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Modelling and Simulation of Tidal Current Turbine for Stability Analysis

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Wind is hardly predictable source of energy. Tidal current turbines extract electric energy from the water. Tidal currents are fluctuating, intermittent but a predictable source of energy compared to wind. Its use is very effective as it relies on the same technologies used in wind turbines. The electrical-side layout and modelling approaches used in tidal in-stream systems are similar to those used for wind and offshore wind systems. The speed of water currents is lower than wind speed, while the water density is higher than the air density and as a result wind turbines operate at higher rotational speeds and lower torque than tidal in-stream turbines which operate at lower rotational speed and high torque [1]-[5].

In the past few years, tidal current energy industry has been rapidly evolving. Many investigations of stand-alone turbines have been reported, e.g., Liand Calisal [6] and Batten et al. [7]. Several pre-commercial prototypes have been deployed in these a by some vendors, e. g., Marine Current Turbine, Verdant, and Archimide. Unlike the wind energy industry, stand-alone is not the only format for the tidal current turbine. Informed by the design of the marine twin-propeller system in the marine industry, many tidal current turbine designers have suggested that a twin-turbine system is a better format. A few studies of the twin-turbine system with horizontal turbines have been reported, e. g., Van Zwienten et al. [8] and Clarke et al [9]. Moreover, the world's first twin-turbine system with horizontal axis turbines was deployed by Marine Current Turbine in 2008. On the other hand, no study on the twin-turbine system with vertical axis turbines has been reported, although vendors have released their concepts.

This paper explains the creation of a bond graph model for a tidal current turbine system through the modelling of the source, the rotor, drive train and the generator. The aim of the simulation model is to illustrate how the tidal current energy system works and how to make use of it in power generation. Harnessing tidal currents power done through various types of water current turbines.

Keywords: Modelling, Tidal currents, Tidal energy conversion, permanent magnet synchronous generator