Application Research on Energy Self supply Ocean Observing Platform

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Abstract. The mobile ocean observation platform is the carrier of equipment of various marine information acquisition and communications and is the energy providers ocean observation platform. It is an important platform to realize digital ocean and is paid attention to in marine observation. Study on a mobile observation platform based on marine renewable energy, the platform can convert all renewable energy into electricity supply platform equipment, effectively solve the energy supply problem in marine isolated platform, is an all-weather, long endurance marine mobile self-subjective measurement platform, can effectively reduce the operation cost, improve operation efficiency.

1. Introduction
The ocean area is near about 71% of the earth, has rich natural resources and high economic values. The ocean is a basic component of the global life support system, is also a kind of precious wealth helps to realize sustainable development. How to make better use and development of marine resources has become the focus of research. At present, most countries in the world have increased marine development to the height of the country. Our country clearly pointed out in the "18th National congress" that "to improve the development capacity of marine resources, to develop the marine economy, to protect the marine ecological environment, and resolutely safeguard the state's marine rights and interests, and build a maritime power. "Digital ocean" is an important means to promote the efficient management of marine [1, 2] in China, is an important guarantee to promote the implementation of national marine strategy of "The Belt and Road" strategy, marine information collection is an important source of information in digital ocean. The marine information collecting technology mainly including two ways of space-based and sea-based, in one is the main way of space-based satellite technology, which has the characteristics of wide range, high precision, convenient data transmission, but can only collect the sea surface information; ocean observation platform is an important way of sea observation, the platform due to the integrated energy supply system, data sensor, communication and other functions, is the current research focus.

Because the ocean observation platforms are far away from the mainland, the supply of energy is the key of the platform running. The traditional way of energy supply problems has disadvantages such as difficult delivery and high maintenance cost and so on, which affect the normal operation of the platform. According to the operation environment and energy demand characteristics of ocean
observation platform, this paper proposes the energy supply solutions installation of energy conversion devices in the platform to convert various of marine energy into electricity and stored all kinds of equipment is proposed in this paper in order to resolve problem of energy supply in offshore isolated data acquisition platform, and to improve system operation efficiency. According to the characteristics of platform operation environment in East China Sea this paper focuses on the development and utilization of tidal current energy.

2. Tidal current energy utilization

2.1. System framework

The tidal current energy is generated by the periodic flow of water caused by celestial gravitational, and the energy is more abundant at the place of seaboard, straits, the month of bay and so on because of tidal speed. According to statistics, the average power of tidal current energy in China exceeds 14GW [3]. The energy density of tidal current is about 30 times that of solar energy, and 4 times that of wind energy [4]. And, there is no need to develop tidal dams for tidal current, which is less destructive to the marine environment and less expensive to develop. Tidal current energy has a very broad prospects for be developed. Great attention has been paid to it and great achievements have been made by present. In this paper, the wheel power driven generator is used to accomplish the tidal current energy development.

In the traditional tidal generator structure, the blades are driven by water flow, and the blades drives the rotor through the transmission device to cut the magnetic lines to produce electricity. In the working environment of high salinity corrosion, marine biofouling, high sediment, some extra protection must be done to the generator, especially the transmission device, which will lead to higher costs, lower efficiency and so on, affecting the promotion of motors [5, 6]. In order to solve the above problems effectively, a new rim-driven marine current power generation (RMCP) jointly manufactured by Institute of Electrical Engineering (Chinese Academy of Sciences) integrates the deflector, blade and generator in one design and removes the transmission device, and the generator is installed in the blade tip, and is driven by the blade directly. The generator is directly immersed in sea on work without additional waterproof treatment required. The blade and generator are used symmetrical design, can adapt to the ebb and flow of the tides in the power bidirectional flow does not change the situation. The unit has good features, such as compact structure, high safety reliability, easy installation, convenient operation and overhaul and so on. The design and the actual: rim-driven generator are shown in Fig. 2 and 3.

The output power of the marine current power generation can be approximately expressed as:
$P = \frac{1}{2} C_r \rho A v^3$  \hspace{1cm} (1)

Among them, the $C_r$ is impeller power capture coefficient which is an important parameter to evaluate the performance of the motor. $\rho$ is the sea water density, $A$ is the swept area of the impeller, and $v$ is the flow velocity.

