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Review

Review of China policy of OED sea use management

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ABSTRACT

China government attaches great importance to the ocean energy development (OED) industry and, in national planning, lists it as a strategic emerging industry, and the ocean energy development is under rapid growth in China. Estimated on basis of relevant OED plans, there will be massive sea area used for OED projects although their potential effects remain undefined, especially those negative impacts on marine ecological environment and other marine activities. Therefore, prior to the upsurge of OED, China government has carried out instructive exploration and trials on the method and mode of OED sea use management, on basis of the features of such sea use in China and relying on the existing marine resources management system. After summary of OED status, this paper makes analysis on the characteristics, trends and existing problems of such sea use in China, introduces the efforts of China government in regulating and managing such sea use through marine functional zoning planning, industry-purposed sea use planning, feasibility assessment of sea area use, environmental impact assessment of marine engineering and so on, and elaborates the future mode and prospect of OED sea use management in China. The research results show that it is rather necessary to, prior to deployment of large-scale OED development activities, consider and demonstrate the rationality and feasibility of the sea use in OED projects regarding such four aspects as the protection of marine ecological environment, the improvement of efficiency of sea area development and utilization, the coordination of sea use contradictions between industries, and the control of scale of sea area used.

With the growing concern on such issues as climate change and environmental protection, etc., it has become a global consensus to develop clean energy and renewable energy, and to reduce carbon emission. As a green, clean and zero-emission renewable energy, ocean energy has been under widespread concern and, in recent years, China government attaches great importance to and encourages its development and utilization. According to the latest marine renewable energy survey organized by the State Oceanic Administration of China, the marine renewable energy available for development and utilization reaches up to one billion kW, including the inshore wind energy resources of 750 million kW, the coastwise tide energy resources whose expected total installed capacity is 21.79 million kW, the coastwise wave energy whose theoretical average power is 12.85 million kW, and the tidal current energy of 130 inshore waterways whose theoretical average power is 1 3.94 million kW. Despite of such great potential, however, the intensity of development in coastal waters has been great in China, the large-scale development of marine renewable energy will certainly occupy large sea area and the marine space of other industries, which increases the degree of difficulty to coordinate contradictions between different marine activities. Therefore, it is a management topic with important research value for China government – how to make full use of the limited marine space resources, coordinate the sea needs of various industries, and promote the healthy development of OED industry.

1. China sea use of OED

1.1. Overview

In recent years, there has been rapid growth in the number of China OED projects. China OED involves the offshore wind energy, tide energy, tidal current energy and wave energy, among which the offshore wind energy development project features the most mature technology, the largest number, the largest scale and the large marine space occupied. As of the end of 2011, in China, there have been 5 offshore wind farms under operation, with 87 offshore wind turbine generators (WTGs) installed whose total installed capacity is 238.3 MW, taking up nearly 40 km^2 of sea area; and, another 14 offshore wind power projects are under construction, with a total installed capacity of 2 250 MW and more than 700

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offshore WTGs, taking up more than 550 km^2 of sea area. The tide energy, tidal current energy and wave energy development projects are still at the stage of research and demonstration, with only a few projects under trial operation, so there has been no large-scale development, application or sea area occupied. The sole tide power plant under operation is Jiangxia Experimental Tide Power Plant whose generating capacity is maintained at 7.2–7.3 million kwh in recent years, ranking the first in China and the fourth in the world, taking up 1.37 km^2 of sea area. Regarding the wave energy and tidal current energy development projects, Xiaomaidao 8 kW-Pendulum Wave Power Plant and Daguandao 30 kW-pendulum Wave Power Plant are under operation, and Daishan Guishan Waterway Experimental 70 kW-floatage Tidal Current Power Plant and Daishan Gaoting "WANXIANG-II" Experimental 40 kW Tidal Current Power Plant are still at the stage of demonstration and pilot. In addition, since 2010, the OED Special Fund of China government has financed 12 wave energy and tidal current energy research demonstration projects, each of which has an installed capacity ranging from 10 to 500 kW and occupies a sea area of 1–20 ha (in total, about 2 km^2).

