Dillingham Tidal Hydrokinetic Project

Abstract submitted to:
AEA
Emerging Energy Technology Fund Program

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Partners
ABS Alaskan Inc., City of Dillingham, Nushagak Electric and Telephone Cooperative, Bristol Bay Economic Development Corporation, and New Energy Corp

Total Project Cost: $1,041,787
Grant funds requested: $749,561
Match committed: $292,226

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Dillingham Tidal Hydrokinetic Project

1. Project Description

a) The fishing communities of rural Alaska have an urgent need for renewable power into improve seafood products, this generally means electricity for chilling seafood at the site were the food is caught. The University of Alaska Fairbanks (UAF) Bristol Bay Campus (BBC) in cooperation with UAF School of Fisheries and Ocean Science (SFOS), City of Dillingham (CoD), Nushagak Electrical and Telephone Coop (NETC), Bristol Bay Economic Development Corp (BBEDC), ABS Alaskan, and New Energy Corporation (NEC) proposes to assess hydrokinetic potential of Snag Point in Nushagak Bay, AK. The Dillingham Tidal Hydrokinetic Project will deploy a 25kW rated low-flow *EnCurrent* hydrokinetic turbine system in Nushagak Bay at the confluence of the Nushagak and Wood Rivers. The hydrokinetic turbine manufactured by NEC will be similar to that deployed in Eagle, AK during 2010. The floating turbine support pontoon structure designed by ABS will be similar to that used in Eagle. Adaptations for this project include a more robust design with debris mitigation and to accommodate the tidal marine-estuarine environment requirements. This is planned as a three year project. All power generatede in this project will be used by the CoD's ice plant to produce lower cost ice for the Nushagak fishing fleet.

b. Project Eligibility:

UAF as an Alaskan postsecondary institution, the CoD, NETC and BBEDC are all eligible to apply for this grant under the AEA's rules (AS 42.45.375(c)(1-3), 3 AAC 107.715). The primary applicant is the UAF Bristol Bay Campus – and the UAF Office of Sponsored Programs has reviewed and endorsed this project.

c. Project Innovation

This project meets U.S. Department of Energy's Technology Readiness Level (TRL) 7 in that the hydrokinetic technology platform to be studies has been tested as a prototype system (for a river system) and has been successfully deployed in Alaskan river environments. Testing this unit in tidal setting represents a major step up in the technology's demonstrated readiness.

NEC *EnCurrent Turbines* have been successfully tests on the Yukon River from 2008-2010 in Ruby and 2010 in Eagle, AK showing it to be mechanically and electrically viable in Alaskan river environments. Past projects made significant progress understanding and developing anchoring, deployment, and operating protocols. In Eagle, on-site fish impact monitoring by UAF during 2010 and an EPRI flume study[2] indicate a limited impact of these systems on fish populations. However, there is a need for more work on this as well as the development of effective debris management strategies. Functionally the *EnCurrent Turbine* system has demonstrated itself to be a commercially viable product. However, the system has not been tested in a tidal, marine/estuarine environment. While there are similarities between the river and the tidal operation, there are also additional operational challenges that need to be assessed.

d. Priority

This project meets the priority requirements as UAF (both BBC and SFOF) is an Alaskan institution. The project is partnering with other Alaskan organizations including BBEDC, CoD and NETC. Further this project is contributing matching and in-kind funds worth $292,226. Finally the project has potential for widespread deployment across the state where there are sufficient tidal or river currents.

2. Technology Validation & Research Methodology

a. Objectives

Hydrokinetic energy has been identified as a potential alternative energy source for rural Alaska,[1,3]. This project will test a hydrokinetic system and investigate the potential cost-benefit and simple pay-back period. The minimum current required is typically1–2 m/s[1] At Snag Point UAF BBC has measured tidal currents in excess of 3m/s with averages between 1 and 2 m/s.

