Solar Photovoltaic Power Generation Technology Research

Yaoyao Wang*
School of Management, Shanghai University, Shanghai, China
*Corresponding author e-mail: wyyscrg@163.com

Abstract. This paper studies solar photovoltaic power generation technology, including solar photovoltaic grid-connected power generation technology, solar photovoltaic micro-inverter technology, solar photovoltaic power generation electrical automation technology, and puts forward Suggestions on solar photovoltaic power generation.

1. Introduction

According to experts, at current energy consumption trends, if the current energy mix remains unchanged, the world will run out of conventional energy by about 2050. China's primary energy reserves are far below the world average, about 10% of the world's total reserves. The development and utilization of new energy is also the top priority of China's energy strategy. It is estimated that at present, the energy provided by solar energy is 2,850 times of the global energy demand, and solar energy has the advantages of cleanness, safety, wide use, sufficient available resources and free from maintenance, which plays a very important role in the long-term energy strategy of human beings. China is rich in solar energy resources, so it is particularly important to make full use of solar energy for photovoltaic power generation [1].

2. Solar photovoltaic theory

Solar energy refers to the radiant energy emitted, transmitted or received by the sun in the form of electromagnetic energy. The development and utilization of solar energy includes solar photothermal conversion, photoelectric conversion, photochemical conversion and other forms.

In China, the development and utilization of solar energy mainly focus on photothermal utilization and photoelectric utilization.

Solar thermal application refers to solar thermal power generation, which is the conversion of solar radiant energy into thermal energy for use, and the reuse of thermal energy for power generation. Solar photovoltaic application is to directly convert solar light energy into electric energy by using solar cells, because this conversion is based on the photovoltaic effect principle of semiconductor devices.

Therefore, solar power generation is also called photovoltaic power generation. Its applications mainly include off-grid power generation system, grid-connected power generation system and hybrid system. Photovoltaic industry refers to the industry formed with the production and application of silicon materials as the core.

The photovoltaic industry belongs to the solar energy industry, and its fine molecule industry is divided into photovoltaic cell and module industry, photovoltaic special equipment manufacturing industry and photovoltaic accessories industry.
3. Solar photovoltaic grid-connected power generation technology
Because of solar photovoltaic (pv) grid power generation technology show the pollutant discharge reduction, safe and efficient, the advantages of the quiet, no noise, and inexhaustible solar energy, which makes in the application of photovoltaic (pv) grid power generation technology does not need considering the energy problem, improve the regulation of space of the photovoltaic, and can realize to the top of the building to good use. For the current solar power grid, the main equipment includes public power grid, transformer and automatic communication system. The main principle of power generation is to set up photovoltaic modules in the upper part of the building or other designated photovoltaic engineering positions to build the corresponding solar photovoltaic power generation system. The solar energy is converted into electric energy through the energy conversion principle, and then the electric energy is transmitted to the inverter through the confluence box. The direct current is converted into the alternating current through the current conversion, and the whole grid-connected generation process is integrated into the power grid [2].

Among them, polysilicon, battery and other technologies have also been developing.

(1) Polysilicon: the fluidized bed process of Asian silicon industry has made a breakthrough, and electronic polysilicon such as Yellow River and xinha has been delivered.

(2) Silicon wafer: CCZ, gallium boron doped, casting single crystal isometric crystal technology developed rapidly, diamond wire cutting applications expanded.

(3) Battery: industrial application speed of PERC, n-type and HIT exceeds expectations; MBB, double-sided technology development speed up; In the new battery, perovskite solar cell developed by semiconductor achieved a new world record conversion efficiency of 23.3%.

(4) Components: shipments of double-glass and half-chip components start to increase.

4. Solar photovoltaic micro-inverter technology[3]
The main function of inverter is to change the variable dc voltage input of the transformed power supply into non-interference ac sine wave output, which can be supplied to the corresponding equipment or fed back to the power grid. Inverter in addition to the conversion of ac and dc voltage, but also can perform such as: disconnect the circuit, to avoid the current surge damage to the circuit. In addition, functions such as tracking the maximum power point (MPPT) and storing data and controlling the charge and discharge of batteries can help improve the efficiency of power generation.

4.1. Advantages of microinverter technology
Compared with traditional high-power centralized inverters, micro-inverters have many advantages:

1) Ensure the operation of the maximum power point of each photovoltaic module. When the internal and external conditions such as cloud changes, shadow occlusion, photovoltaic module aging,
When dirt accumulation and other changes occur in practical applications, the total power generated by using the micro-inverter can be increased by up to 25%.