Estimated on basis of relevant OED plans, in China, the ocean energy power projects will reach a total installed capacity of 15.05 million kW and use a total sea area of 3 000 km^2 by 2015; and, by 2020, the figure will reach up to 41.85 million kW and over 8 000 km^2. Among these OED plans, the vast majority are still offshore wind power projects, added with about ten MW-level tidal current energy demonstration power plants, several 10 000-kW tide power plants, and dozens of independent-power-system demonstration plants serving islands.

1.2. Characteristics

OED project is a new industry in China and, compared with traditional marine industries, it features a special mode of sea area use and operation which can be summed up into the following aspects:

1.2.1. A large sea area per OED project

In China, OED projects often require a certain size of power generation to ensure the satisfactory economic benefits, so they usually occupy large-scale of sea area. Regarding offshore wind farm projects, for example, the total installed capacity of single offshore wind farm planned is generally 100 000–300 000 kW, with 30–100 WTGs arranged in column(s). WTG spacing is 600–1 200 m and, according to statistics, each 100 MW of wind power capacity actually occupies 12.6–24 km^2 of sea area, mainly within 15–17.5 km^2. Correspondingly, the offshore wind farm generally occupies more than 30 km^2 of sea area in China. In addition, it is needed laying a large number of submarine cable pipelines within the offshore wind farm, between WTGs, between WTG and booster station, as well as between booster station and landing point. Statistics show that each 100 MW of installed capacity requires a total length of about 50–150 km of submarine cable which will also occupy a large sea area. To achieve long-term stability of power generation, tidal current plant requires a large water storage capacity. The tidal current power plants under operation or construction in China all take enclosed bays as power generation reservoirs, usually several square kilometers of sea area. On basis of current wave/tide power generation technologies, the sea area use and the installed capacity per unit area are close to those of offshore WTGs, so the large-scale wave energy or tidal current energy power plants will also occupy a large sea area.

Through the analysis of China OED projects, a single OED project takes up a lot of marine space mainly due to the following four reasons:

(a) In China, the total reserve of ocean energy resource is enormous, but the average power density is not high.
(b) Under the low level of existing power generation technologies, the conversion rate of marine energy into electric energy is only 10–20%, the capacity per unit is low, and the electricity generation capacity per unit of sea area is not high.
(c) In China, a single OED project must achieve certain level of installed capacity, which is a necessary condition for the project to be incorporated into national grid and to enjoy preferential power purchase price.
(d) The cost of transmission cable occupies a high proportion (usually from 20% to 30%) in the cost of the entire ocean energy development project, which requires adding generating units and increasing installed capacity to reduce the average cost.

1.2.2. Three-dimensional and networked sea use of OED project

OED project mainly includes erection of ocean energy power generation equipments, construction of booster station and laying of submarine cables, which involves various modes of sea use and multiple layers of marine space (seabed, sea water, sea surface and even superjacent air space). In offshore wind farm projects, for example, WTG is piled into the seabed, immersed in sea water and (fan blade) exposed in air, and the transmission pipelines submarine cross with each other and extend to the coast by way of booster station. Therefore, OED project is a comprehensive mode of sea use, with clear characteristics of Three-dimensional and networking.

1.2.3. Absolute exclusiveness of OED sea use

In OED projects, it is needed to establish the ocean energy power generation equipments between which there are large amounts of submarine cable pipelines and, for purpose of preventing vessels from collisions with generation units and impact on submarine cable, the majority of OED sea area will be closed to marine navigation. OED projects usually adopt the block-shaped arrangement, which not only breaks the continuity of other marine development activities within OED sea area where it is impossible to carry out other marine development activities besides cage culture and mudflat aquaculture, but also excludes fishing, shipping, sailing, oil drilling, military training and other activities, with an obvious feature of exclusiveness.

