STUDY ON THE DEVELOPMENT STATUS AND TREND OF DISTRIBUTED POWER IN CHINA

Jiang Wu 1†, Jianxing Ren 1, Fangqin Li 1, Weiguo Pan 1, Jianrong Sun 1, Qunzhi Zhu 1, Qifen Li 1, Zhongzhu Qiu 1 and Weijun Gao 2

1 School of Power Source and Environmental Protection, Shanghai University of Electric Power, Shanghai, P.R. China
2 Faculty of Environment Engineering, the University of Kitakyushu, Kitakyushu, Japan

ABSTRACT
Most of the electric power in China is from coal combustion power station, so that the pressure of environmental protection is high. At the same time, there is big difference of development between East China and West China, which brings some difficulties to centralized power delivering. Because of its characteristics, distributed power (DP) can slow down these contradictions, so it develops quickly in China. The DP is mainly used in special situations, temporary electric power consuming, power-peak adjustment and improvement of safety of the power network, and it also can be a good power supply method for some developing areas in West China, where centralized power supplies are not suitable. On the other hand, the cost of the DP is high, and the introduction of DP may induce voltage fluctuation of the main power network and relative problems. These issues need to be further studied. With the improvement of the DP technologies, devices, and efficiency, its application range will extend to various situations. DP will not only act as an important supplement of the traditional electric power supply mode, but also hold important position in the field of comprehensive energy applications, and it will become an important developing direction.

KEYWORDS
Distributed Power; Power System; Quality of Electric Power; Development Status; Trend analysis

INTRODUCTION
As the base of economic, energy source industry, especially electric power source, is extremely important to develop economic and society, and to improve the living conditions. At present, most of the electric power supply systems are centralized power supply systems characterized by big units, large power network and high voltage, and the percentage can be up to 90% in this world. In this kind of power supply system, the electric power is generated by high-power generation, delivered by high-voltage delivering electric power network, and distributed to the consumers with high-, medium-, low-voltage switch system. In this kind of system, the tidal current is just with one direction, i.e., from the power plant to electric power network, and then to the consumers [1-3].

The development of energy source is now facing high pressure of environmental protection, and it becomes more and more difficult to build new power plants and delivering power lines. At the same time, the present society demands more and more strictly on the quality of the electric power supply, safety and reliability. Due to their defaults, the large power network system cannot meet this kind of demands. They include: (1) In the large interconnected electric power supply, the local accident is very easy to dissipate. The disturbance generated by default at any point can affect the entire electric power network. When the disturbance status is serious, it can induce power outage at a big region and even whole disruption and yield catastrophic results. This kind of accident happened on August 14th, 2003.
in American-Canada power outage. This kind of large power network is also subjected to war and destroy by terrorist and the national safety is possible to be harmed. (2) The centralized power supply system cannot catch up the load changing in time. At the other hand, it costs too much to build power plant to meet the peak, and the economic benefit is very low. With the increasing of the difference between the peak and wave of the power load, the load ratio is now deceasing annually, and the capacity factor of the power generation and delivering devices. (3) The development of the large power network cannot meet the increasing requirement on the power and the environment protection. The distributed power is a new developing electric power technology. Its rise is the result of sustainable development policy and technology progress. As a supplement of the centralized power, the distributed power plays a key role to apply renewable energy source and reduce environmental pollution. It attains wide recognition by the national and international electric specialists, and it is credited as one of the key technologies of the electric power supply in this century. The combination of the large power network and distributed generation is widely regarded by a lot of experts in the fields of energy and electric power as the main method to save investment cost, reduce energy consumption, and improve the safety and flexibility, and the developing direction of the electric industry in the 21st century. The electric power experts from EPRI in the US predict that the annual increasing of the distributed power holds 25% of the annual increasing of entire power capacity by 2010. The common effects of the electric power marketing and distributed electric power will make the electric industry in this world present a brand-new visage [4-7].

In China, the purposes to accomplish full-scale easy-living by 2020 and reach the level of medium developed country by 2050 have been proposed, which requires national economic keeps a good developing rate for a long time. Under the circumstance with a high economic developing rate, the energy industries in China face dual pressure from both of economic increasing and environmental protection. China is the biggest coal producing and coal consumption country, and the coal holds 76% of the commercial energy source, so that it has become the main part of the air pollution in China. So saving the energy source, improving the source using efficiency, and applying clean energy source to replace high carbon fossil fuel are the principles the energy construction need to follow in China. To develop energetically new energy and renewable energy, such as solar energy, wind energy, biomass and sea energy, is one of the main measures to increase power supply and reduce environmental pollution.