2) In the traditional photovoltaic system, the solar panel does not need series diodes, and the power loss between the modules caused by serial and parallel photovoltaic modules can be eliminated.

3) Micro-inverters have a lower power load to ensure higher product reliability, while traditional centralized inverters only have a 5-year operation life.

4) The system has high redundancy, and the failure of a single module will not affect the whole system. The failure of a micro inverter will not affect other generating units, and the impact is very small.

5) As a whole, photovoltaic cells and micro-inverters reduce the application difficulty of photovoltaic grid-connected system, which is easy to expand, plug and play, high flexibility, and easy to be popularized in the civil market.

6) The installation is very convenient and the wiring is simple, which greatly reduces the time and cost of installation and maintenance. Based on the above advantages, micro-inverters have become the focus of photovoltaic industry and are considered as one of the main structural forms of photovoltaic applications in the future.

5. Solar photovoltaic power generation electrical automation technology application[4]

5.1. Application in photovoltaic building and water pump system

The application of electrical automation in solar photovoltaic building and water pump system is mainly reflected in the communication mode and monitoring software. Currently, the more common communication modes include serial port, general packet wireless service technology and beidou wireless communication. For solar photovoltaic building and water pump system, the large number of solar panels involving, failure is hard to find, in order to ensure the safety of the electricity, you need to use electrical automation technology for power generation of solar panels, real-time monitoring, at the same time also need to find fault on the basis of the guarantee of the failure occurs in the first place for feedback. Only flexible use of monitoring software and communication equipment can create favorable conditions for the safe operation of solar photovoltaic buildings and water pump systems.

5.2. Application in dc inverter of photovoltaic power generation system

Solar photovoltaic system can convert sunlight into electricity in a short time, and its system structure and related parameters are very complex. Before China's photovoltaic power generation system is mainly direct current, but the development of society to photovoltaic power generation system put forward higher requirements, need to convert direct current into alternating current, in this process electrical automation technology plays an important role. The electrical automation needs to effectively control the photovoltaic array, charge and discharge controller and the battery, especially the inverter, in the photovoltaic power generation system. Only by ensuring the efficient operation of various related devices, can the photovoltaic power output direct current be converted into alternating current smoothly. In addition, electrical automation can efficiently transfer the output ac electric energy to the power grid system, thus providing convenience for people to use and promoting the further development of solar photovoltaic power generation.

5.3. Application in reactive power compensation control of photovoltaic power generation

Photovoltaic power generation system structure is very complex, which most of the application components for electronic components, electronic components in the start-up process will produce harmonics, to maintain the stability of power system has a negative impact, easy to cause the problems such as voltage and overload, is not conducive to promote the high quality of the photovoltaic effect. Moreover, there will be no power loss when the electronic components start up, which will cause a certain waste of electric energy. Therefore, in order to ensure the stability of solar photovoltaic power generation, it is necessary to determine the actual demand for reactive power through electrical
automation technology, and then control the power loss within the normal range, so as to avoid the occurrence of voltage instability and other conditions through the control of reactive power loss, and maintain the stability of the power generation system.

6. Suggestions for the development of solar photovoltaic power generation

(1) Photovoltaic industry is one of the few industries in China that can simultaneously participate in international competition and has an industrial leading edge.

(2) The fundamentals of the photovoltaic industry are good, and the development potential is huge. The direction of the country's development of photovoltaic industry is unswerving, and the state's support for the photovoltaic industry is unshakable.

(3) The new policy is introduced, the market demand drops rapidly, which will cause a great shock to the industry, and enterprises will face great pressure in the short term; Photovoltaic enterprises should work hard, from the scale, speed and price to quality, technology and efficiency, from extensive development to fine development, to promote the realization of parity online as soon as possible.

(4) The photovoltaic industry should strengthen self-discipline, no matter in China or abroad, should eliminate exaggerated false publicity, eliminate low price vicious competition, down-to-earth, conscientious to promote the sustainable and healthy development of the photovoltaic industry.

(5) No matter whether supplementary policies will be issued or not, the policy thinking of regulating the scale of photovoltaic development will not change, and subsidy decline is inevitable. The previous development mode of marching forward triumphantly and burning oil has been unsustainable. Reducing cost, improving quality and increasing efficiency is the core and key of the future industrial development. At the same time, it is also hoped that policy makers to strengthen implementation, innovation means, effectively reduce the photovoltaic power station construction construction of non-technical costs.

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