the overall load rate of the system, and the power assets have not been effectively utilized to the maximum extent. And large scale energy storage technology is popular in the power market because of its own advantages. Energy storage technology has obvious advantages in performance, capacity and scale, which will be applied to the power system, can be stored in the instantaneous power, power generation and electricity will no longer need at the same time, the use of power grid, operation, planning, scheduling, etc. the structure will change with the.

Application of large-scale energy storage technology will be involved in the whole process of the power system, the peak load power supply is no longer difficult, not only can make full use of the existing network equipment, and the operation efficiency of the power grid will be increased; in case of power failure, the technology can easily deal with, through the power supply with high efficiency and quality, allowing users to get the unique electric storage experience; widely used technology in power system, no longer need to build many power grid, traditional power grid construction mode will also change, to really play no electric power equipment Co. [4] for measurable effect.

## **4. Development and cost of all kinds of energy storage technology**

### **4.1 Development of various kinds of energy storage technology**

Types of energy storage technology is more, so far, has mature including pumped storage, lead-acid batteries, and some flow battery, lead battery energy storage technology is relatively mature, but the promotion is not a high degree of technology, stability and efficiency still need further verification.

The energy and functional density of battery energy storage is very high. Taking sodium sulfur battery as an example, its density is 200W. H/kg, and the storage capacity of flywheel and pumped storage battery is usually 30Wh. Kg. The energy storage technology of liquid - flow battery and lead - energy battery has high power density, which not only can supply power supply with high power, but also has a very sensitive reaction degree. If there is a transient decrease in voltage or a transient stop in power supply, energy storage can be done by means of liquid battery and lead battery, so as to avoid affecting the stability of power system [5].

Electromagnetic energy storage technology can be used in power system, but whether mechanical energy storage technology can be recycled or used depends on the system parts. Under normal circumstances, the useful life of electromagnetic energy storage technology is no less than 15 years. In fact, the performance and failure mechanism of the motor material are the key factors to determine the battery energy storage life. Normally, the use of sodium and sulfur batteries in the power system often cycles at 4500 times, and its speed is very fast.

### **4.2 The cost of all kinds of energy storage technology**

For the power system, choice of pumped storage or air storage, because of its high cost, great popularization; and the battery energy storage in the economy is not dominant, the cost is higher than the air pumped storage or storage, but its application in power system, set up in the preparation of high flexibility degree, and sensitive reaction. Therefore, electric power enterprises should rationally select and apply all kinds of large-scale energy storage technologies according to actual situation and demand, and set up energy storage system to control the cost [6].

## **5. Application prospect analysis of large scale energy storage technology in power system**

### **5.1 Application of energy storage technology in power system**

According to the power statistics, the storage capacity is the largest. In the last two years, the capacity of storage and storage in China is 30GW. It is obvious that in the power system, the main function of storage energy storage is peak adjustment, frequency modulation, peak elimination and so on. The electricity price system of pumped storage, or the operation and management, is related to the power structure of the country used. At present, in the construction of pumped storage and related management mechanism in China, the power grid operation unit is the main body of management. More than half of the construction cost is absorbed by the power grid units. The rest are shared by users and power generation units, and the two half are taken up.

The compressed air energy storage has been widely used in the United States and Germany. The installed capacity of these two countries is different. The main function of the energy storage technology is to peak load or to eliminate costly power plants, so as to achieve capital savings. In the future, the battery energy storage systems, such as sodium sulphide and lithium ion, will be widely used in the field of new energy and frequency modulation.

### **5.2 Estimate the prospect of energy storage technology market**

Wind and solar energy have been favored by many countries, and these countries are generally focusing on the planning and application of this kind of resources. At present, the power grid and new energy are developing at a high speed. According to the actual situation of power system development, the future development of energy storage technology in China is also discussed, and its

technical verification is carried out. In fact, in most cases, it is applied to rapid emergency response. In the power system, the large scale application of energy storage technology can not only reduce the peak and fill the valley, but also improve the security of the power system. Although the technology is very advanced and the market prospect is considerable, the cost is relatively high, the business system is not perfect, the subsidy mechanism is not yet mature, and there are still many uncertainties in the price of electricity, so it is hard to predict [7].

