Small Hydrokinetic Power VIVACE

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Abstract

The purpose of this research is to examine the potential advantages and issues of implementing a recent development in small hydrokinetic power known as Vortex Induced Vibrations for Aquatic Clean Energy (VIVACE). The objective of this project is to investigate whether VIVACE hydrokinetic energy systems are capable of powering towns, as well as being low impact, cost effective power generators. The analysis in this research includes 1) a review of VIVACE technology, 2) energy estimates for the (test) region of Barcelos, Brazil in the Amazon, 3) calculations per kilowatt hour generated by a VIVACE system for the Barcelos region.

Project Goals/Objectives

- Study potential global applications of VIVACE to provide renewable, environmentally friendly energy solutions
- Develop test case for the purpose of examining feasibility and cost-effectiveness of VIVACE power systems
  - For Barcelos, producing electricity local to city would decrease costs

Results/Outcomes

- **Power Formula**
  - Used following formula to determine power output per cylinder

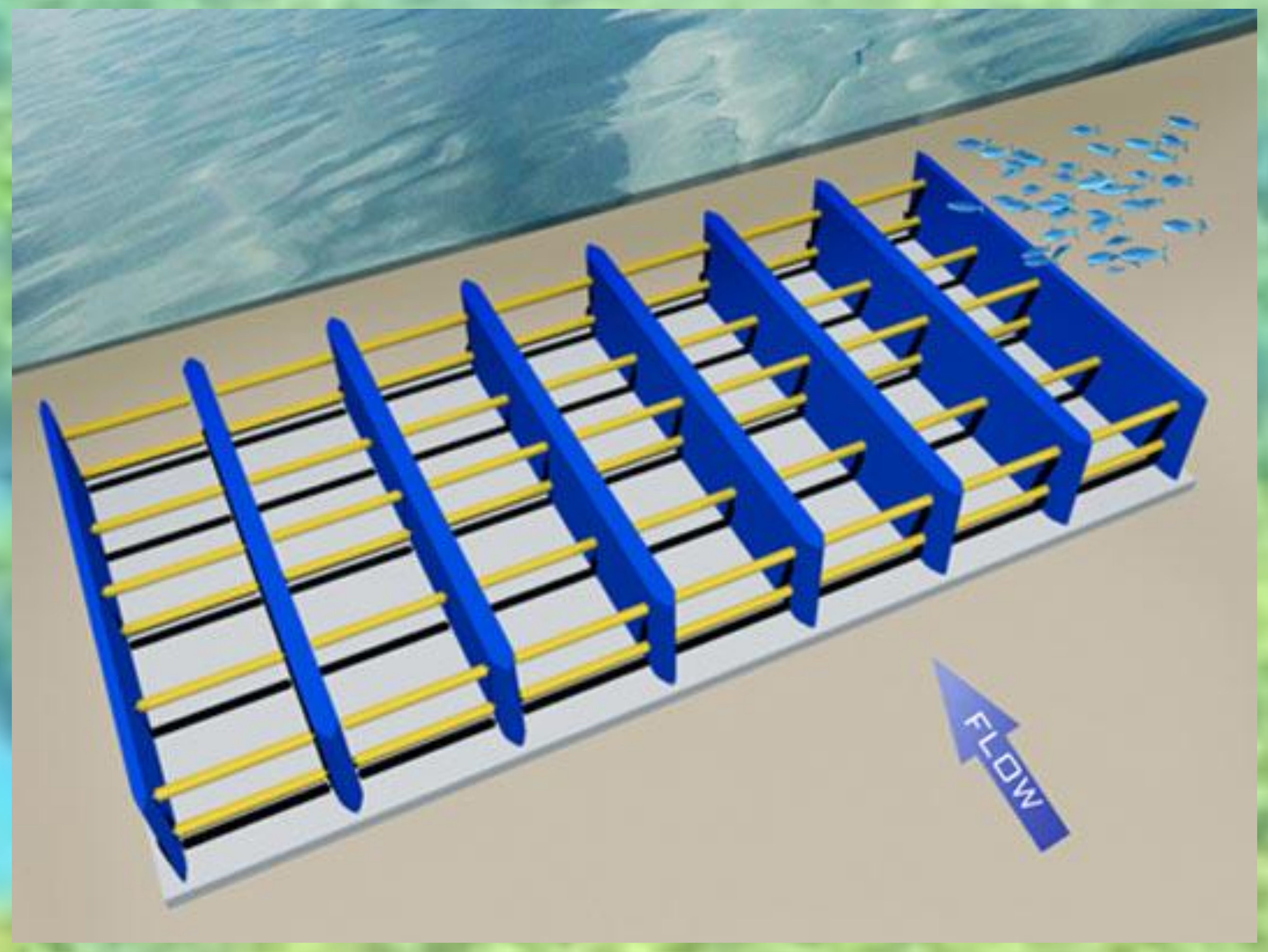
    P = ½ * ρ * D * L * U^3 * efficiency
  - Minimum number of cylinders required: 1056.
  - Number of cylinders recommended: 1100.
- **Total Area Required**
  - 4856 square meters.
  - 2 megawatts would require a 50 meter x 97 meter farm.
- **Environmental Impact**
  - Minimal impact on river bottom.
  - Does not kill fish or other aquatic animals.
  - Corrosion resistant materials prevent rusting and pollution.
- **Impact on watercraft**
  - As long as modules are more than 15 meters underwater, they are safe from boat traffic.
  - Swimmers would have a very difficult time diving deep enough to hit a module; professional diving gear would be required to swim that deep.

Waterfront of Barcelos, Brazil [1]

Vortex used to power VIVACE Converters [3]

High Utilization Expected for VIVACE Eases Capital Cost Constraints [5]

	Capital Cost $/kW	Fixed O&M $/kW	Variable O&M $/kW	Fuel Cost $/MWhr	Capacity Factor	Cost per kWhr $/kWhr
Conventional Generation						
Pulverized Coal	1,437	43.60	0.011	1.70	85%	0.041
Nuclear	2,180	67.90	0.005	0.53	90%	0.046
Natural Gas Combined Cycle	467	5.41	0.043	2.12	45%	0.062
Alternative Generation						
Wind	1200	156.43	18.00	0.00	25%	0.069
VIVACE	3000	70.72	0.00	0.00	90%	0.055



Artist depiction of a large VIVACE farm[2]

Conclusions

- A 2MW array would cost $8 million to install.
- It would take a little over 10 years to recoup the capital.
- The array is expected to make over $12 million in profit over its lifetime of 25 years.
- VIVACE will provide a clean and renewable source of energy for Barcelos which is not intrusive to the environment or economy.

References

[1]: http://archive.pahrumpvalleytimes.com/2008/Dec-26-Fri- 2008/photos/3223906.jpg.
[2]: http://fs-testserver-v2.com/files/vivace-ed2.jpg.
[3]: http://sealandaire.com/wp-content/files_mf/cache/th_3b651670e2f30f81201e5ad0e93774b3_vortex-shed-e1307475147414.jpg.
[4]: http://www.destination360.com/south-america/brazil/images/st/brazil-amazon.jpg.
[5]:http://www.osti.gov/bridge/product.biblio.jsp?osti_id=896401.