



RIVGEN™ POWER SYSTEM COMMERCIALIZATION PROJECT – DEMONSTRATION PHASE

REQUEST FOR GRANT APPLICATIONS AEA-12-047

Prepared For

Alaska Energy Authority
813 West Northern Lights Blvd.
Anchorage, AK 99503

Submitted By

ORPC Alaska LLC
725 Christensen Dr., Suite 4A
Anchorage, AK 99501

Date: March 9, 2012

PARTNERS:

Native Village of Igiugig
Marsh Creek

TOTAL PROJECT COST: \$1,726,685
GRANT FUNDS REQUESTED: \$1,491,750
MATCH COMMITTED: \$234,935

Previous Project Titles/Application Numbers for Grants from the Renewable Energy Fund or Denali Commission Emerging Energy Technology Grant Program:

EETG: UAF 11-0017: Nenana, Alaska Hydrokinetic (RivGen™) Power System Phase I, \$830,325.

Previous Project Title for Abstract Submitted to the Emerging Energy Technology Fund:

AEA-11-027: Nenana RivGen™ Power Project: Integration Stage, \$750,000.

PROJECT MANAGER

Monty Worthington
Director, Project Development
ORPC Alaska
725 Christensen Dr., Suite 6
Anchorage, Alaska 99501
Tel: 901-388-8639
mworthington@orpc.co

ADMINISTRATIVE POINT OF CONTACT

Genetta McLean
Grants and Licensing Manager
Ocean Renewable Power Company
120 Exchange Street, Suite 508
Portland, Maine 04101
Tel: 207-221-0906
gmclean@orpc.co

AUTHORIZED SIGNATURE

Christopher R. Sauer
President & CEO
Ocean Renewable Power Company
120 Exchange Street, Suite 508
Portland, Maine 04101
Tel: 207-772-7707
csauer@orpc.co

A handwritten signature in blue ink, appearing to read "Chris Sauer", is written over a horizontal line.

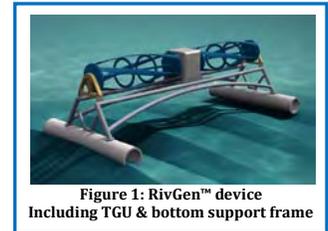
Signature of official authorized to obligate this proposal

1. Project Summary

a. Project Description The RivGen™ Power System Commercialization Project – Demonstration Phase (RivGen™ Project) will be carried out by ORPC Alaska, LLC, a wholly-owned subsidiary of Ocean Renewable Power Company, LLC (collectively, ORPC). ORPC develops breakthrough technology and eco-conscious projects that harness the power of the world’s oceans and rivers to generate clean, predictable, affordable energy.

ORPC technology consists of a family of modular power systems: the TidGen™ Power System, for use at shallow to medium-depth tidal sites; the OCGen™ Power System, for use at deep tidal and offshore ocean current sites; and the RivGen™ Power System, for use at river and estuary sites. The core technology component and “engine” for all ORPC power systems is the patented turbine generator unit (TGU). The zero-emission TGU uses proprietary advanced design cross flow (ADCF) turbines to power an underwater permanent magnet generator mounted at the TGU’s center on a single driveshaft. The ADCF turbines are built from composite materials that will not corrode. The TGU has a gearless, direct-drive design that requires no lubricants and so does not contaminate the surrounding water.

The RivGen™ Project will utilize ORPC’s RivGen™ Power System (Figure 1), a submersible hydrokinetic system designed for smaller river applications in water depths of 15 feet or more, including those in remote, off-grid communities. The RivGen™ Power System is comprised of three primary components: ORPC’s RivGen™ TGU, designed to fit fully assembled in a standard shipping container; a modular bottom support frame; power electronics; and underwater power and data cables. This project will be the first installation of ORPC technology in Alaska and is a crucial step in commercializing the technology for remote river sites, providing a new energy source for rural Alaskan communities.



The RivGen™ Project will be carried out in several distinct steps. First, an ORPC RivGen™ device, consisting of a RivGen™ TGU mounted on a bottom support frame, will be installed and tested in Cook Inlet near the town of Nikiski, Alaska, where tidal currents offer a “virtual river” testing environment. After this testing is complete, the RivGen™ device will be disassembled and shipped to the village of Igiugig, Alaska, unless it is determined that the device is not yet ready for remote deployment, or project permitting to be undertaken by the Native Village of Igiugig is not complete. In either of these cases, alternative locations for the power system demonstration will be considered. At Igiugig, the device will be installed in the Kvichak River, and fitted with power electronics and underwater power and data cables to shore, creating a complete RivGen™ Power System that will be connected to the village’s microgrid. The RivGen™ Power System will then be monitored and evaluated for performance for a period of 6-12 months. After this period, ORPC will disconnect the power system from the microgrid, remove it from the river site, disassemble it, and transport it to Nenana, Alaska for testing in the Tanana River.

b. Project Eligibility The RivGen™ Project qualifies as an eligible emerging energy technology demonstration project because it will test and demonstrate the RivGen™ Power System, an emerging energy technology that generates renewable electricity from river currents. This project will also be the first to install, operate and monitor a RivGen™ Power System in Alaska under limited clear-river conditions.

