

Analysis of China's Marine Renewable Energy Current Situation

Jian Li, Xiaokun Ma, Xiangnan Wang, Hongming Qiu, Changlei Ma

National Ocean Technology Center, Tianjin 300112, China

Abstract. China's Marine renewable energy is in a period of rapid development. Since the establishment of the national special fund for Marine renewable energy in 2010, a large number of demonstration projects, research and test projects have been strongly supported and promoted, forming a number of technology and equipment with independent intellectual property rights. But as a new energy field, some problems have been found in the process of project implementation, this paper is based on the 2010-2020 projects of marine energy special project research, analyzes the progress of the wave energy, tidal energy, classifies and summarizes the research and test projects, expounds the current marine energy special project in the process of implementation problems and deficiencies, put forward some suggestions for the development of Marine renewable energy special projects in the future.

Keywords: Marine renewable energy; tidal energy, wave energy;

1. Preface

In June 2010, the State Oceanic Administration and the Ministry of Finance jointly issued the Interim Measures for the Management of Marine Renewable Energy Special Funds, which funded the development of domestic Marine energy utilization and Marine energy technology through a special fund of 200 million yuan per year. The first batch of special fund projects have been launched in 2010. According to the schedule, most of the projects have enter the final acceptance stage [1]. During this period, the Marine renewable energy special project was orderly developing, formed a number of independent intellectual property rights of Marine energy transformation and utilization technology, it is also cultivates a group of special talents in the field of Marine renewable energy, and fills in the gaps of the Marine renewable energy in China, especially in the field of Marine power generation. Through support the national finance continuously, now it is has been formed a standardized theoretical research system of Marine renewable energy, but in the practical application of some key technologies it is still greats shortcomings. This paper analyzes the current development of Marine renewable energy from the three parts of research and test for tidal energy, wave energy and demonstration project, and puts forward some suggestions.

2. The analysis for tidal energy power generation research and test

The research and test for tidal energy is a research or test that converted the tidal current energy into electric energy

or other available resources. The energy density of tidal current energy is very large [2], which has the incomparable sustainability, regularity and predictability compared with other ocean energy. At present, China's tidal power generation devices according to different needs can adopt towed type, floating type and base type. Among them, the towed type and floating tidal power generation devices have simple structure and strong maintainability, most of which supply power to buoy, latent mark or sea bed base [3]. Because the fixed structure of the towed type and floating type power generation device is limited, the power generation device will not only by the effect of tide, but also may be under the action of the ocean surface waves, so the spindle of power generation device will be extremely complex and easily broken, and it's reliability index is the main factors for the development of towed type and floating type power generation device. In contrast, the base type tidal energy power generation device avoids the adverse factors on the ocean surface, and the power generation efficiency and reliability of the device are relatively improved. If the guide cover or variable pitch technology is used, the power generation efficiency and reliability will be further improved [4]. For example, in August 2012, Harbin Engineering University launched "Haiming I" tidal energy power generation device in Guishan Waterway. The designed power generation of the device was 2150kW, and the diameter of its turbine blade was 4 meters. In June of the following year, "Haiming" was launched in the sea area of Zhaitang Island in Qingdao. The blade diameter of its turbine was 12 meters, and the energy conversion efficiency was about 34%. In 2013, the 20kW the base type tidal energy power generation

developed by Northeast Demonstration University was tested at low velocity in the waters of Zhaitang Island in Qingdao. In 2018, the 300kW semi-direct drive horizontal shaft variable propeller unit jointly developed by Guodian United Power and Zhejiang University went to sea test in Ruoshan Island of Zhejiang University and successfully generated electricity. In terms of the grid connection for tidal power generation device, Zhejiang Zhoushan Joint kinetic Energy New Energy Development Company Limited developed LHD modular tidal energy power generating assembling unit, which completed offshore installation in 2016 and completed grid connection to power generation in August. By 2019, it has generated 1.5 million kWh. Although our country tide energy power generation device is mature relatively, but there are many deficiencies in safety maintenance, such as base type tide energy power generation devices are arranged more than in ten meters or dozens of meters deep underwater, its maintainability maybe become the key to limiting tide energy power generation device, because the Marine environment is complicated, especially in the marine energy power generation device, there are some deficiencies in corrosion prevention, mechanical structure and the key component of stiffness, strength, etc. So it needs to be tested for long-term normal operation characteristics of marine energy power generation device. In the terms of efficiency of power generation, different parameter input will make the power efficiency calculation different, and at the present the marine energy industry is not specialized for the scientific and authoritative explanation of the marine energy power generation efficiency. So each project has its own power generation device conversion efficiency calculation formula, which led to the power generation efficiency data matches the requirements of the task, but the generating power is far away from the task.

