EarthRun Energy

Presents

Cnidaria System
"Empowering People"

A plan composed by Austin Johnson and Erin Phillips
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Grant Funds Requested $50,000
Match Committed $12,750
Total Project Cost $62,750

Same Title as Previous Emerging Energy Grant Application

1.) Project Summary

a. **Project description**

EarthRun Energy (ERE) is a start up renewable energy RD&D (research, development & deployment) company. ERE's current project is a transformative hydrokinetic river energy technology. Using technology inspired by natural systems (bio-mimicry), in this case the propulsion dynamics of jellyfish; the goal is a competitive, clean and sustainable means of producing energy in the form of electricity.

The ERE project is the Cnidaria System, pronounced "nah-dair-ee-uh." This is a phylum in the Animal kingdom including all Classes and Species of jellyfish. Due to the system's use of biomimicry the name Cnidaria was a fitting and informative title for the project. Cnidaria is a simple technology that enables energy to be "pulled" from the water currents, with no spinning turbine blades in the water. The system operates without threat to fish or water mammals.

On the Yukon and Kuskokwim, as well as other large rivers in Alaska, most villages rely on diesel fuel that is either barged or flown into the villages at a high cost.

The rivers currently provide subsistence food and a transportation corridor; this project will add power production to the benefits of the river. The production of electricity from the river has the potential to offer the villages energy at a lower cost than diesel-generated electricity. Other potential benefits are, cost stability and lower environmental risk than petroleum barges, tanks and transfer pumps.

Possible funds from this grant application will be used to continue development on the Cnidaria system. During the summer of 2013, ERE will continue to develop and refine the second generation Cnidaria system. ERE will continue testing throughout the summer as the design is modified. The goal is to further refine the design, as we work toward commercialization.

R&D accomplished to date:

During the summer of 2010 ERE developed the first Cnidaria system prototype. The prototype was developed using a rapid application development philosophy where ERE improved design as the prototype was being built. ERE fabricated Cnidaria within the original budget. During the summer of 2011, a second prototype of the Cnidaria system was built by ERE. This system was tested in Anchorage waterways to demonstrate the potential of this unique technology.

b. **Project Eligibility**

EarthRun Energy is an energy technology company with an Alaska business license thus making the company an eligible applicant.

We are at Technology Readiness Level 5, with our second-generation prototype. As stated in TRL 5 the basic technological components have been integrated and tested in a relevant environment. After testing of our original prototype ERE engaged a professional engineering consultant, Earle Ausman of Polarconsult Alaska, and have worked to incorporate improvements.

EarthRun Energy owns all intellectual property associated with the Cnidaria system, and is pursuing a patent application for the second-generation prototype upon its completion.

c. **Project Innovation**

The Cnidaria System is unlike conventional hydrokenetic systems, and addresses the inherent problems that plague those systems. With simplicity as a leading factor in the design, ERE is working to develop in-stream river energy systems with higher overall reliability, lower cost, and greater ease of installation and maintenance.

How it works:

The river current pulls a series of open sails fixed to a continuous cable away from an anchored power pulley. As the sails reach the end of their run, they are pulled around and collapse like an umbrella to be pulled back towards the power pulley by the other outgoing sails. The power pulley will be anchored to the river bottom and will use a planetary gear to drive an underwater generator. The Cnidaria will be attached to the river bottom by a rock basket filled with enough weight to hold the system in place. Rising from this basket will be a flexible mast that will extend above the surface of the water. During installation, a rigid pipe will be lowered over the mast and locked into place. This pipe will have the entire pulley and sail assembly attached to it. Once the pipe is locked into place, the system is ready for operation. When logs sweep downriver and run into the mast a flexible fastener will allow the whole system to bend downstream allowing the log to pass over the system without causing damage. Once the log passes, the

fastener will restore the system to an upright position, which will allow operation to continue. The flexible part of the mast extending above the surface of the water will have a navigation light as well as a buoy that moves up and down as the water level rises and falls, this buoy will also have a navigation light.