The RivGen™ Power System is currently at TRL 6 and will progress to TRL 8 through the project, as evidenced by the following factors: 1) The RivGen™ Power System is based on ORPC’s proprietary TGU, which has been proven technically and commercially viable in prototype and beta testing; 2) the RivGen™ TGU will be tested in March 2012 at ORPC’s research test site in Maine in a simulated operational environment prior to demonstration in Alaska; and 3) the RivGen™ Project will provide an opportunity to demonstrate the power system under actual deployment conditions by validating its performance in simulated river conditions and an actual but limited-condition river.

c. Project Innovation The RivGen™ Project will increase the RivGen™ Power System’s performance primarily by demonstrating its operability in a new range of conditions. Prior to this project, the RivGen™ TGU will have been validated only in a tidal current environment and in a surface-mounted configuration. During the project, the RivGen™ Power System will be validated by: 1) performing bottom-mounted RivGen™ device testing in a tidal environment; 2) deploying the RivGen™ device in a river; 3) deploying the RivGen™ Power System at a remote site; 4) interconnecting the power system with a diesel microgrid; and 5) successfully generating power and displacing diesel fuel using the RivGen™ Power System. During this project, the first data on RivGen™ Power system reliability, operating costs, and life span will also be collected. This data will inform future efforts to increase reliability, drive down capital, installation and operating costs, and increase the longevity of the RivGen™ Power System.

d. Priority The RivGen™ Project will be carried out by ORPC Alaska, a limited liability company located in Anchorage. ORPC Alaska is committed to partnering with local firms, including Marsh Creek, an Alaskan company jointly owned by Kaktovik Inupiat Corporation and SolstenXP, with offices in Anchorage, Deadhorse and Kaktovik, Alaska. The Native Village of Igiugig will be supplied renewable power and will provide project support through its wholly-owned utility, Igiugig Electric Company and other subcontractors such as Alaska Energy and Engineering (AEE), an Alaskan company with offices in Anchorage. ORPC will also provide the project with engineering and project management support.

Since 2008, ORPC has been working with the Alaska Hydrokinetic Energy Research Center (AHERC), based at the University of Alaska Fairbanks, to develop debris mitigation techniques that will enable RivGen™ Power Systems to be deployed in a wide array of Alaskan rivers and rivers around the world. ORPC is also working with AHERC on environmental aspects of the RivGen™ Power System. The RivGen™ Project is supported by \$234,935 in matching funds provided by ORPC.

The RivGen™ Project has the potential for widespread deployment in Alaska. To identify the most viable Alaskan sites for RivGen™ Power System deployment, ORPC has been working with the University of Alaska Anchorage (UAA) to assess the state's river resources. RivGen™ Power Systems will enhance the long-term viability of rural Alaskan communities with abundant river hydrokinetic resources by increasing the efficiency and reliability of their electrical generation systems, by lowering energy costs, and by contributing to local economic development through the growth of local river power projects.

2. Technology Validation and Research Methodology

a. Objectives

1. RivGen™ Device Testing

RivGen™ device testing will require the following logistical objectives, described in further detail below:

- Dry fit TGU and bottom support frame
- Deploy RivGen™ anchors
- Deploy RivGen™ bottom support frame with “dummy load” simulating RivGen™ TGU
- Assemble the RivGen™ device
- Deploy and test fully assembled RivGen™ device
- Remove device and mooring anchors