but in adjacent sea area as well, with obvious feature of exclusiveness. The degree of exclusiveness is directly related to the operation and management mode of OED projects. For example, in Jiangsu Province, the Rudong 150 MW Inter-tidal Zone Wind Farm Phase-I Demonstration Project adopts the semi-open management mode and within the wind farm, with consent of management body, it is allowed to carry out beach cultivation and other marine development activities that do not affect the wind farm operation, so this project is partially exclusive; however, a mode of closed management is adopted in Shanghai Donghai Bridge Offshore Wind Farm Phase-I Project where, except for the main channel reserved, there is no access for vessels, so it is completely exclusive and incompatible with other marine activities.

1.3. Main problems

1.3.1. OED project too close to coastline

OED projects cover large amount of marine engineering whose construction cost is proportional to the depth of water. Due to the shallower coastal waters and the shorter transmission distance, for purpose of cost reduction, the OED projects tend to choose inter-tidal zones and shallow sea areas. According to the 2012 statistics by the State Oceanic Administration of China, in China,

all the offshore wind farms completed are arranged in shallow sea or inter-tidal zones within a distance of 15 km from coastline, and all the experimental power plants of other ocean energy resources under construction or completed are arranged in the alongshore sea area. In the inter-tidal zone and shallow sea, however, there are rich marine resources, dense ocean development activities, as well as intensive sea needs and conflicts. OED projects arranged too close to coastline may meet many difficulties in the process of construction and implementation, especially coordination of sea use contradictions, and might even fail to start construction.

1.3.2. Unreasonable design of cable routing

In most OED projects of China, for purpose of saving the costs of construction and maintenance, the design of cable routing adopts the mode of parallel direct landing of transmission cables, resulting into too many landing routes of cables, which exacerbates the fragmentation of marine space. The unreasonable design of routing leads directly to the following three questions:

(a) In the period of project construction, a large number of transmission cables laid can cause great disturbance to the marine ecosystems, and lead to the death of a large number of benthic, plankton and fish species; The existence of transmission cable will theoretically damage the continuity and integrity of marine ecosystems.
(b) According to related provisions, within 500 m from on sides of submarine cable pipeline, it is prohibited dredging, drilling, piling, anchoring, clubbing, seabed trawling, netting and aquatic breeding, and navigation is also restricted, so the excessive seabed cables will seriously hinder other marine development activities (such as fishing, shipping, tourism, etc.).
(c) The unreasonable design of transmission cable between booster station and landing points separates the coastal zone from open sea, which will seriously restricts the development potential of coastal zone and inshore waters.

1.3.3. Low output value of per unit sea area

The design of existing OED projects mainly focuses on the engineering cost and economic benefits, with the value of marine space resources neglected, and the process of site selection and project layout lacks the opportunity cost analysis, so they take up excessive sea area and lead to the inefficient use of sea area. Regarding offshore wind farm projects, for example, the successful offshore wind farm honors an installed capacity of more than 10 MW per km^2 around the world while, in China, this figure is only about 3.8 MW in offshore wind farms built or proposed, and only 4.0–4.5 MW in those included in offshore wind power planning approved. Shanghai Donghai Bridge Offshore Wind Farm Phase-I Project has entered the stage of commercial operation, for example, it has a total investment of over 3 billion Yuan and takes up 13 km^2 of sea area, but its output value per hectare is only 193 000 Yuan/year, lower than that of most sea-using industries.

1.3.4. Lacking in-depth study of impact on marine environment

The large-scale OED project has had a short history in China, there is little proved in-depth research about its impact on marine environment, ecology and resources and, in particular, there is little research about the impact of magnetic radiation and noise on marine ecosystem. The results of existing study show that impact of single project on ecology may be acceptable, but it is hard to evaluate the cumulative effect of OED projects constructed and concentrated in coastal areas in future. In addition, there has been little in-depth research about the synergistic and additive impacts on marine ecological environment from OED projects and other marine development projects.

