



PULSE-STREAM HYDROKINETIC POWER DEMONSTRATION IN IGIUGIG

CONFIDENTIAL

039 RECEIVED MAR 09 2012

1	Project Title	Pulse-Stream Hydrokinetic Power Demonstration in Igiugig
2	Applicant contact information	Faith Warthen fdw@heraenergys.com Phone : 907-346-1115
3	Partners	Hera Energy LLC Igiugig Village Council Alaska Energy & Engineering Inc. Pulse Hydro Ltd.
4	Total project cost; Grant funds requested; Match committed;	\$1.4m \$750k \$695k
5	Previous project/application title(s) and/or number(s) for grants from the Renewable Energy Fund or Denali Commission Emerging Energy Technology Grant program	None
6	Previous Project title(s) for abstracts submitted to the Emerging Energy Technology Fund, if applicable.	None

AIDEA AFA

1. Project Summary

1.a. Project Description

Engineering, deployment and testing of a grid-connected Pulse-Stream Hydro 12kW hydrokinetic generating machine at Igiugig from August 2012 – February 2014.

1.b. Project Eligibility

The project brings a new technology to Alaska for the first time. Pulse has been developing this technology – for both rivers and tidal sites - for over 10years and is currently building a commercial 3kW Pulse-Stream Hydro machine. This will be deployed and tested in the UK – reaching TRL 8 - before installing the Alaska machine. The deployment at Igiugig will be 12kW, representing a modest scaling up of the existing 3kW product, and deployment in significantly more challenging conditions – mainly higher flow-rates and very cold weather.

The project can therefore be considered to move the 12kW Pulse-Stream Hydro technology from TRL7 to TRL8 under Alaska conditions. And with success will lead to the 12kW machine being a permanently deployed TRL9 hydrokinetic power generator.

1.c. Project Innovation

The two most successful hydrokinetic projects in Alaska to date (at Eagle & Ruby) have used vertical axis turbines mounted on catamaran hulls. While these projects have achieved much, they encountered significant challenges, especially with the accumulation of debris onto the devices and their mooring arrangements.

Hera Energy has identified the Pulse-Stream oscillating hydrofoil hydrokinetic generator as a device that has been designed to address the issues identified at Eagle & Ruby, and has a developing track record of performance in the UK.

Pulse-Stream technology has been deployed in 2 forms to date – a 1kW Pulse-Stream Hydro generator was successfully installed in 2005, and a 100kW Pulse-Stream Tidal generator was installed in 2009. The image at right shows the tidal machine. The company is now manufacturing a commercial 3kW Pulse-Stream Hydro product for installation in the UK - which will demonstrate the hydro technology in a commercial deployment before the Alaska project begins with a larger machine.

The Pulse-Stream Hydro machine offers the following benefits & innovations

- Unique “oscillating hydrofoil” approach to power generation, which reduces the tendency to foul and allows operation in shallow water – where rivers flow fastest.
- Slow moving oscillating design with small in-water profile presents very limited risks to wildlife
- Single point mooring and integrated cable arrangement reduces fouling tendency
- Monohull design reduces fouling tendency
- Low cost of energy (25 - 40c/kWh initially, falling as deployment increases), enabled by simple design and installation approach



Pulse-Stream Hydro is being developed in the UK, and the company is seeking international markets. Hera Energy has established a distribution arrangement with Pulse Hydro to introduce the product to



PULSE-STREAM HYDROKINETIC POWER DEMONSTRATION IN IGIUGIG

the Alaskan market. By demonstrating the Pulse-Stream Hydro machine at Igiugig, Hera will be bringing a new, low cost and highly reliable hydrokinetic technology to Alaska, which has potential for deployment in many locations; providing reliable and affordable electricity to off-grid customers and communities.

1.d. Priority

The proposed project involves 2 Alaskan firms and the Igiugig Village Council directly, and potentially will also engage UAF. The Pulse-Stream Hydro machine will be built and supported in Alaska using local resources wherever possible.

Match funding is being provided by Pulse Hydro Ltd.

Igiugig is an excellent test site for the use of hydrokinetics to offset high fuel costs in remote communities. With success at Igiugig, Hera plans to deploy similar systems at remote villages across the state.

