Research on the method of eliminating new energy in smart grid

Xin WANG, Yun LIU and Yi SUN
School of Electrical & Electronic Engineering, North China Electric Power University, 2 Beinong Road, Huilongguan Town, Changping District, Beijing, China
50101892@ncepu.edu.cn

Abstract. Electric power system has great development in China, the smart grid system is more and more perfect, as the global energy problem gradually revealed, how in the smart grid system of recruiting energy dissipation has become a new research point, through the analysis of the current existing new energy development and given new energy of the main technology, puts forward two Suggestions, the first is to optimize new energy power generation forecasting, the second is give full consideration to the development of distributed power supply.

1. Smart grid should consider the power generation of new energy sources
With the rapid development of modern society and economy, the electric power industry in China has been rapid development of power system operation voltage increasing, the network scale is expanding, the concept of smart grid is proposed and implemented in twenty-first Century has become the hotspot of research in power system of major scientific and technological innovation and modern power industry [1-2]. At the same time, with the growing depletion of fossil energy, the energy industry of a country’s economic development is becoming more and more important, accordingly construction energy conservation and emission reduction, green energy, social goals of sustainable development has become the economic development of every country priority, new energy power generation has been rapid development. The 13th five-year plan for renewable energy has clearly defined the total renewable energy generating capacity of the country by 680 million kilowatts in 2020, generating 190 million kilowatts of electricity, accounting for 27 percent of the total capacity [3]. Renewable energy grid to the system and stable operation of the scale has brought new challenges, how to access a variety of renewable energy safe, reliable power source is the smart grid technology in the process of development must consider the question.

2. China's new energy development status
In 2016, the installed capacity of wind power in China was 17 million 340 thousand kilowatts, and the total installed capacity reached 150 million kilowatts. From the perspective of power generation, wind power generation in China reached 241 billion kilowatts in 2016, accounting for 4% of the total electricity generation in the country. Since 11th Five-Year, China's wind power generation has increased rapidly, with an annual average growth rate of 56%, accounting for 4.02% of the total electricity output in the country from 0.07% in 2005 as in Figure 1.
In 2016, the installed capacity of solar power in China increased by 34 million 760 thousand kilowatts, and the total installed capacity reached 77 million 420 thousand kilowatts, an increase of 81.6% over the previous year, an increase of 11 percentage points from last year, accounting for 4.7%
of the total installed capacity. In the 2011-2016 year, the proportion of solar power generation installed is increasing year by year. Since 12th Five-Year, the scale and change trend of solar power generation are shown in Figure 2.

![Wind power generation(TWH) in China from 2006 to 2016](image1)

Figure 1. Wind power generation(TWH) in China from 2006 to 2016

![The scale and trend of solar power generation in 2011-2016](image2)

Figure 2. The scale and trend of solar power generation in 2011-2016

In general, the development trend of renewable energy is swift and violent. At the same time, the development of renewable energy has a great prospect because of the support of national policy. Since the end of 2016, the national development and Reform Commission, Energy Bureau and other ministries jointly issued a series of policy documents relating to a new energy plan "13th Five-Year", "renewable energy development" 13th Five-Year "plan" clearly at the end of 2020, the national wind power installed capacity reached 210 million kilowatts, solar power installed capacity reached 110 million kilowatts, so the new energy the grid technology research and innovation of market consumption pattern has important significance.

3. Main ways of eliminating new energy - demand response

In terms of new energy development and use, obliges admit more renewable clean energy, power, and safeguard to safe, reliable and efficient operation of the grid, the grid need to interact with users of flexible, mainly through the Demand Response (Demand Response, DR), the user can through the interrupt Response methods such as contract, price into power generation plan, literature [4-5] to study the use of power load flexibility, reduce system reserve capacity, in ensuring the safety of power grid system standby cost at the same time, at the same time, through the Demand Response to given new energy has attracted wide attention of researchers, research in literature [6] Demand side Response and
wind power grid collaboration efficiency, design Demand Response of the mass grid wind power implementation mode, to promote wind power grid given, make sure the system stability and economy of operation.

The implementation approaches of the demand response to new energy mainly include the transformation of the rigid load to the flexible load, the improvement of the economic reliability of the power system, and the promotion of the optimal utilization of distributed energy.