The RivGen™ device, comprised of the TGU and the bottom support frame, will be assembled, moored and tested at the Nikiski test site. After the bottom support frame is modified to accept the TGU chassis, the TGU and bottom support frame will be dry fit on land. To minimize risks to the TGU, the TGU will then be removed and a “dummy load” will be installed on the bottom support frame for initial testing. The mooring anchors will be deployed off of the Rig Tenders Dock in an area where the tidal currents create a “virtual river” environment during periods of peak flow. The bottom support frame and dummy load will then be attached to the moorings to test device deployment and retrieval. For deployment, the bottom support frame's buoyancy chambers will be flooded to sink it. For retrieval, water will be purged from these buoyancy chambers with compressed air to refloat the system. Once the field crew is satisfied with reliability and control of the deployment and retrieval operations, the bottom support frame will be returned to land and refitted with the TGU. These same tests will then be completed with the TGU attached, but locked out so that its turbines cannot rotate. RivGen™ device testing will be deemed complete when ORPC has validated the safe and effective deployment of the anchors, bottom support frame, and RivGen™ device during periods of high current at the Nikiski site, and is confident that these same operations can be completed at Igiugig in the Kvichak River with the equipment that will be available onsite. If ORPC does not attain this level of confidence, ORPC will consider alternative river locations with greater infrastructure support for power system demonstration before deploying the RivGen Power System at the remote Igiugig site. At the conclusion of testing, the RivGen™ device will be returned to shore and disassembled.

2. RivGen™ Power System Demonstration

The RivGen™ Power System demonstration will require the following logistical objectives, described in further detail below:

- Ship RivGen™ Power System components (packaging and intermodal shipping) to Igiugig
- Assemble RivGen™ device in Igiugig
- Install underwater power and data cables and on-shore power electronics
- Install anchors (verifying in-river anchor deployment)
- Install RivGen™ device in the Kvichak River
- Attach underwater power and data cables
- Activate device (perform systems check and begin monitoring and operations)

The RivGen™ Power System Demonstration will verify that all components of the RivGen™ Power System are suitable for remote deployments. This applies not only to the RivGen™ device and power electronics, but to equipment shipping procedures, power system operations, and microgrid integration.

Marsh Creek will pre-test the RivGen™ power electronics to ensure that they meet specifications, can reliably be connected to simulated diesel generation, and will interface properly with the RivGen™ TGU. After the RivGen™ device is satisfactorily tested, it will be disassembled and packaged for intermodal shipping. All power system components will then be shipped to Igiugig, first by land to Homer, then by sea to Williamsport, again by land to Pile Bay on Lake Iliamna, and finally across Lake Iliamna to Igiugig, where they will be unloaded and reassembled. This rigorous multi-leg journey will verify that the RivGen™ Power System can be shipped to remote locations, and be received and assembled at these sites.

The on-shore station, consisting of the power electronics housed in their shipping container (20' CONNEX), will be installed on site at Igiugig, interconnected to the Igiugig grid at a point of service provided by Igiugig Electric Company, and tested to ensure successful and safe interconnection. The anchors will then be installed in the Kvichak River at Igiugig and the RivGen™ device will be launched in the river, floated out to site and attached to the mooring system. Power and data cables will then be installed and attached both to the RivGen™ device and to the on-shore station; system checks will be performed to ensure control and monitoring of the system is functional. The RivGen™ device will then be lowered to the riverbed by flooding the buoyancy chambers in the bottom support frame. Once the RivGen™ device is safely and securely deployed, the RivGen™ Power System will be activated. The power system will subsequently operate for several months, over which time ORPC will collect data on system performance. The Native Village of Igiugig, through sub contractors including Alaska Energy and Engineering and LGL Alaska Research Associates, will oversee permitting for the demonstration including environmental monitoring, with a particular focus on interactions between fish and the RivGen™ device. After system operations have provided sufficient collected data, and before either maintenance is required or the lake ice-out begins (typically in May), the RivGen™ device will be removed from the water.

3. Continued Operations or Decommissioning

After initial testing and operations of the RivGen™ Power System are complete, ORPC will compile a report on the environmental compatibility and technical performance of the project, power produced, and the economics of RivGen™ operation. The project partners, including the Native Village of Igiugig, AEE, Marsh Creek, and ORPC, will then decide whether continued RivGen™ testing is prudent and if RivGen™ technology seems appropriate for long-term operation at Igiugig. Once all testing is deemed complete, ORPC will use the allocated funds to completely remove and decommission the RivGen™ Power System, and ship it to Nenana, where the next phase of commercialization will take place. This phase will validate the RivGen™ Power System's functionality in the Tanana River, where suspended sediment and debris loads complicate operations.

b. Methodology

1. RivGen™ Device Testing

Initial testing of the RivGen™ device will be completed at a site in Cook Inlet near Nikiski, Alaska. This site is adjacent to the Arctic Slope Regional Corporation Rig Tenders Dock, where ORPC tested the RivGen™ bottom support frame in 2011. This energy site was chosen because it offers a "virtual river" environment during peak currents combined with convenient periods of slack tide in which to tackle unexpected technical challenges. RivGen™ device testing will require the logistical objectives outlined in section 2.a.1 above. For each task, ORPC will document equipment requirements, the time required for each task, and lessons learned.