2. Technology Validation and Research Methodology

2.a. Objectives

The primary objective is to show that Pulse-Stream Hydro can generate power cost-effectively at Igiugig without damage to the environment. The elements of this demonstration include:

- 1 - reliable power generation through the seasons
- 2 – manufacture, transportation, installation and operating costs
- 3 – understanding of fish interactions and any other unexpected interactions with the environment

2.b. Methodology

The Kvichak River RISEC Project (KRRP), in Igiugig Alaska by the Igiugig Village Council (IVC), has accurately characterized the river at Igiugig and identified a number of locations suitable for hydrokinetic devices to be deployed.

From this study, Hera has identified a number of possible locations in the Kvichak River for deployment of the Pulse-Stream Hydro technology.

Project partner Igiugig Village Council has received a preliminary FERC permit for the site, and is developing the electrical infrastructure for connection of the Pulse-Stream machine. The KRRP will also have the necessary permits in place to allow for deployment of Pulse-Stream.

The Kvichak River has extensive data on fish, collected for the Alaska Department of Fish and Game (ADF&G). This data has been used by LGL Alaska Associates to develop the biological monitoring plan. Fish and other environmental interactions will be monitored and measured by LGL as directed by the KRRP and Hera Energy pursuant to the permit requirements.

Hera, working with Pulse Hydro, will manufacture, deliver, install and commission the 12kW generating machine in the Kvichak River. Once installed, the machine will operate for 2 months, allowing for initial tests and fish studies. It will then be removed, inspected and stored at Igiugig until Spring of 2013, when it will be deployed for extended testing after the ice break-up.

Pulse Hydro already has a good relationship with the University of Alaska, Fairbanks, and the CEO is a member of the AHERC Advisory Committee. Hera will aim to use these relationships to bring learning from other hydrokinetic projects into the development of the current project. UAF will be approached to become a project partner if the project moves to the Full Proposal stage.

The budgeted costs are recorded in section 3 below, and will be the basis for comparison during the project. Electricity production will be measured at the onshore metering point, and its correlation to flow-



PULSE-STREAM HYDROKINETIC POWER DEMONSTRATION IN IGIUGIG

rate, measured in the river, will be established in order to demonstrate the performance of the machine. Reliability data will be collected in order to establish accurate operating costs.

3. Summary of Project Schedule and Summary of Project Budget

The project schedule and budget is summarized below. The grant contribution is requested to support the installation and testing period for the device. Production testing takes place over one full season, with the machine removed during the first winter and the 2014 ice break-up period. It is assumed that re-installation after the 2014 break-up would be on a commercial basis and would not require further support. The decommissioning cost shown would only be required if the unit failed to deliver its objectives.

Project Task	Dates	Costs in \$,000		
		Cost	Match	Grant
Building and Operating 1kW & 100kW prototypes in UK (only a portion of the total cost is included here)	1/1/2004 - 10/31/11	292	292	-
Engineering, Manufacturing & Testing of 3kW Prototype in UK	11/1/2011 - 7/1/12	290	290	-
Engineering, Manufacturing and Installing 12kW Device at Igiugig	6/1/2012 - 8/15/12	213	113	100
Initial Operating Period - Monitoring, Maintenance	8/15/12 - 10/15/12	100	-	100
Fish Monitoring*	9/1/12 - 9/17/12	50	-	50
Removal, Inspection, Storage & Redeployment	10/15/12 - 4/15/13	100	-	100
Production test Operating Period	4/15/13 - 2/1/14	150	-	150
Fish Monitoring Studies*	4/15/13 - 2/1/14	100	-	100
Contingency Device De-commissioning cost	5/1/14	150	-	150
Totals		1,445	695	750

* These costs are included in case the KRRP does not have sufficient funds to undertake this work. If KRRP can cover these costs, they will be removed from the present project.

4. Project Team Qualifications

Hera Energy LLC

Will manage the manufacturing, deployment, installation & monitoring of the Pulse-Stream Hydro device in Alaska. Hera Energy is a new company created to deliver hydrokinetic electricity solutions to communities and businesses in Alaska. Hera staff have lived and worked in Alaska for over 30yr, and have built strong relationships with Alaskan companies to support the delivery of hydrokinetic projects.