As of 2012, there have been no projects using the *EnCurrent Turbin*e in a tidal marine/estuarine environment. This project will fill that need. While still subject to the river high water debris conditions found farther inland, the turbine system will also encounter (with the except of salinity) the full range of issues inherent in a tidal marine application – significantly broadening the range of operating conditions the turbine system is subjected. System component costs are defined and largely driven by economy of scale –

as more systems are deployed, costs should decrease. System deployment, operation, maintenance, and retrieval costs are significantly impacted by the development and refinement of the anchoring, deployment and retrieval, and system operation methodologies. This project directly addresses those issues, resulting in increased performance and reliability.

b. Methodology

Key project technology issues and objectives to be addressed:

i) Operational

Develop and monitor the following for the hydrokinetic power generation system

- developing efficient and cost effective deployment and retrieval processes for tidal hydrokinetic system
- monitoring and assessment of magnitude and potential impact of subsurface debris
- management of surface debris – both ebbing and flooding tides
- anchoring the system in a bi-directional flow with up to 9 m water column depth changes
- maintaining system operation (stable turbine alignment) in light to moderate wind and wave conditions
- system protection during storms with high winds and up to 2.5m seas
- effect of the tidal environment on the submerged portion of the power cable
- effect of flex stressing on the barge structure
- turbine performance with the velocity variability of the tidal action – particularly self starting
- impact of the system on water craft activity

ii) Environmental

Monitor interactions of the hydrokinetic power generation system with the following. Tools used include high resolution sonar and Acoustic Doppler Current Profiler:

- Fish populations – the estuary off Snag Point supports all five species of Pacific salmon,- other abundant species includes starry flounder, Dolly Varden, and sculpins
- Marine mammals – the primary the Beluga whale (Nushagak Bay has been identified as a calving area), but also spotted seals.
- Debris monitoring - monitor surface debris as well as use of sonar to monitor submerged debris
- Water column velocity, flow direction, and column depth data, one on the platform and the other will be used to make transacts in search of other high current velocity sites.

iii) Economic

- Further analysis of the hydrokinetic resource potential for the project site. While some ADCP water column velocity and direction data has been collected for the past three years and has been sufficient to demonstrate regular flow velocities achieving the maximum turbine rating of 2.4 m/s, the data is not sufficient to make an accurate assessment of commercial potential for the site
- Metering of the outgoing power.

3. Summary of Project Schedule and Summary of Project Budget

In this three year project starting September 2012 and ending February 2015, the first year aims are to identify/acquire permits, defining operational issues, define estuarine environmental impacts, and develop monitoring methodologies. The summers of year two and three will involve operation of the hydrokinetic system, conducting its environmental impacts and monitoring its performance. The three year program will allow for hydrokinetic resource assessment so that modifications to either the system operation or monitoring can be made as necessary The Year two and three operating season is anticipated to be June 1 to Oct 1. The final year will see Final Project administration and performance analysis/reports

YEAR ONE - 2012

- Permits applications and site analysis (Sept-Dec 2012)
- Turbine/barge/Power building system acquirement and design (Oct 2012-Mar 2013)

YEAR TWO & THREE (2013-2014)

- Acquire necessary permits (Apr 2013)
- System design and transport Fairbanks-Dillingham (May 2013)
- Interconnect electrical (Sept 2012) and System assembly (Aug-Sept 2013)

- System assembly and deployment (June-2013)
- System operation (Jun-Oct 2013-14 – summer months)
- System retrieval (Oct 2013 and 2014)
- Project administration and performance analysis/reports Feb 2014
- System review and modifications (Jan-May 2014)
- Systems dismantle and return shipping to Anchorage (Oct-Nov, 2014)

YEAR Four (2015)