3. The analysis for wave energy power generation research and test

Wave energy is the most widely distributed energy in the marine. Wave energy power generation device is relatively small but the application range is large. The commonly used wave energy power generation device mainly consists of oscillating water column type, oscillating floating type, pendulum type, duck type, etc. The wave energy power generation device generally works on the surface of the ocean [5], where the sea conditions has a certain impact for the device. Especially for the wave energy power generation device which is without fixed support structure, and its survival ability is the key factor for the power generation device can reach the technical maturity whether or not. Wave power generation technology in our country is relatively mature, for example the wave energy power generation device which is developed by Chinese Academy of Sciences Guangzhou energy has generated more than ten thousand degrees electric power in Wanshan Island in 2017, Shandong university and Jinan far new energy development company joint development the point absorption hydraulic wave energy power generation

system which is completed testing in 2016, Ocean university of China developed oscillation float wave energy power generation device and tested in Qingdao zhaitang island sea area successfully in 2014[6]. In general, the wave energy research in our country although started slowly, but the development is relatively rapid, it has made certain achievements which is basic close to the international advanced level in the theoretical research and equipment manufacturing. Recently a horizontal axis rotor turbine wave energy power system adopts the principle of wave energy reciprocating utilization, greatly improve the energy conversion efficiency, but there are more different opinions for the conversion efficiency calculation method for this device. The distribution of the wave energy is average and the energy is easy to obtain, it can solve the problem that regularly replaced the battery for the buoy, submersible ocean observation equipment, and reduce the ocean observation equipment maintenance cycle by using the wave energy. Although wave energy resources in our country and abroad have been certain development, but through the situation of the specific test, it is also exposed some problems, such as a single wave, single current laboratory can analyze the wave energy power device ideal model, but when faces the marine environment, especially the actual environment of ocean waves, it needs consider the efficiency of the surface wind field and the surface flow.

4. The analysis for ocean thermal energy

Ocean thermal energy is mainly in the form of the temperature difference between the surface layer and the bottom layer of seawater stored in the ocean thermal energy. The main source of ocean thermal energy is solar thermal radiation, the ocean receives about 15% of the sun's energy as thermal energy stored in the ocean, the sea surface to 60 m or so of the surface layer of the general temperature of 25-27 °C, 60-300 m of the middle layer of seawater due to the weakening of the sun's radiation, seawater temperature with the depth of the drastic changes in the depth of the deeper seawater below 300 m due to the lack of sunlight all year round, the temperature The temperature of the deep sea water below 300 m is reduced to about 4°C due to the lack of sunlight all year round. Generally speaking, the temperature difference of seawater should have a minimum difference of 20°C in order to generate electricity stably, and low latitude areas such as Cuba, Indonesia, and the South China Sea are ideal places for the use of ocean thermal energy. In addition to the application of ocean thermal energy in the field of power generation, it also has the desalination of seawater, seawater farming and hydrogen production and other aspects of use.

The concept of ocean thermal energy was put forward more than a century ago, but only in the last 40 years to obtain the technical progress. 1881 French physicist Assomval in the world for the first time put forward the idea of ocean thermal energy power generation; in 1929 his student French engineer Claude confirmed the possibility of ocean thermal energy power generation and,

the following year, in Cuba, established the world's first ocean thermal energy power station, obtained 10 kW of electricity; in 1979 the United States in Hawaii, the power station of ocean thermal energy power generation, obtained 10 kW of electricity. In 1979, the United States in the waters off the island of Hawaii established the first practical application of ocean thermal energy generation device, the device uses ammonia as a working medium, the power generation power of 50 kW; 1980 Taiwan Power Company had planned to release the heat of the nuclear power plant and the ocean ocean thermal energy power generation and with the selected Hualien, Taitung and other bottom to carry out a joint study; in 1985, China's Academy of Sciences, Guangzhou, China energy Guangzhou Energy Institute of the Chinese Academy of Sciences in 1985, the use of "droplet lifting cycle" method of research, through theoretical calculations when the temperature is lowered from 20 °C to 7 °C when the release of seawater heat can be lifted to a height of 125 m seawater, and then through the turbine to generate electricity, in 1989, the Guangzhou Energy Institute completed the "droplet lifting cycle" test bed, the installation of a new generation of energy. In 1989, Guangzhou Energy Research Institute completed the "droplet lifting cycle" test bed, with an installed capacity of 10 W and 60 W. In 1993, the United States established an open cycle test device in Hawaii, with a power generation capacity of 210 kW, and the actual output power of 40 to 50 kW, and can produce fresh water; in 2004-2005, Tianjin University completed the research on the use of hybrid ocean energy ocean thermal energy, and 200 W ammonia saturated steam turbine for miniaturisation test was developed.

