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Abstract:

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Scientific Validation of Standards for Tidal Energy Resource Assessment

Promising new technologies are emerging for exploiting tidal currents – a freely available, renewable, accurately predictable resource – technologies that produce no emissions and have minimal environmental and visual impact. Accurate and reliable estimates of marine energy resources are essential throughout the development cycle for any marine energy project; such as during site selection, for predicting power output and variability; and for evaluating alternative design options. Technical Committee 114 of the International Electro-technical Commission (IEC-TC-114) is currently developing a standard to determine, objectively and reliably, the scale and character of tidal energy resources in a region. The draft standard has not yet been trialed in a real world case study. Hence, it is not yet known whether the draft standard can be applied successfully in Canada or elsewhere, nor whether it will yield the desired outcomes. The current research applies the methods prescribed by the draft standard to assess the tidal current resource across the Fundy FORCE project site (Minas Passage, Nova Scotia). The ~$80M FORCE project involves establishment in Minas Passage of four grid-connected ocean berths for high-energy testing and demonstration of commercial-scale hydrokinetic turbines. As part of a collaborative effort between the University of Ottawa, the National Research Council of Canada and the FORCE consortium, this research leverages a considerable volume of existing data, including velocity measurements, high resolution seabed bathymetry, and previous analysis of wind, wave and tidal current data. Central to the project is development and refinement of a two-dimensional (depth-averaged) numerical model of tidal hydrodynamics in the Bay of Fundy. The model was calibrated by adjusting bottom friction and turbulence parameters to minimize differences between modelled and measured data, and then validated by comparing model outputs to a second, independent dataset. The ability of the model to accurately predict tidal currents and tidal energy resources was assessed through comparison with velocity measurements at the FORCE berths. Moreover, the sensitivity of the predictive skill to parameters such as model resolution (spatial and temporal), bathymetric detail, and inclusion/exclusion of various physical processes and modelling features were also investigated. This work will help to quantify the principal sources of error and uncertainty inherent to the resource assessment methodology. This study will help identify any shortcomings in the draft standard and offer recommendations for its improvement. It will also help determine whether the draft standard is suitable for use in the Canadian context, or whether amendments are warranted by unique aspects of the Canadian marine environment. The main purpose of the project is to establish a scientific basis for the draft standard, promoting its acceptance in Canada and abroad, leading to the advancement of a promising new clean energy technology.