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Performance Assessment of Horizontal Axis Tidal Turbine with Variable Length Blades

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Abstract : Renewable energy is the only alternative sources of energy to meet the current energy demand, healthy environment and future growth which is considered essential for essential sustainable development. Marine renewable energy is one of the major means to meet this demand. Turbines (both horizontal and vertical) play a vital role for extraction of tidal energy. The influence of swept area on the performance improvement of tidal turbine is a vital factor to study for the reduction of relatively high power generation cost in marine industry. This study concentrates on performance investigation of variable length blade tidal turbine concept that has already been proved as an efficient way to improve energy extraction in the wind industry. The concept of variable blade length utilizes the idea of increasing swept area through the turbine blade extension when the tidal stream velocity falls below the rated condition to maximize energy capture while blade retracts above rated condition. A three bladed horizontal axis variable length blade horizontal axis tidal turbine was modelled by modifying a standard fixed length blade turbine. Classical blade element momentum theory based numerical investigation has been carried out using QBlade software to predict performance. The results obtained from QBlade were compared with the available published results and found very good agreement. Three major performance parameters (i.e., thrust, moment, and power coefficients) and power output for different blade extensions were studied and compared with a standard fixed bladed baseline turbine at certain operational conditions. Substantial improvement in performance coefficient is observed with the increase in swept area of the turbine rotor. Power generation is found to increase in great extent when operating at below rated tidal stream velocity reducing the associated cost per unit electric power generation.

Keywords : variable length blade, performance, tidal turbine, power generation
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