NOVA SCOTIA ENERGY
R&D CONFERENCE 2014
ENERGY FOR CHANGE

"Knowing your Site and Sticking To It"

Abstract: Ms. Robynne Murray & Ms. Katie Gracie, Dalhousie University

---

Development of high performance tidal turbine rotors for passive feather regulation

(R.E. Murray, K. Gracie, D.A. Doman, M.J. Pegg and C.M. Johnstone)

Economically viable deployment of tidal energy converters (TECs) into the world energy mix is currently challenged by large capital and maintenance costs. While there is always considerable financial risk associated with an infant industry, reductions in capital and maintenance costs alongside increases in the robustness of TEC engineering systems will reduce the need for financial backers to absorb such high costs. Furthermore, these improvements on the technology side will progressively mitigate the requirement for the elevated feed-in tariffs required to bring tidal energy into economic competitiveness with other forms of renewable energy. Optimization of power capture and regulation systems, and increases in the structural robustness of these systems, will help towards this end.

The available power at tidal sites fluctuates with the tidal cycle, with a maximum power available only for a small percentage of time. Because of the non-linear increase in generator and turbine component costs with increasing size, it is uneconomical to size components for this peak power. Therefore, power regulation has become an important aspect of turbine design. Currently, a large percentage of turbine failures leading to unscheduled maintenance requirements are a result of blade failures and problems with control systems associated with power regulation. Furthermore, high turbine structural loads necessitate heavy and expensive turbine support structures which currently make up a large percent of the capital cost of a turbine. There is a call for technological advances which increase the structural robustness of power regulation systems and/or reduce structural loads at higher flow velocities.

This presentation reports the progress of research into two power regulation and load mitigation technologies being undertaken in a collaborative project between Strathclyde and Dalhousie Universities. The two technologies being researched are aimed to cover the span of tidal sites from low to high velocity. Both of these technologies use fixed-pitch blades for

passive feather power regulation. A requirement of the implementation of passive feather regulation is turbine blades specifically designed to enable “feathering” as flow speeds increase. As a blade feathers in relation to the tidal flow, the efficiency with which it captures power reduces, allowing for a regulated peak level of power. Compared to the complexity, capital expense and potentially high maintenance costs associated with variable pitch mechanisms and complicated control algorithms, fixed-pitch passive feather regulation blades require no moving parts, are less structurally vulnerable at the root and may prove to be cheaper to produce, potentially resulting in increased robustness and reduced maintenance. Each