2. Main approaches of China OED sea use management

2.1. Marine functional zoning

National Marine Functional Zoning Plan is a marine space planning that China government proposed and started to organize its preparation in late 1980s. In the Plan, the sea area and island is divided into different types of marine functional zones on basis of their natural resources, environment, geographic location, and development and utilization status while taking into account the need of national or regional economic and social sustainable development. The purpose of this Plan is to, effectively, control and guide the sea area use and its spatial layout, control the scale and intensity of sea area use, adjust the structure of sea area uses and the composition of development and utilization modes, improve the efficiency and effectiveness of marine development and utilization, regulate the process of marine development and utilization, and reduce environmental impact of marine development and utilization. From the beginning of this century, this Plan has been granted with more significance, and any project using the sea area must comply with requirements under this Plan. OED projects are no exception, they must be arranged in suitable functional zones, and those OED projects with MFZ incompliance will not be able to acquire the license of sea area use. In the National Marine Functional Zoning Plan (2011–2020) recently issued, there is the dedicated term of “renewable energy zone” which mainly includes the major inshore tide energy zones of Zhejiang, Fujian and Guangdong; the coastal wave energy zones of Fujian, Guangdong, Hainan and Shandong; the tidal current energy zones of Zhejiang Zhoushan Islands (Guishan Waterway), Liaoning Dasanshandao Island, Fujian Yushandao Island and Haitandao Island; the temperature difference energy zone near the Xisha Islands; and, the seashore and inshore wind energy distribution zones.

2.2. OED industry planning

China government vigorously promotes and encourages OED projects and, in order to guide the marine energy industry for healthy development, the National Energy Administration and the State Oceanic Administration (SOA) are jointly preparing the Twelfth Five-Year Plan of Ocean Energy Development. The coastal provinces, autonomous regions and municipalities also prepare their offshore wind power development plans. These plans are medium and long-term planning and outlook of OED project site and scale. In the Twelfth Five-year Plan of Ocean Energy Development it is planned to, by 2015, build 15–20 independent power system demonstration plants to solve island power supply, 6–8 MW-level demonstration plant that can be incorporated into state grid, and start the construction of 2–4 kilowatt-level tidal power plants and; by 2020, solve the problem of electricity supply of 50 sea island, with a total installed capacity of 200 000 kW. According to the offshore wind power plans of coastal provinces available, by 2015, the national installed capacity offshore wind power will reach 14.95 million kilowatts and; by 2020, 41.65 million kilowatts. In the process of preparation and review of these plans, the State Oceanic Administration of China already has carried on the review of sea use in these plans, and provided review opinions to compress the area of sea use and adjust the sea area to be used. Therefore, these industry development plans will also play an important role of increasing the utilization efficiency of sea area

resources and pre-coordination of sea use contradiction between various industries.

2.3. Feasibility assessment of sea area use

According to the provisions on sea area use management, it is required to submit such feasibility assessment materials while applying for sea area use, and the competent marine administration department will organize the review of such materials which serves as a basis of approval of sea use. Such assessment is to analyze the feasibility on basis of investigation, analysis, calculation and prediction of the location, resources, productivity allocation, history, functions, overall effectiveness, disaster prevention, defense security and other aspects of proposed sea area, and generate the corresponding written opinion. It is an objective reality that OED project impacts the natural resources and environmental conditions, but different modes of utilization and operation will result into different degrees of impact. Such assessment aims to determine the appropriate mode of utilization and operation, so as to reduce OED impacts and maintain marine functions healthy. In practice, such feasibility assessment is helpful in regulating the OED sea use, protecting the state ownership of sea area and the legitimate rights and interests of legal sea users, promoting the intensive use of marine resources, and ensuring the sea use approval and decision-making to be scientific and democratic.