At the downriver end of the system where the sails are pulled around back towards the power pulley there will be another buoy separate from the system. Boat traffic is warned by the lights and buoys (see attached drawing for a visual representation of this description).

This system is designed to survive in the harsh river environment by mimicking nature. When the sail is open and pulling it is like a tree floating down the river. When the sail is closed and being recoiled it is mimicking a fish swimming up river. The amount of power the system can produce will be based on river current and river depth, our goal is for the system to produce at least 50kw of electricity for the entire year including the winter.

Since the system is submerged, it will be able to run under the ice. During ice break up, the system will be pulled out of the water to prevent damage from the large ice flows and maintenance will be performed. ERE intends to quantify the in-stream river capacity factor (percentage of the year that a system is making electricity) with an anticipated factor above 90%, whereas wind energy's capacity factor is roughly 25%, and solar power is often less than 40%. The entire Cnidaria system can be transported in a small airplane to the villages. The Cnidaria System will be installed using two small local riverboats and five men. Because we do not need a barge to ship our system or expensive machinery to install it, our total price is kept low.

d. **Priority**

The priority considerations established by AS 42.45.375(d) state number one priority for Alaska residents and organizations. ERE is owned and operated by Alaska residents and exists as an Alaskan organization. ERE's project also has in-kind matching funds and potential for wide spread development within the state, thus satisfying the number three and four priorities.

2.) Technology Validation and Research Methodology

a. **Objectives and Methodology**

In the summer of 2013 ERE will continue the development of the second-generation prototype and environmental testing. Through use of vendor and professional engineering consultant relationships made during the building of our prototype we will enhance the second-generation prototype. During testing, we will use a 10kw generator and sails scaled down for test operations. Using our boat we can vary the simulated current velocity as well as sail spacing, this will allow us to get real world data for optimizing the system.

ERE will continue to test at Sand Lake; where initial testing was accomplished. ERE has access to a private boat launch and dock on Sand Lake. The prototype was built in an Anchorage workshop and any modifications of improvements will be made here. ERE will use a GPS and a Powermeter to determine speeds and energy output. All data will be recorded by ERE for use in comparing our system to other existing river power generation units.

Sand Lake is a turbid lake environment that will closely simulate the rivers where the system will be placed. However, Sand Lake will not have any logs or other such debris in it, these tests will be done when the unit is anchored in a river. If the system is installed at AHERC then ERE will determine how well the system will work in a river environment. No permits are required for testing in Sand Lake. ERE will research necessary permits needed for testing at AHERC.

3.) Summary of Project Schedule and Summary of Project Budget

Phase I is set to be completed over the course of the summer of 2013 and through the winter of 2013/2014. Specifically during the summer when the waterways are free of ice, we will build and test the technology for the system. During the following winter ERE will identify sites, secure land use permits, and further develop commercialization plans. Phase II will take place in the summer of 2014 with a pilot project at full scale, which we hope to install at the Alaska Hydrokinetic Energy Research Center. We will use the data gathered from this unit to further develop commercialization of the product. This brings ERE to Phase III, which is all analyzing and reporting which will be done during the winter of 2014/2015 bringing the system closer to commercialization and readiness for the summer of 2015 and ensuing winter.

For Budget Summary see Appendix 1 (Budget Form).

Phase 1 Budget (May-Dec 2013)	Anticipated Completion Date	EET Fund Grant Funds	Grantee Matching Funds	Source of Matching Funds: Cash/In-kind/Federal Grants/Other State Grants/Other	TOTALS
Project scoping and contractor solicitation completed	1.5.11	$0	$0		$0
Site control verified	Completed	$0	$0		$0
Permitting completed	N/A	$0	$0		$0
Final design completed	1.5.11	$0	$0		$0
Financial plan finalized	Completed	$0	$0		$0
Technology validation and research plan finalized	1.9.11	$45,200	$11,150	In-Kind and Property	$56,350
Preliminary Commercialization Plan Completed	1.1.12	$4,800	$1,600	In-Kind	$6,400
TOTALS		$50,000	$12,750		$62,750
Budget Categories:					
Direct Labor & Benefits		$26,250	$8,750	In-kind	$35,000
Travel & Per Diem		$0	$0		$0
Equipment		$0	$4,000	Property	$4,000
Materials & Supplies		$17,150	$0		$20,750
Contractual Services		$3,000	$0		$3,000
Construction Services		$0	$0		$0
Other		$3600	$0		$3600
TOTALS		$50,000	$12,750		$62,750