The CHARACTERISTICS OF THE DISTRIBUTED POWER

The distributed generation device can be the replacement of the new-built electric delivering hallway. The public concern on the effect of electromagnetic has made it more and more difficult to build new electric delivering hallway, for example, North American and Europe have decided not to construct new electric power delivering hallways. In addition, cooperating with the large electric power network, the distributed power energy can improve the reliability of the power supply, and maintain the power supply for the important consumers when the power network is under a breakdown status and/or unexpected disaster, such as earthquake, storm, anthropogenic destroy and war. The distributed power or the distributed generation is small, environment compatible, independent electric power with the power of several kilowatts to 50 MW. These power supplies are provided by electric power department, electric consumers or the third party to meet the special requirements of the electric power system and consumers, such as peak adjustment, power supply for jumping-off consumers, commercial region and the resident region, to save the investment cost of the delivering and transforming electric power and improve the reliability of the power supplies. These small power generation units can be fuel cell, micro-turbine, or the combination of them, and it also can be electric power generation system of renewable energy, such as photovoltaic, wind power, solar energy, and biomass. The increasing prominence of the energy problem, the issue of the national policy encouraging the development of the new energy, the increasing market of the electric power, and the
development of the distributed power technologies have made the distributed power become one of the important energy sources [8].

The combination of the distributed power generation system and main power network has the advantages as follows:

1. The power station in the distributed electric power generation system is independent, and the consumers can self-control, so that the large-scale power outage will not happen, and the safety reliability is high.

2. The distributed electric power generation can compensate the disadvantage of the instability in the large power network, and provide power supply continuously when the unexpected calamity happens. It has become an indispensable compensation of the centralized power supply system.

3. It can monitor on-line quality and performance of the regional electric power. It is very suitable to provide power supply for the countryside, pasturing area, mountainous area, developing medium or small city, or residents in the commercial region and it can reduce the pressure of environmental protection.

4. The delivering and transforming loss of the distributed power is very low or even zero. It does not need to build power-distributing station, so it can avoid additional cost of delivering and transforming electric power. At the same time, the cost of construction and installation is very low.

5. It can meet the requirement at special situations, such as distributed power generation car for the important agora or celebration.

6. It has good performance of adjusting the power peak, relative operation is simple, and systems involved are few, start and stop are quick, so it is easy to accomplish complete automatism.

THE DEVELOPING STATUS OF DISTRIBUTED POWER IN CHINA

The centralized power generation, long-distance delivering electric power and the electric power system interlinking with the large power network are now the main methods of power generation, delivering and distribution in China. However, West China is with wide region and few people, and its economy is behind East China, so that its regional power load is low and dispersive. It will take much investment and long time to build a big scale and strong centralized electric power supply and distribution network in West China. The energy source supply problem has seriously prohibit the economic development and people’s living quality in these regions, so the power supply must adopt the combination of distributed power and centralized electric power network. The regions in West China are rich with regenerative energy, such as wind energy and solar energy, and now the development of solar and wind energy in there is the No. 1 in China. It has the impersonal condition to develop distributed power. It is of important significance to vigorously develop this technology to ensure the energy source supply and accelerate the economic development.

It needs to energetically develop the distributed power in West China so as to decelerate the cry for the centralized power supply system, delay the construction of centralized power network, and reduce the cost of constructing the power network system in there. In other regions in China, it needs to construct distributed power to increase the energy source supply, reduce the environmental protection, and improve the capability of sustainable development. Although it is not easy in the near future to change the energy configuration that the coal holds the main energy source, to develop the distributed power quickly and enforce the development of the regenerative energy is very necessary and indispensable so as to improve the reliability of the energy supplies, ensure the continuous high-rate development of the economy and guarantee the favorable carryout of the strategic of developing West China and sustainable development. At the same time, it is useful to form energy science and technology with own knowledge property right.

At present, the development and application of the distributed power is at the quick developing phase. The adoption of wind energy, solar energy, terrestrial energy and other energy has provided the solution for the electric power supplies in part regions. The large scale development of the distributed
power is useful to reduce the openness of new electric power delivering, alleviate the pressure of environmental protection, improve the reliability of the electric power supplies, and solve the small load of electric power in remote region, especially west region. This can ensure the economy's health, stable and sustainable development.

In 1970's, the conception of distributed power system (DPS) has existed, and it was applied in the field of communication power. Before that, there are two same devices for each communication system, so although the reliability was improved, the cost was doubled. The introduction of DPS not only improved the reliability, but also reduced the cost, so that it brought wide attention. It separated the entire load into several groups, and provided power supply for each group by single power-transforming unit. Each subsystem is independent, so it reduced the effect of fault of the single apparatus on the entire system [9-10].

At present, DPS has widely applied into lots of fields, including communication, aviation, spaceflight, computer power and other relative applications. Besides high reliability, it has the advantages of saving energy, high efficiency, economic and convenient maintenance, so it has the trend to gradually replace the traditional centralized electric system. Because the distributed power system has the characteristics of extension and model, it can be applied at various situations.