Igiugig Village Council

Igiugig Village Council has an extensive infrastructure, including a 3,300-foot airport runway with AWOS and GPS approach. The community is barge-accessible for Anchorage/Kenai/Homer May through October via the Pile Bay/Williamsport Road, and across Lake Iliamna. The IVC and local residents own a 30' x 80' barge and multiple 450HP fishing boats capable of moving it. Power skiffs ranging from 18' to 24' and 80 to 150HP are available to assist in installation and operational support. IVC also owns Iliamna Lake Contractors, which has access to the lifting equipment required for installation of the hydrokinetic device.

Alaska Energy & Engineering Inc.

AE&E is an Alaska-owned, Anchorage-based firm incorporated in 1993 specifically to provide design and project management services for rural energy projects. AE&E has built its reputation on the ability to provide practical design solutions and construction support, and has fostered excellent working relationships with permitting and regulatory agencies. The primary fields of expertise are electric power generation and distribution, rural fuel storage and handling facilities, and energy systems integration.

Pulse Hydro Ltd.

Will provide the technology, and technical support for the Pulse-Stream Hydro device. Building on 10 years of experience with hydrokinetic devices, Pulse Hydro is a spin off from Pulse Tidal Ltd, which has



PULSE-STREAM HYDROKINETIC POWER DEMONSTRATION IN IGIUGIG

been operating a 100kW tidal hydrokinetic machine for 3yr in the UK. Pulse Hydro is currently manufacturing a 3kW Pulse-Stream Hydro device for deployment in the UK.

5. Discussion of Commercialization of Funded Technology

Pulse-Stream Hydro is designed to make hydro-power as accessible as solar and small wind. The market for wind and solar is well proven, with large-scale deployment underway in areas where the financial return is attractive for customers.

The current project is a vital step in demonstrating that Pulse-Stream Hydro can meet the reliability, cost and environmental targets required for it to be a financially attractive proposition. Igiugig is an excellent test site as it includes many of the challenges associated with deploying in remote communities in Alaska, but the river does not freeze over the winter and debris entrained in the water is limited. Success at Igiugig is therefore the first step for Pulse-Stream in Alaska, positioning the product to gradually access more and more challenging environments and hence a wider range of locations. Beyond Alaska, Pulse-Stream has significant potential in the wider US market – where EPRI estimates there is 12GW of potential power generation available from the largest rivers. This level of power generation would imply a market for 1,000,000 Pulse-Stream Hydro 12kW machines.

Early customers for Pulse-Stream Hydro include those paying high off-grid charges for electricity (villages such as Igiugig are an excellent example), as well as small businesses, and particularly farmers, in states where incentives are provided for renewable energy.

Over time, the cost of Pulse-Stream Hydro will fall through manufacturing efficiencies and learning, allowing the technology to compete in states without incentives, and addressing a wider cross-section of customers.

In parallel with the US activity, Pulse Hydro Ltd. is marketing its products in Europe and Asia, so that deployments in the US will benefit from experience accumulated elsewhere and costs will fall quickly.

6. Signed Applicant Certification

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

A handwritten signature in purple ink, appearing to read "Faith Warthen", written over a horizontal dashed line.

Faith Warthen
Director, Hera Energy LLC

7. Proof of Eligibility

Please see attached Alaska business license for Hera Energy LLC.

Alaska Entity #: 135389

State of Alaska
Department of Commerce, Community, and
Economic Development
Corporations, Business and Professional Licensing

CERTIFICATE
OF
ORGANIZATION
Limited Liability Company

THE UNDERSIGNED, as Commissioner of Commerce, Community, and Economic Development of the State of Alaska, hereby certifies that Articles of Organization duly signed and verified pursuant to the provisions of Alaska Statutes has been received in this office and have been found to conform to law.

ACCORDINGLY, the undersigned, as Commissioner of Commerce, Community, and Economic Development, and by virtue of the authority vested in me by law, hereby issues this certificate to

Hera Energy, LLC

and attaches hereto the original copy of the Articles of Organization for such certificate.



IN TESTIMONY WHEREOF, I execute this certificate and affix the Great Seal of the State of Alaska on **May 24, 2011**.

A handwritten signature in cursive script that reads "Susan Bell".

Susan Bell
Commissioner