

Design and Development of a Submersible Generator Optimized for the Conditions of Current Energy Conversion

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This proposal requests support for the design and development of a robust submersible generator, as a distinct subsystem of hydrokinetic assemblies and optimized for the conditions of current energy conversion. The approach of designing the generator as an independent system component has many advantages and is consistent with the application of generators in most electromechanical systems including: wind energy conversion, power generation, conventional hydropower and industrial applications. The proposed generator will be designed around two industry leading turbines for which generators do not yet exist. They are the Gorlov Helical Turbine and a hydrokinetic version of the popular FloDesign turbine. The team consists of a partnership of leading U.S. industrial, academic organizations actively involved in the design, development and application of generators and generator components and related technologies. The result will be a robust, manufacturable, efficient submersible generator which will significantly advance the application of current energy conversion.

As in the early stages of wind turbine development; hydrokinetic devices have been employing a wide range of generator types, models and sizes. These include above-surface generators, submersible, sealed, flooded air gap, brush and brushless, synchronous, permanent magnet, induction, rim mounted, axial mounted, geared, integral to the turbine and separate. The primary objective of this effort is to apply a thoughtful and considerate approach to the design of a generator optimized for tidal energy conversion using a team of highly qualified and experienced generator design and manufacturing engineers based upon a verifiable analysis of the prime mover and its environment.

The methods to accomplish this task include:

- Analysis and characterization of prime mover including kinetic energy and velocity distribution.
- Define ambient operating conditions including temperatures, pressures and operating extremes.
- Determine optimal generator design topology
- Electromagnetic circuit design
- Mechanical design of generator including magnets, laminations, windings, bearings, housing, materials specifications, load coupling methods, etc.
- Component sourcing and design for manufacture
- Investigation of manufacturing requirements and issues and costs
- Final CAD and 3D models

The design of a robust, submersible generator as a separate component of complete hydrokinetic assemblies and optimized for the appropriate kinetic energy and ambient operating conditions, will benefit the industry and accelerate the application of hydrokinetics as similar efforts did for the wind energy. Success in this effort is assured by the use of highly qualified generator design engineers and manufacturers and representatives of industry. Success in this project will lead to job creation in a range of US industrial sectors.

Organization: ¹ Free Flow Energy, Inc. (FFE), ² Massachusetts Institute of Technology (MIT), ³ Motor / Generator Industry Representative

Discipline: ^A Electrical Engineering, ^B Mechanical Engineering, ^C Structural Engineering, ^D Oceanography
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