### 5.3 Forecast and calculate the capacity demand of power storage market

As far as the application of large-scale energy storage technology in power system is concerned, the restrictive factors of energy storage market mainly include three aspects: the development and renovation of energy storage technology, the development of power grid, and the establishment of a sound price and reward and punishment mechanism. Combined with the above contents, we can implement the prediction model construction, and use this model as a carrier to input the relevant correction coefficients of demand and factors, and get the storage capacity market capacity in the future. Formula:  $P_{total} = (1-K_1) * K_2 * (P_r + P_s + P_d) * 6(1+a)^{(r/R)}$ .

In the formula,  $K_1$  and  $K_2$  respectively refers to all kinds of market demand cross coefficient and incentive coefficient, 0-1 is the range of the former;  $a$  refers to the cost effect coefficient;  $R$  and  $r$  refers to the current generation cycles and the best conditions were  $P_r$ ,  $P_s$ ,  $P_d$ ; energy storage capacity demand generation energy, peak, distributed power supply using these three different conditions.

$$P_r = C_1 \times P_{wind} + C_2 + P_{solar}$$

Similarly, the formula, with installed capacity of solar power generation planning and planning capacity is  $P_{wind}$  and  $P_{solar}$  respectively, wind power generation,  $C_1$  and  $C_2$  respectively refers to the two kinds of energy state, and power storage coefficient corresponding to the ratio.

$P$  the  $L$ ,  $Max$  and  $C_3$  said that in the future the maximum difference between peak and valley time under specific and storage market accounted for at peak coefficient.

$P_d$ ,  $Max$  and  $C_4$  respectively refer to the future specific time for distributed energy market and energy market capacity of the largest proportion of energy storage coefficient.

By calculating the capacity demand of electric energy storage market, in the power system, the large-scale large-scale energy storage technology is scientifically selected and applied reasonably, providing the most cost-effective power supply and reducing unnecessary resources and energy waste [8].

## 6. Conclusions

To sum up, the large-scale energy storage technology is very applicable in the power system, and the prospect of its market development is immeasurable. The power company should give full play to the advantages of the technology and fundamentally solve the problems of intermittent and stochastic fluctuations existing in the process of new energy generation, so as to reduce the pressure during the rush hour and make full use of the power equipment. At the same time, according to the actual situation and requirements in the power process, we should select the highly applicable energy storage technology, improve the operation quality of the power grid, provide users with the supply of high-quality power resources, and make the technology more market oriented.

## References

- [1] Zhang Lixia. Analysis of the application prospect of large-scale energy storage technology in power system [J]. Jiangxi building materials, 2016, (15): 204.
- [2] Ye Jilei, Xue Jinhua, et al. Application status and Prospect of energy storage technology in power system [J]. China electric power, 2014, 47 (3): 1-5.
- [3] Gao Huaming. Development trend analysis of large-scale energy storage technology in power system [J]. Information system engineering, 2016 large-scale energy storage, (5): 42.

- [4] Yuan Xiaoming, Cheng Shijie, et al. Application prospect of energy storage technology in solving large-scale wind power ice network problems [J]. automation of electric power system, 2013, 37 (1): 14-18.
- [5] Xu Shouping, Li Xiangjun, et al. Review of the development status and demonstration application of large-scale energy storage system [J]. power grid and clean energy, 2013, 29 (8): 94-100.
- [6] Li Jianlin, Jin Wentao, et al. Typical application and technology trend of large-scale energy storage in renewable energy power generation, [J]. electrical and energy efficiency management technology, 2016, (14): 9-14.
- [7] Wang Jing, Ma Hongbo, et al. Application of energy storage technology in the field of frequency modulation in Shanxi electric power system [J]. wireless interconnection technology, 2017, (18): 129-130.
- [8] Zhang Jianxing, Zhang Yu, et al. Development opportunities and challenges of large scale battery energy storage technology in power grid [J]. power and energy, 2013, 34 (2): 182-186.