A Study on Energy Extraction from Tidal Currents

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Abstract : The oceans are an untapped resource, capable of making a major contribution to our future energy needs. In the search for a non polluting renewable energy source, there is a push to find an economical way to harness energy from the ocean. Tidal stream is one of ocean energy form that is being investigated as potential source for power generation. Tidal current turbines are therefore designed as conversion machinery to generate power from tidal currents. A study on energy extraction from tidal currents is presented in this paper.

Key words : Ocean energy, Tidal turbine, Energy extraction, Renewable energy, Energy conversion

1. Instruction

The actuator disc is a popular method which is widely used to analysis tidal turbine performance. In this paper, a 20×9×6m flow field is introduced as shown in Figure 01, where an actuator disc is submerged at 1m depth underwater representing the 1m diameter tidal turbine. Thus, as water flow its energy can be absorbed by this actuator disc. Using ANSYS CFX simulation, the rate of energy extraction can be determined. The CFX simulation is set-up based on the combination of actuator disc and volume of fluid (VOF)[1] theories.

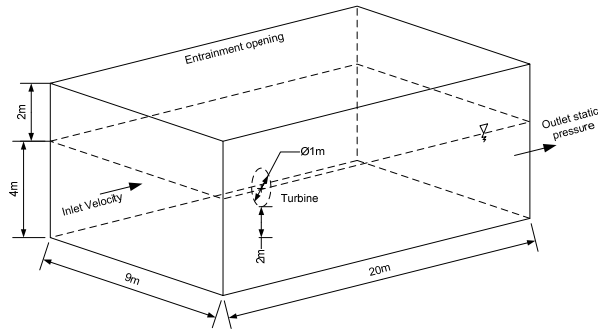

Fig.1 Flow field overview

2. CFX Simulation

A hexa mesh is generated with 700000 nodes for the simulation. The disc is defined as a wall boundary with wall source. The bottom and side boundaries of the flow field are all free slip walls, the top boundary is entrainment opening, water flow from inlet boundary with different velocities and move out of the flow field at outlet boundary with static pressure equals to zero.

3. Results & Discussion

Fig. 2 and 3 present the visualization of 3D free surface and water level elevation along the x-axis. This result proves that the current simulation is of low-resistance case. Solving these equations shall obtain velocity deficit along x-direction, therefore we can determine percentage of energy absorbed from the tidal currents. Actuator disc source is initially given, and turbine characteristic is automatically calculated by CFX-Solver. Initial water level is 4m. Simulation is carried out at various value of inflow velocity.

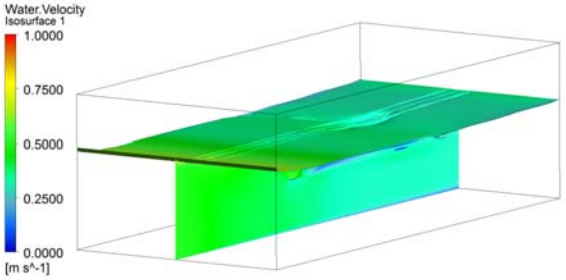

Fig. 2 3D Render of free surface (U_0 = 0.5m/s)

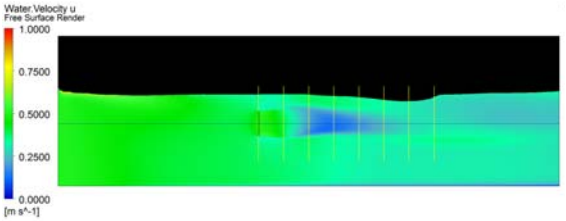

Fig. 3 Water level elevation (U_0 = 0.5m/s)

참고문헌

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