2.4. Environmental impact assessment of marine engineering

To prevent and control the marine environment pollution by marine engineering, facilitate the sustainable development and utilization of marine environment and resources, protect the marine environment, preserve the marine ecological balance and ensure the human health, there has been such a provision of marine environmental protection that: the sate implements the environment evaluation system of marine engineering. The environmental impact assessment is an important work at the initial stage of OED project construction, with focus on analysis, prediction and assessment of the potential environmental impact of OED project once completed; and, on basis of the mode of sea use determined, it makes analysis of its impact during construction and proposes appropriate environmental protection measures, so as to achieve the goal of protecting marine environment. The marine environmental impact report is generally prepared at the stage of feasibility research of OED project, approved by the competent marine administration department, and reported to the competent administration department of environmental protection for filing, subject to the supervision of the latter.

2.5. Approval of OED projects

In China, the large-scale OED projects must be reviewed by oceanic administration department of national/provincial level. In order to protect the health of marine environment and promote the rational use of marine resources, oceanic administration department proposes some basic rules regarding the siting and layout of OED projects: OED project site must comply with the marine functional zoning plans; offshore wind farms, in principle, should not be less than 10 km away from the coastline; where the beach width is more than 10 km, the water depth where OED project located shall not be less than 10 m; and, in those marine nature protection areas, marine special reserves, important fishing waters, important navigation channels, typical marine ecosystems, estuaries, bays, natural relic protection areas and military training areas, there shall be no OED projects planned or arranged. Practice indicates that persistence to these principles in OED project review may mitigate the impact of OED project construction on marine environment, and evade the sea use contradiction between industries.

3. Future mode and prospect

3.1. Strengthen the guiding role of MFZ

Strengthen the MFZ guidance in OED project siting, and ensure that the construction of OED projects must comply with MFZ requirements. Those OED projects with MFZ incompliance shall not be granted with the license of sea area use. It is required to guide OED projects to be away from the spawning, feeding and wintering areas, the migration channels, the birds protection areas as well as the bio-diversity areas, so as to reduce the OED impact on ecological environment; away from ports, waterways, aquaculture areas and important fishing zones if possible, so as to reduce the impact on shipping and fishing; and, encouraged to develop the far sea OED technology so as to mitigate the resource and environment pressures of coastal zone and minimize the sea use conflicts with other industries.

3.2. Innovate the OED sea use management system

We shall establish the cross-sector linkage mechanism, headed by the energy and marine administration departments and participated by the transport, maritime, fisheries, military, environmental protection and other relevant departments. The mechanism shall cover such OED links as preparation of planning, review of project siting and so on, responsible for coordinating the demands and needs of different industries so as to facilitate the OED project approval and construction. Regarding the approval of OED projects, to facilitate the construction of OED projects, we shall shorten the time of OED project approval and sea-use license approval. In addition, there shall be the ecological compensation system and public participation system established, which encourages OED projects under construction/operation to adopt those low-power and low-pollution new technologies, so as to protect the marine ecological environment and safeguard the legitimate rights and interests of those legal sea users.

3.3. Build the operational technology system of OED sea use management

This operational technology system we need shall consist of two parts: First, the regulations, rules and guidelines, they are used for the standardization of scope, procedures, methods and other contents of OED sea use management, such as the rules of OED project siting, the guidelines on arrangement of OED project, and the measures of environmental impact assessment of OED project; Second, technical standards, they are relatively accurate expression of technical requirements, such as the standard of installed capacity of ocean energy power plant and the standard of ecological compensation of OED project. It will be time-consuming to establish and improve the legal and operational technology systems of sea area management.

4. Conclusion

The development and utilization of ocean energy is essential to solve the shortage of energy in coastal areas, achieve the energy conservation and emission reduction, and address the climate change. Ocean energy has an important role in meeting energy needs, improving energy structure and reducing environmental

pollution, therefore, OED honors very broad prospects and should be encouraged with policies. Before carrying out the large-scale OED activities, however, it is essential to consider and demonstrate the rationality and feasibility of their sea use at least from such four aspects as protecting marine ecological environment, improving the efficiency of sea area development and utilization, coordinating sea use contradictions between industries and controlling the scale of sea area use.

Reference

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