- Final Project administration and performance analysis/reports Feb 2015

Table 1. Project Schedule and Summary of Project Budget

Milestone or Task	EET funds	Matching funds	Match Source	TOTALS
Pre-Deployment				
1. Project scoping and contractor solicitation completed	0	0		0
2. Site control verified	0	1,000	UAF BBC	$1,000
3. Permitting obtained	15,296	1,544	ABS	$16,840
4. Balance of pre-deploy complete	17,500	12,320	ABS	$29,820
First year lease system payment	62,000	0		$62,000
4. Final design and construction completed	83,000	11,890	NETC	$94,890
Deployment and Research				
1. Deployment (delivery and installation)	77,000	32,758	ABS, CoD	$109,758
2. Technology validation and research plan			BBEDC, BBC	$0
a. Project monitoring activities	190,572	156,061	UAF SFOS	$346,633
b. Project improvement activities	0	0		$0
3. 2013 Operations complete, system stored	55,000	29,555	ABS, CoD	$84,555
Final 1 year lease payment	30,000	0		$30,000
4. 2013 Year end - plans undated, reports submitted	4,800	3,200	ABS	$8,000
5. Systems Modifications/2013deployment	38,000	9,898	ABS	$47,898
First year 2 leased system payment	33,000			$33,000
6. 2013 operations completed, system stored	52,434	30,800	ABS, CoD	$83,234
Second year 2 leased system payment	33,000	0		$33,000
Post -Deployment				
4. Final decommissioning of system complete	4,800	3,200	ABS	$8,000
5. Final performance report(s)	2,500			$2,500
6. Analysis and Recommendations	2,500			$2,500
UAF Facilities and Administration 25% MTDC	48,159			$48,159
TOTALS	**$749,561**	**$292,226**		**$1,041,787**
Budget Categories				
Direct Labor & Benefits	108,168	130,061		238,229
Travel & Per Diem	6,604			6,604
Equipment	58,000			58,000
Materials & Supplies	12,000			12,000
Contractual Services	516,630	147,165		663,795
Other (Commodities , equp rental)		15,000		15,000
UAF Facilities and Administration 25% MTDC	48,159			48,159
TOTALS	**749,561**	**292,226**		**1,041,787**

4. Project Team Qualifications

Project team members

- Dr. Todd Radenbaugh – Assistant Professor Environmental Science UAF BBC
- Dr. Mark Johnson – Professor Oceanography and Marine Science UAF SFOS
- Jim Norman – Owner ABS Alaskan
- Mike Megley – CEO Nushagak Electric and Telephone Cooperative:
- Jody Seitz– City Planner City of Dillingham
- Jean Barrett– Harbor Master City of Dillingham
- Bob Moll – President New Energy Corporation:

5. Discussion of Commercialization of Funded Technology

- Fishing industry: The potential of reduced dependence on diesel, lower energy costs as well as increased energy security are significant public benefits. Further, there is a potential for slush ice barges that provide a clean and inexhaustible source of power to the fishing industry. Every fishing boat in the district could have access to this power. More ice capacity in the region should allow higher fish prices for fishermen and stimulate business to produce more value added seafood products. The use renewable hydrokinetic energy to power an ice barge will help put the region on a path toward economic and environment sustainability.
- Hydrokinetic (even tidal) is more predictable and much more stable and consistent.
- Potential Market Size: There are multiple potential markets for the hydrokinetic technology this project demonstrates including: Municipal power generation villages and cities that are on the coast or villages. In Bristol Bay alone there are over 15 towns and villages that use over 10.5 MW of energy and potentially benefit from this technology. Further, across coastal Alaska there is an immense need for slush ice and refrigeration to improve the fish products. This technology could be used to power fish processing plants. Moreover tidal currents could be used to power barges that produces slush ice or flash freezing for the fishing fleet.

6. Signed Applicant Certification (sec. 4.6)

E. Proof of Eligibility

UAF as an Alaskan postsecondary institution, the CoD, NETC and BBEDC are all eligible to apply for this grant under the AEA's rules (RFA AEA-11-027 section 1.10). The primary applicant is the UAF Bristol Bay Campus – and the UAF Office of Sponsored Programs will review and endorse this project. "*By signature on this application, I certify that we are complying and will comply with the amount of matching funds being offered.*"

Andrew Parkerson-Gray
Director, Office of Sponsored Programs
Authorized Organizational Representative