**Figure 2.** The structure diagram of generation system

**Figure 3.** The generation samples

2.2. *Fairwater design*

The speed of tidal-current directly determines whether the power flow turbine can operate and the upper limit of energy output. In order to effectively increase the flow speed through the turbine, the fairwater derived from the wind turbine diffuser which is a current collecting device installed in the wind turbine impeller outside generate negative pressure near the wind wheel and make more fluid to flow into the hood increasing the internal fluid velocity is used in RMCP [7]. The fairwater has the characteristics that the entrance area is larger than the exit area, ease to be designed installed and maintained, and has two main structures of bicubic curves and Victorinox curves, Fig. 4 is a design of a dome for laboratory prototype tests. Fig. 5 shows the velocity of water inflow and outflow obtained from actual tests and simulation calculations in towing tanks. It can be seen from the experimental simulation that the water flow rate can be increased to about 2 times, and the output energy is increased to 8 times according to (1) formula.
2.3. **Turbine performance optimization**

Capture power and output power are the two most important parameters of the power generation system, and they are the most direct parameter indexes to reflect the performance system. During the experiment, the output terminal of the turbine is connected with the resistance load box, and the measuring instrument measures the electrical parameters at the load end to get the system speed, voltage and current and then work out the output power. When the flow through the blades stable and continuously made the density of streamlines on both sides of the blade different. On one side, the status is relatively denser streamline, smaller pressure, slower flow velocity, and the other side is just the opposite. The blade rotates as a result of pressure difference between the two sides driving the turbine to generate electricity. The researches show that the matching blade angle is an effective way to improve the turbine performance, and the fluid dynamic performance is different when blade angles changed, and when the turbine load changes, the blade tip ratio $\lambda$ will change accordingly, which will affect the energy conversion efficiency. At rated flow velocity 3m/s, the power capture coefficients are calculated at blade deflection angle and tip speed ratio are modified respectively showed as Fig. 6.
2.4. Turbine test
The sealing and corrosion resistance of turbine are critical because stator and rotor are immersed directly in the sea water in working time. The epoxy resin directly integrates the generator stator core and the winding wire package to prevent the sea water from entering the stator silicon steel sheet and to destroy the electrical insulation, and the rotor permanent magnet is sealed and antiseptic treated with epoxy resin. The stator and rotor are static sealed respectively, and seawater can directly from the air gap, filling after the completion of the whole rim generator is soaked in water by immersion test for three months, the insulation performance of epoxy resin without cracking off phenomenon.

At present, the test platform with two RMCP total outputs power 15KW is already built at Zhoushan, Zhejiang province join with Institute of Electrical Engineering. The platform is based on a fishing boat and has been running for more than 1 years. At present, we mainly focus on how to complete the marine sensor network more efficiently and build a more stable energy supply system.

3. Power control system
Comparing the general power generation equipment, ocean tidal currents can be arranged in a harsh environment, so it is necessary to investigate and design its mechanical, corrosion, insulation and many other aspects. Referring to relevant design and experimental experience, structure of the underwater turbine is simplified as much as possible, while the control equipment of the power electronic is removed to make the generator rotate naturally, and the possibility of failure is reduced to the maximum. Due to unsteady flow, the output electric energy voltage and frequency of electric energy is not stable, and that is not possible to be used, so that the first function of the control system in the platform is the power setting. Therefore, the first task of the control system on the platform is the readjustment of the electrical energy converting the rang of output voltage from 0-400V AC to 220V (±2) AC and converting the frequency to 50HZ (±1). The control system can change the output current generated by turbines to DC (direct current) for the internal equipment power supply, the system can provide ±5, ±12V, ±24V drive power without the batteries avoiding the battery and other equipment input. The output voltage after rectifying is shown as shown in Fig. 7.
Figure 7. The output voltage

4. Conclusion
This paper studies the use of tidal marine information acquisition platform to solve the energy supply power system, introduces the optimization performance of the motor drive flange, and the use of electrical control system of the motor cannot rule out the current adjustment for setting rules for the current power supply platform, effectively solve the problem of obtaining isolated platform energy, improving the operation efficiency of the platform.

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