

Original Research Article

Technical and economic status of photothermal power generation and research on the development and construction of photothermal power stations*Kuan Ding**State Grid Xinjiang Electric Power Co., Ltd. Turpan Power Supply Company, Turpan, Xinjiang, 838000, China*

Abstract: As a new form of power generation, photothermal power generation technology can convert solar energy into heat energy and generate power according to the thermal conversion process. It can effectively use China's internationally leading thermal power turbine technology to reduce the impact of coal power capacity reduction policy on conventional industries. The actual power generation is relatively stable and controllable, the overall operation mode is flexible and changeable, and has good environmental benefits. Therefore, it has been widely used in urban construction and development in recent years. This paper mainly studies the current technical and economic status of thermal power generation in China and the corresponding construction and development measures.

Keywords: Photothermal power generation; Solar thermal energy; Concentrated solar power (CSP); Parabolic trough

1. Introduction

In an era defined by the urgent pursuit of sustainable energy solutions and the imperative to mitigate the environmental impacts of traditional power generation, photothermal power generation has emerged as a technology with significant potential. This form of power generation, which converts solar energy into heat and then into electricity, offers a unique set of advantages that position it as a crucial component in the global energy transition.

2. Analysis of technical and economic status quo of photothermal power generation

Nowadays, China's large-scale solar thermal power generation project has become a key construction content, starting from the Ordos 50MW solar thermal power generation project in early 2011,^[1] whether it is the construction scale or preferential policies have created favorable conditions for the research of solar thermal power generation technology, although this industry is still in its infancy in China, but it is one of the important directions of new energy use. It has a very broad development prospect. Combined with the comparison results of the three forms of solar thermal power generation and photovoltaic power generation shown in the following table, there are three problems urgently needed to solve in China's solar thermal power generation, first of all, application technology. Compared with foreign countries, the core equipment of China's solar thermal power generation system is not advanced, the actual conversion efficiency is low, but if the direct reference of foreign technology products, the construction and development cost is high, will hinder the steady development of thermal power generation technology and economy;^[2] Second, the cost of technology. The commercialization of an emerging industry is determined by the cost, and at present,^[3] China's solar thermal power generation is in the initial stage, whether it is the input technology or application costs are relatively high, the economic benefits obtained by enterprises are low, which leads to the slow pace of economic development of solar thermal power

generation technology; Finally, preferential policies. Because the cost of solar thermal power generation is too high, the relevant departments will provide policy subsidies to promote the development of the industry, but at present, only part of the bills and regulations to promote the development of solar thermal power generation in China, and did not propose a more standardized and perfect subsidy policy, which leads to most enterprises will not actively invest in solar thermal power generation projects. With the excellent results achieved in the implementation of the bid opening of various solar thermal projects, most enterprises begin to attach great importance to the technological and economic development of solar thermal power generation, obtain rich data information according to the development of domestic leading technologies, and calculate the investment cost and power generation cost combined with the light resources in the region, and finally determine whether to participate in the investment and construction.^[4]

Table 1. Comparison results of three forms of solar thermal power generation and photovoltaic power generation.

Category	Module Type	Tower Type	Tubular Type	Linear Type
Capacity	20-30 MW	10-20 MW	5-5 kW	10 MW-100 MW
Operating Temperature	300 °C	565 °C	800 °C	25-50 °C
System Efficiency	14%	15%	27%	14%
Domestic Commercial Operation Status	Planned Commercial Operation	Planned Commercial Operation	Pilot Operation	Commercial Operation
Technical Risk	Low	Medium	High	Low
Power Storage	Possible	Possible	Requires Battery	Requires Battery
Integrated Design	Possible	Possible	Possible	
Land Occupancy	200 acres/10 MW	800 acres/10 MW	20 acres/10 MW	350 acres/10 MW
Daily Cost (RMB/kWh)	1.2 ten thousand RMB	4 ten thousand RMB	5 ten thousand RMB	1.6 ten thousand RMB
Annual Electricity Generation (Million kWh, based on regional planning)	200	200	Unknown	140

3. Analysis of development and construction measures of solar thermal power stations

3.1. Pre-development work

During the 14th Five-Year Plan period, China's solar thermal power generation began to develop towards large capacity, high parameters, long-term heat storage, and low cost. Due to the high industry entry barriers, substantial actual capital investment, and severe technical risks, investors must clearly define the project development site when initially planning a project, gather relevant data such as solar radiation data, routine meteorological data, land information, power facilities and planning materials, transportation information, local equipment procurement prices, and other information, and then consider the overall feasibility of the project from a cost perspective. Typically, the feasibility study report is prepared by the design institute responsible for the feasibility study, at which point it indicates that the project development has entered the construction decision-making stage. The main tasks include confirming the conditions for factory construction, clarifying process technology, proposing technical solutions, completing investment estimation and economic evaluation, etc. After meeting the entry conditions, the project construction party can apply to the local government department. With the approval authority delegated to provincial energy bureaus, and provided that the above conditions are met, the project can be approved and registered. Following this, the project party can proceed with the

preparation for construction.^[5]

3.2. Project management suggestions

Due to factors such as land costs and power rationing affecting the financial budget of project investments, these elements must be comprehensively considered when analyzing investment models to avoid unnecessary safety risks during construction management. If an excessive number of solar thermal power stations need to be built, practical and feasible preferential measures should be proposed based on industry strength to ensure that the solar thermal power generation technology projects are fully connected to the grid. In line with the requirements for green and environmentally friendly economic development, targeted preferential policies should be actively promoted for project development. At the same time, ample time and effort should be prepared during the project planning period to formulate practical and feasible project plans, clearly identifying the challenges in the construction and management of solar thermal power systems to prevent delays caused by lack of experience. Additionally, thorough research on key equipment and components should be conducted, and preventive measures should be proposed early based on issues identified in previous project construction management to avoid long-term impacts on project construction management.^[6]

4. Conclusion

To sum up, power generation industry is in the initial stage. The technical economy and project construction should always follow the principle of gradual development to obtain national and social support, so as to promote the steady development of the industry towards scale and commercialization, gradually improve the technical cost advantage of projects, and finally move towards marketization.

References

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