5. The analysis for ocean salinity gradient energy

Ocean salinity gradient energy is the energy generated by using the potential energy between seawater and freshwater. The principle is that when two different concentrations of salt solutions are mixed, salt ions with high salt concentration will move to the solution with low salt concentration until the concentration of the two solutions is the same, and the ocean salinity gradient energy is to use the chemical potential difference generated by this characteristic and convert it into electricity to generate electricity. At present, the utilisation of ocean salinity gradient energy is still in the laboratory research stage, and there is still a long way to go before offshore demonstration and grid-connected power generation for practical application.

The use of ocean salinity gradient energy relative to other ocean energy use started later, in which the United States, Israel in the ocean salinity gradient energy research is in the leading position, China and Sweden, Japan and other places in recent years have also carried out the corresponding research. In the 1970s and 1980s, Israel and the United States conducted experimental research on hydraulic towers and strong osmosis systems, and the 150 kW ocean salinity gradient energy power generation

device built in Israel is currently the largest installed capacity of ocean salinity gradient energy devices; in 1985, the Institute of Fluid Mechanics of Xi'an Institute of Metallurgical Architecture adopted the semi-permeable membrane principle of the research and development of the ocean salinity gradient energy power generation device produces only 0.9-1.2 W (membrane area 14 square metres); China's ocean affairs and ocean affairs and ocean affairs and ocean affairs and ocean affairs and ocean affairs are the first to use ocean salinity gradient energy in China. In 1985, the Institute of Fluid Mechanics of the Xi'an Institute of Metallurgical Architecture adopted the semi-permeable membrane principle to develop a ocean salinity gradient energy power generation device, which produced only 0.9-1.2 W (membrane area of 14 square metres).

6. The analysis for Marine renewable energy demonstration project

The Marine energy demonstration project is a integration for Marine energy and wind energy and other renewable energy, which organize a power system project based on renewable energy. Most of project use the mature Marine energy power generation device[7], and its stability has been verified in research tests. Marine energy independent power system demonstration project is the focus of the marine energy special project, and the process is in the exploration, although the power generation device which used in the demonstration project is relatively mature. but because the demonstration project is a comprehensive utilization for renewable energy, so the influence for island sea area and the large demonstration project, the structure of the marine energy power generation device, are all the restricting factors of the demonstration project: (1) The using application of the sea area. The application of sea area use is the key element that restricts the "landing of demonstration projects". The planned sea area in the implementation plan of multiple projects is not consistent with the actual using of the sea area, so it results the actual hydrodynamic parameters of the sea area cannot match the requirements of the power generation device. The project team should communicate with the local government in detail before the project is subscribed to ensure that the sea area application can be completed smoothly. The local government should also relax the conditions of the using of the sea area, change the thinking of "political performance first", and cooperate with the Marine energy project; (2) The ecological protection of island. The ecological protection of Island is also one of the factors which should be considered in the Marine energy demonstration project, especially when the implementation plan is compiling, it needs to be fully investigated and analyzed for the impact of the demonstration project on the local island ecology, and protect the local ecological conditions.(3) Standard support. At present, there have been many complementary studies in the field of wind power and photovoltaic, such as GB/T 19115-2018 wind-solar-complementary power generation system, GB/T 29544-2013 off-grid wind-solar-complementary power generation system-safety

requirements, etc., but none of them involves the field of Marine energy, so the standards which support Marine energy, wind and light complementary are still blank.

7. The conclusions and recommendations

The tidal energy and wave energy have the characteristics of capturing energy simple, distribution energy wide, and designing the power generation device mature, which have become the hot spot of the current Marine renewable energy utilization. The marine energy utilization in China is still in the development stage, a number of key technologies are still being explored and studied, so this paper put forward the following Suggestions for the future Marine renewable energy development: (1) marine energy projects have analyzed the theoretical data perfectly, but the actual test experience, especially in the reliability of the power generation device, maintainability, environmental adaptability, have no detailed about solution and certification scheme. Therefore, it is necessary to control the design and manufacturing links strictly, strengthen the sea testing, the outline testing and relevant standards should be formulated for Marine r energy power generation devices to promote the development of Marine energy.(2) Establish the project node control mechanism, it needs to inspect the actual process of the project according to the progress of the project regular or not, solve the problems which are found in the project implementation process timely, and avoid to reducing the technical input for the Marine energy power generation device in order to the delay of the projects.(3) Continue to strengthen the construction of the comprehensive support platform for Marine energy, it needs to promote the process of the technology and industrialization of the Marine energy, and provide technical support for the development of China's Marine energy industry.(4) Cooperate with the local government, it needs to negotiate and communicate in the using of the sea areas and ecological protection, give feedback on problems timely, and ensure the Marine renewable energy projects smooth implemented smoothly.

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