2. RivGen™ Power System Demonstration

ORPC will document that the RivGen™ Power System output and interconnection meet specified parameters and reliability requirements by dry testing the system with the assistance of Marsh Creek personnel and facilities. The remainder of the RivGen™ Power System testing will be performed at and en route to the Kvichak River at Igiugig, or at a surrogate site if it is deemed that initial RivGen™ device testing has not validated the system for remote deployment. The RivGen™ Power System demonstration will take place under actual deployment conditions, complete with remote logistical challenges, microgrid integration, and deployment in a robust Alaskan river environment. RivGen™ Power System demonstration will require the logistical objectives outlined in section 2.a.2 above. For each task, ORPC will document equipment requirements, the time required for each task, and lessons learned. During RivGen™ Power System operation, ORPC will also document 1) RivGen™ Power System output relative to river current velocities; 2) availability of the RivGen™ Power System; 3) cost of monitoring and operations; 4) cost of any required or unexpected inspection, maintenance or repair, and 5) actual delivered power to Igiugig grid.

During continued operation of the RivGen™ Power System, ORPC will document the real costs associated with monitoring, operations, inspection, maintenance and repairs to further refine the RivGen™ Power System's cost of power. The following instrumentation will be used throughout the RivGen™ Project to collect data on the associated metrics:

Instrument:	Data collected:
Current Meter	
Dual Axis Inclinometer	Provide real time attitude data on RivGen™ device
Accelerometers	Relative motion/vibration along driveline, bottom support frame
Load Cells	Strain and loading on anchors and moorings
Power Electronics	Data log power output and quality, availability, efficiency

3. Summary of Project Schedule and Summary of Project Budget

Milestone	Completion Date	EETF Funding	ORPC cost share	Total Cost
1) RivGen™ device testing	11/1/12	\$524,750	\$31,631	\$556,381
2) RivGen™ Power System installation	7/1/13	\$425,000	\$59,054	\$484,054
3) RivGen™ Power System operation	5/1/14	\$319,000	\$121,470	\$440,470
4) RivGen™ Power System removal	7/1/14	\$223,000	\$22,781	\$245,781
Totals		\$1,491,750	\$234,935	\$1,726,685

4. Project Team Qualifications

Ryan Tyler, Project Engineer, manages ORPC's commercialization of the RivGen™ Power System and works in Maine and Alaska. He has previously worked as a researcher for the Alaska Hydrokinetic Energy Research Center. Monty Worthington, Director of Alaska Project Development, has over 10 years of experience designing, implementing, and maintaining renewable energy systems in Alaska, the West Coast, and Asia. He assumes oversight of the RivGen™ Project, including permitting and development. Douglas Johnson, Development Director, has over 30 years of business development experience in Alaska. He is responsible for developing present and future opportunities for the RivGen™ Power System.

5. Discussion of Commercialization of Funded Technology

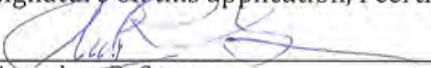
The RivGen™ Project is ORPC's first step in commercializing the RivGen™ Power System. ORPC is beginning the initial phase of commercialization with deployment in the less technically challenging clear river environment of the Kvichak and will progress to "fouled" river environments (rivers fouled with debris and/or sediment) over the next four years. ORPC anticipates that fouled river applications will be installed and will reach full commercialization within five years.

Worldwide target markets for ORPC's RivGen™ Power Systems are in remote locations, and include existing coastal power grids and off-grid coastal, island, and riverside communities. Customers will include public and municipal electric utility companies, public power districts, the military, communities, and developers of hydrokinetic projects. Markets in Alaska include rural energy markets, typified by remote communities with isolated microgrids on large glacial rivers and their estuaries or on coastal tidal sites, and the Railbelt Grid. The RivGen™ Project's initial customer will be the Native Village of Iguigig.

ORPC estimates that RivGen™ Power System projects could provide the rural Alaskan energy market with 10% of its needed energy. ORPC's work on site assessment with UAA will enable the company to more accurately identify the size of the market, through ORPC's ongoing RivGen™ market research project. As international markets develop, the sales of RivGen™ Power Systems to isolated circumpolar, island, and river communities throughout the world are difficult to predict, but since 1.5 billion people currently lack electricity in areas not yet connected to central power grids, the potential market is tremendous.

6. Signed Applicant Certification

By signature on this application, I certify our compliance with the amount of matching funds being offered.



 Christopher R. Sauer
 President & CEO
 Ocean Renewable Power Company, LLC