Design and hydrodynamic characteristics of the gate-type tidal current energy converter
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ABSTRACT
In this paper, a gate-type tidal current energy converter has been designed to use tidal current safely and efficiently. According to the sea condition around Zhoushan Islands, the structure and mooring system of the gate-type tidal current energy converter have been developed. The mooring tension and motion response of the device under different working conditions have been studied. All those have proved that the gate-type tidal current energy converter and its mooring method are feasible. The design and results in this paper can provide the reference for the development and application of a gate-type tidal current energy converter.

KEY WORDS: Tidal current; energy converter; mooring system; mooring tension; motion response

INTRODUCTION
As a kind of clear ocean renewable energy, tidal current energy has become one of the most deserved development ocean renewable energy with the advantage of large reserves, wide distribution, easily forecast and little environmental pollution (Dai, 2010; Lv, et al.,2008; Lv, et al.,2011). The development of tidal current energy has turned from concept design to commercial exploitation in the world. Varieties of devices have been put into commercial operation stage gradually. The “SeaGen” of Marine Current Turbine Co. is the largest tidal current energy project in commercial operation around the world. The technical scheme of it is using three legs of single steel pile and horizontal arm to support two units, which made the total installed capacity of 1.2MW(Douglas C A, et al.,2008). The “Evopod” of Ocean Flow Energy Co. adopted semi-submersible horizontal axis turbine scheme. A new 1/4 model tested in 2015 in South Peninsula, with the strong ability to survive in extreme sea condition. The output power of it is 37 kW, and successfully connected to the power grid (Mackie G, 2008).

Today’s mainstream trend is to design the tidal current energy converter floater such as floating, gravity-based, semi-submersible, which have achieved some results. Based on Daishan, China, 300 kW tidal current energy power station demonstration project, the new type tidal current energy converter is on exploration. Choosing the double rotors gate-type power station as the design and research object, the structure and mooring system design are carried out in order to provide reference for the development of tidal current energy converter in future.

DESIGN OF THE GATE-TYPE TIDAL CURRENT ENERGY CONVERTER

According to the sea condition in Zhoushan and other factors such as design power of power station, combined with the relevant design rules of the carrier platform, the form and size of the main structure of the power station are determined.

Main technical parameters and design rules

Through collecting and look up the historical climate and sea data there, combined with the relevant information of the power station, the following data is given as Table 1.

The main basis for the design carrier platform is The RULES FOR CLASSIFICATION OF MOBILE OFFSHORE UNITS (CCS,2005). In the design process, the main basis and reference standards are as following:
1. The maximum operating power is 300kW;
2. Mooring system can satisfy the requirement of power station positioning and the design life;
3. The cost control of the power station;
4. The solution of installation, maintenance and other problems of the power station.