The research on distributed power is not too much in China, and the majority of the studies is electric power source itself, such as how to build high-efficient fan, improve the stability of the fan operation, better the application mode of solar energy and increase the using efficiency. The studies on the effect of distributed power on the layout and operation of electric power system are mainly qualitative analyses. However, it is very important to quantitatively study the effects of distributed power system on the operation of electric power system, so as to accelerate the development of distributed power in China. The electric power network out of the country has been advanced and strong enough to endure some impulsion, so the introduction of DP has big effect on the operation of the main power network. Based on such facts, the research results of the DP in other countries, especially about the operation of combined power network, cannot be applied in China. Whether the analytical results agree with the ones in the electric power network in China or not needs more comparison. The solutions can be adopted in the situation in China or not need more studies. These issues are the key topics to be solved, so as to develop the distributed power at a big scale in China, especially in West China.

In practical applications, the distributed power has two operation modes: independent and interconnection. If the DP is operated independently, it is difficult to ensure the energy source quality, such as the continuity and electric supply power. To increase some energy-store devices or operate interconnected with diesel oil generator, it can improve the quality of electric power supply at some extent, but the investment, operation and maintenance cost is increased. Now the general application is to interconnect the DP in a region to operate and form a power network of certain scale to supply the electric power for a region, and interconnect with the centralized electric power supply network at a suitable chance. This mode can accomplish mutual supplement among various energy sources to obviously enhance the quality and economy of the electric power supplies.

THE DEVELOPING TREND OF DISTRIBUTED POWER IN CHINA

The effect of distributed power system (DPS) on the current electric power system is huge and far-reaching. Its effect on the power generation and delivering system is that the requirement of newly building centralized power plants and long-distance electric power delivering lines are reduced. At the same time, the power distribution system will happen essential change, and the power distribution network will become a inter-network of DP and consumers. The configuration and operation of the power distribution system will become more complicated, and the design and operation of the power
distribution network will be changed drastically. The contents of the rising automatization of power distribution network and DSM need to be reconsidered [11].

The widespread of DP will affect the direction of the electric power market and the final structure. Firstly, electric power company and consumer will form a new kind of relationship. The consumers not only may buy electric power from the electric power company, but also can sell the electric power it holds to the electric power company, and can provide service of creating peak and emergency power support. Secondly, distributed power generation also opened a convenient door for other industries, a natural gas company for instance, to enter the electric power market. So the contests of the electric power market will be more intense in the future.

With the introduction of lots of DP into the power distribution network, the mode of the electric power network will change, and the electric energy will be closer to the consumers. However, the electric power distribution system will inevitably be changed with the introduction of DP into the power distribution system, and it will make operation and attempt more difficult. There are some technical and economic issues to be solved in the field of distributed power. For the economic issue, to contest with the general electric power, it needs to reduce the cost of DP further or make DP as the peak-adjusting power and provide other services so as to improve its contest ability. As for the technologies, there are also lots of problems in the field of DP. The position of DP in the electric power distribution network and its installation capacity need to be optimized to improve the operation reliability of the electric power distribution network. On the other hand, it will induce a series of problems in the operation of the system, such as the introduction of the DP will make the electric voltage adjustment more difficult, and the interconnection network operation of the DP will give rise a lot of problems for the main power network, including power voltage fluctuation, direct current slanting magnetism and etc. The serious extent of these problems is relative to the power voltage, short capacity of the connected power network, devices, and the control method, the characteristics of the electric power and its capacity and other aspects. The effect factors of the DP on the electric power quality of the electric power distribution network needs to be studied, so as to propose corresponding control measures. The introduction of DP may increase the short current of the electric power distribution network, and make protection scheme complex. The policy and regulation for using the regenerative energy and comprehensive application of energy are not complete, and the favorable policy of tax is defective, which makes enthusiasm to apply these energy sources is not high. In addition, fuel supplies, place choice of power generation, power generation efficiency and interconnection electric power price are all the issues to be solved for the further development of the distributed generation.

**CONCLUSION**

Because of its characteristics, the distributed power (DP) plays good function in power-peaking adjustment, providing electric power for far-reaching consumers, commercial and resident regions, saving cost of electric power delivering and distribution, and improving the reliability of the electric power supplies, and it develops very quickly in China. On the other hand, the cost of DP is high and it may induce voltage fluctuation of the main power network when it is introduced. These issues need to be further studied. With the improvement of the DP technologies, devices, and efficiency, it is believed that distributed generation holds huge potential in the coming decades. Its generation cost will decrease gradually and its application range will extend to various situations. It will not only act as an important supplement of the traditional electric power supply mode, but also hold important position in the field of comprehensive energy applications, and it will become an important developing direction.

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