4.) Project Team Qualifications

ERE founders, Austin Johnson and Erin Phillips, are dedicated to research and development of renewable and sustainable solutions to today's pressing energy challenges.

Austin Johnson is a Mechanical Engineering undergraduate student at University of Alaska Anchorage. He spent the fall of 2009 and the spring of 2010 in Europe on an extensive renewable energy research trip. Traveling to Sweden, Norway, Denmark, and the UK exploring innovative renewable technologies and sustainable communities. Projects and technologies already in widespread use in Europe inspired Austin and Erin to develop a product that will provide clean, reliable, renewable energy to communities in rural Alaska and other parts of the world. Erin worked with Austin through the summer of 2010 as the initial designs were built and tested. Erin is an Environmental Science undergraduate student at Alaska Pacific University.

5.) Discussion of Commercialization of Funded Technology

With all Phases of ERE's proposed project set to be completed in the next five years this project represents the potential future of river energy commercialization. The goal is to have a system that is easily constructed and transportable. This will make the system marketable on a global scale.

At the present time, the Alaskan in-stream river energy market is untapped. There are few commercial systems in the water and only a handful of prototypes that have produced energy from the rivers of Alaska. With diesel costs forecast to continually escalate, the conventional method of producing electricity in villages has become unsustainable.

For thousands of years, the native Alaskans lived off of the land. It has only been in the recent times (since mid-20th century) that the unsustainable ways of living were introduced into the communities. ERE believes that is very important that the energy for the villages be produced in a sustainable way from the land that has provided for the residents. We see our challenge to show that we have a technology that can provide a better life for the people in the most remote parts of Alaska.

ERE is poised to be a leader as an Alaskan-based in-stream river energy company. That will enable ERE to establish stronger relationships with our customers, quicker deployment of our energy systems, faster repair times, and an overall home field advantage. All of this will provide a more direct interface between ERE and the electricity consumer.

Many of the villages on the large rivers of Alaska can benefit from this technology in addition to private lodges. Our first goal is to install 40 systems in Alaskan rivers. With 40 systems installed and charging 10 cents per kilowatt-hour annual gross income is $1.75 million. Outside of Alaska, this technology could be utilized on any major river where power is needed.

Due to the projected low costs to build, operate, and maintain a Cnidaria system, ERE expects to be able to charge in the range of 10 cents per kilowatt-hour, relatively low by rural Alaskan standards. Which vary depending on the remoteness of a village but are generally in the range of 50 to 80 cents per kilowatt-hour, according to the Institute of Social and Economic Research.

Conventional Hydrokinetics:

The in-stream river energy industry is in its infancy, but most hydrokinetic companies appear to be using adaptations of technology pioneered in the wind industry, essentially wind turbines placed in the river. ERE is pursuing an entirely new concept that avoids the inherent problems with conventional designs. In order to be viable, hydrokinetic systems must be reliable in remote locations, without constant maintenance, and cannot be vulnerable to the inevitable floating debris such as trees floating down the river. Fish runs must be protected from harm from spinning blades or wheels. In the Cnidaria system, no parts move faster than the river current and there are no spinning blades to produce rotational energy. ERE knows of no other company that can demonstrate those benefits

<u>Proof of Eligibility:</u>

By signature on this application, I certify that we are complying and will comply with the amount of matching funds being offered.

X_____Date:_____ X_____Date:_____

Austin Johnson Erin Phillips