3.1. Transformation of rigid load is flexible load
Demand response to price means and incentives to guide the user response system scheduling demand, adjust and optimize power use behavior, will be in the traditional sense of the uncontrolled power load into controllable flexible load, according to the load response, by changing the supply and demand in market relatively cheap new energy power generation consumes more ratios, which to a certain extent, improve the utilization of new energy resources.

3.2. Improve the economic reliability of power system
The demand response can motivate the power end user to respond to the system scheduling requirements, and realize the goal of optimizing the power generation side and the power side. Renewable energy scale grid will have big impact to the system safe and stable operation, after introducing demand response when the renewable energy generation output drop occurs, the system can be according to the agreed upon in advance demand response protocol, require the user to cut electricity load to meet the balance between supply and demand of system, good economic returns and give the user agreement.

4. New energy utilization status.
At present, the new energy consumption has achieved some success. During the 12th five-year plan period, the annual wind power generation capacity is 1905. The "12th five-year plan" averaged 1,295 hours of solar energy per year. But as a result of new energy, especially renewable energy has the characteristics of instability and intermittent, renewable energy generation, such as subject to scenery characteristics and nature of reverse distribution, energy reserves and demand of renewable energy in the given situation is not ideal, abandon the wind power for the whole year of 2016, China's 49.7 billion KWH, abandon the wind rate of 17.1% on average. In 2016, in the five provinces of northwest China, the total amount of abandoned light was 7.04 billion KWH, and the average rejection rate was about 20%. The data show that the rational use of renewable energy has not been fully, waste of energy at the same time, the huge economic losses, restricting the renewable energy given the reason mainly has two aspects.

4.1. Renewable energy and network difficulties.
For the traditional electric power system, the operation of the power grid companies planning and load characteristics of the demand side, electricity characteristics are closely related, but with obvious characteristics of intermittent the increase of the proportion of renewable energy grid, makes the supply side of the power system and presents the obvious randomness, greatly increase the risk of the operation risk and scheduling of grid system. In addition, there is a certain conflict of interest between thermal power enterprises and renewable energy enterprises, which makes it very difficult to access renewable energy.

4.2. The market mechanism does not improve the absorption of renewable energy in a larger scale.
The current electricity price policy is inflexible and also affects the trans-provincial trade of renewable energy. Compared with thermal power, the marginal cost of renewable energy generation is low, and it has the cost advantage in the trans-provincial transaction, which can help to mobilize the enthusiasm of the end province. However, at present, China has not formed a complete set of price mechanism for power generation, and the advantage of low marginal cost of renewable energy power is not reflected.
5. Suggest
Reasonable planning and construction of thermal power projects and new energy generation projects simultaneously optimize the prediction of new energy generation. Because of new energy power generation has stronger intermittent and randomness, in order to achieve the given as much as possible in demand response program of new energy, you need to power generation enterprises to strengthen the prediction of new energy output curve, provide a more accurate new energy grid electricity, so power grid scheduling and can control the user response of load can to respond in a timely manner.

Fully consider the development of distributed power supply. Renewable energy is decentralized, and the distributed power source close to the load is an important part of the future power grid. In order to guarantee the reliability of power supply and power quality, distributed energy storage technology is also very necessary, and distributed energy storage is an effective way to solve the instability and intermittency of dispersed resources.

Reference
[1] Research Reports International. Understand the smart grid [R].2007.
[2] Amin S M, Wollenberg B F. Toward a smart grid: power delivery for the 21st century [J]. IEEE Power and Energy Magazine, 2005, 3(5) : 34-41.
[3] Thirteen five - year plan for renewable energy development, http://www.ndrc.gov.cn
[4] Le Anh Tuan, Kankar Bhattacharya. Compet-itive Framework for Procurement of Interruptible Load Services [J]. IEEE transactions on Power Systems, 2003, 18(2) : 889-897.
[5] Wu Jiguang, Liu Junyong, Niu Huaping, et al. Determination of Optimal Reserve Capacity in Electricity Market Environment [J]. Automation of Electric Power Systems, 2005, 29(15) : 10-13, 22
[6] Zeng Ming, Li Chen, Chen Yingjie, et al. Implementation Mode of Power Demand Side Response to Large-scale Wind Power Integrated Grid in China [J]. East China Electric Power, 2012, 40 (3) :363-366.