

## **Tidal Current Power Rotor Performance under Various Conditions**

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### **ABSTRACT**

Among several ocean renewable energy sources, the TCP (Tidal Current Power) has number of advantages over others. The power from TCP is continuous and predictable and reliable regardless of weather conditions or seasonal changes since the current speed and orientation can be predictable. The western coast of Korea has many potential sites for TCP with strong current speed caused from more 10 meter tidal range. Also in the south, there are numbers of promising TCP areas with high flow speed between narrow channels between islands. To extract sizable energy from tidal current, the TCP farm having numbers of device units is required. However, the size of TCP farm is limited and is to be minimized not to disturb the ship channel or the fishing areas. As being known, the distance or gap between devices should be maintained to ensure the maximum performance. The interference between devices for various gaps is not the same. This interference has direct impact to the performance or the efficiency of the device. This paper introduces the performance study of TCP devices considering the interference between rotating rotors with axial, transverse and diagonal arrangements. Series of experiments have been carried out in CWC (Circulating Water Channel) and the various cases are analyzed by CFD model.

**KEY WORDS:** TCP (Tidal Current Power); renewable energy; HAT(Horizontal Axis Turbine); interference effect; performance of rotor.

### **INTRODUCTION**

The ocean renewable energy resources have the greater potential over the other resources due to the high density where the power generation is proportional to the flow density. Not like the other renewable sources, the TCP is very predictable and reliable energy source. Many studies have been introduced on the application of tidal current power system such as those by Garbuglia et al. (1993) and Young (1995). Bernshtein (1995) has introduced a new concept for a current stream power system and has also carried out experiments in the sea. In Japan, the Darrious type has been studied by Shiono et al. (1999). Walsum (1999) has

introduced the current power system in Fundy which has the largest tidal range. Jo et al. (2007 and 2008) have investigated the interference effects of rotors placed on a multi-module and have published the experiment results on the application of tidal current power system in the cooling water weir.

Since the actual power production can be affected by the interference between devices, it is very important to estimate the interaction effect for various arrangement and conditions in TCP farm. In particular, the rotor type is one of the important factors that can contribute to the interaction significantly that convert the flow into the rotational energy. Therefore the design and optimization of rotor configuration is essential. Also the gaps between device and arrangement layout have a great impact to the interaction and the performance of the device. In this paper the performances including interaction rates are demonstrated. From this study, the interaction rates for various conditions are introduced that can estimation the capacity of TCP farm.

Since tidal current energy is in proportion to the cube of flow velocity, TCP can be applied to the region with strong current. To accelerate the flow speed, a duct system has been studied that could obviously generate more power. The series of experiments have been conducted in CWC for the application of upstream duct to TCP system. The CFD results are compared with the experiment and further developed to study on the different parametric conditions.

### **INTERFERENCE EFFECTS**

The TCP farm is required for the commercialization of the technology. Development region needs strong current, so area is limited. The maximum output must be generated in limited area and the arrangement of devices determines the total capacity. Interaction studies for minimizing the loss of power provide the important information that we are able to predict the exact power capacity required prior to the development of the TCP farm. The interference effect according to gap between the rotors is also important. Axial and diagonal arrangements of rotors have been investigated through the measurement of RPM decrement. All rotors have the same layout configurations.