ADVANCE CONTRACT AWARD NOTICE (ACAN)

1. Title

Modeling River Hydrokinetic Turbine Arrays to Optimize Energy Extraction

2. Advance Contract Award Notice (ACAN)

An ACAN is a public notice indicating to the supplier community that a department or agency intends to award a contract for goods, services or construction to a pre-identified supplier, thereby allowing other suppliers to signal their interest in bidding, by submitting a statement of capabilities. If no supplier submits a statement of capabilities that meets the requirements set out in the ACAN, on or before the closing date stated in the ACAN, the contracting officer may then proceed with the award to the pre-identified supplier.

3. Definition of Requirements

Natural Resources Canada (NRCan), under the Energy Innovation Program, is undertaking Research and Development (R&D) activities that aim to develop guidelines for river hydrokinetic energy (RHE) turbines array configurations and energy extraction optimization.

Deploying multiple turbines in an array is a natural choice for RHE developers to achieve the economy of scale and a good business return. In order to evaluate the performance of each individual turbine in the turbine arrays as well as to optimize power generation from turbine arrays, there is a need to understand the turbine's configuration, spacing, as well as turbine-river interactions. Presently very limited work has been done in this area due to the infancy of the RHE sector and the technical challenges related to the complex flow features between turbines and rivers.

Numerical method is an effective approach to study large scale turbine arrays. However, simulating multiple turbines with detailed modeling of the full turbine's geometry presents an enormous technical challenge in terms of computing resource and time required. Therefore simplified turbine arrays modeling tools that only require affordable computing resource becomes critical.

Mavi Innovations Inc., University Laval, Lambda2 and NRC carried out a turbine arrays study in 2015-2016. The study was funded as part of Marine Renewables Canada EcoEII project. The study identified simplified modeling methods (Effective Turbine Model) for simulating RHE turbine arrays. Overall, the simplified models match the simulation results with full turbine geometry. However, further improvements on the robustness and the accuracy of the models still need to be implemented. More research is also required to further develop simplified turbine models that can replicate other phenomena for turbine array configuration and spacing, such as the wake behind the turbines. In addition, as the model developed is based on the cross-flow type of turbines, there is a need to develop a simplified model for the horizontal axial-flow type of turbines as well. Once a modeling methodology is in place for both turbine types, the simplified models could become an effective tool for studying power generation of multiple rows of turbines deployed along a stretch of river. The present contract is to address this modeling gap.

4. Tasks, Deliverables, Milestones and Schedule

Task 1: Develop simplified turbine models for both cross-flow and axial-flow turbines

This task includes firstly the development of a simplified **cross-flow** turbine model for emulating the wake behind a real turbine, which can be used to determine the turbine's spacing; and secondly, the development of a simplified **axial-flow horizontal** turbine model for emulating the drag, power and the wake behind a real axial-flow horizontal turbine in addition to the cross-flow type turbine.

2D and 3D Computational Fluid Dynamics (CFD) simulations for turbines will be performed to calculate the torque and drag over a range of tip speed ratios that cover the full operating range of turbines. This will create the performance curves that will be used to tune the simplified turbine models. In addition, these detailed turbine simulations will be used to characterize the wake in order to develop an approach to wake modeling using the simplified turbine models.

Task 2: Perform a numerical case study to model the flow in the man-made channel at the Canadian Hydrokinetic Turbine Test Center (CHTTC)

This task includes updating the geometric model of the man-made channel at CHTTC based on a bathymetry data recently collected at the CHTTC by University of Manitoba researchers. Mavi's original model used under the work for Marine Renewable Canada had to assume vertical channel sidewalls due to lack of bathymetry data. In October 2016, the CHTTC research team used sonar along the channel banks to measure the near shore geometry.

This task also includes the implementation of a free surface condition in the numerical model to calculate the impact of the turbine array on upstream and downstream water elevations along the channel – factors needed to be taken into account by the RHE developers.

Simulation results will be validated by using the flow measurement carried out at CHTTC.

Task 3: Perform RHE turbines array modeling for the man-made channel at CHTTC to determine the most effective turbine layout to maximize power extraction over a pre-define stretch of river.

This task is to model various configurations of turbine arrays in order to understand how best to space turbines. This work is based on the models developed in Task 1 and Task 2. A range of (at least 3) basic layouts of turbines deployed in multiple rows (in line and staggered configurations) along the specified length of the river will be evaluated; and this task is also to identify the most effective RHE turbine array layout for the following two cases: (a) Fixed total project rated capacity; (b) Maximum power extraction at CHTTC.

Task 4: Develop an approach that industry can use to develop real projects and prepare the final report

This task includes the development of an approach/guideline that industry can use to develop real turbine arrays projects that may either be constrained by available grid capacity at the interconnection point or power requirements of the local community (case (a) in Task 3), or the projects may be constrained by the usable river length (case (b) in Task 3) that may be governed by physical constraints such as depth and river speed.

At the completion of this project, a final report covering all modeling work and the approach/guideline will be provided to NRCan. NRCan reserves the right to make all results and reports available internally and to the public.

Tasks		Deliverables/Milestones	Time Schedule
Task 1	Develop simplified turbine models for both cross-flow and axial-flow turbines	Simplified cross-flow turbine model(s) developed to match real turbine wake; Simplified horizontal axial-flow turbine model(s) developed to match real turbine performance and wake; Interim summary report on the modeling work.	March 20, 2017
Task 2	Perform a numerical case study to model the flow in the man-made channel at CHTTC	Geometric model of the CHTTC channel, and CFD numerical model including free surface feature ready developed; CFD simulation (including free-surface features) results for CHTTC channel, and results comparison with the flow measurement; Interim summary report on modeling work and model validation.	March 20, 2017
Task 3	Perform RHE turbines array modeling for the man-made channel at CHTTC to determine the most effective turbine layout	Simulation results for at least three turbine arrays configurations. Simulation results for two scenarios: Fixed total project rated capacity; and Maximum power extraction at CHTTC. Interim summary report on simulation results.	November 20, 2017
Task 4	Develop an approach/guideline that industry can use to develop real projects and prepare the final report	An approach/guideline that industry can use for real array project. Final report describing the modeling work under this project and method to calculate total extractable energy, and turbine array configuration approach/guideline.	March 15, 2018

5. Criteria for Assessment of the Statement of Capabilities

Any interested supplier must demonstrate by way of a statement of capabilities that it meets the recognized standard (certification) associated with this particular program by satisfying the following criteria:

- The Contractor must have a minimum of five (5) years of experience testing, evaluating and validating Computational Fluid Dynamics (CFD) models for river hydrokinetic turbines applications

- The Contractor must have a minimum of five (5) years of experience undertaking river flow modeling
- The Contractor must have a minimum five of (5) years of experience developing river hydrokinetic turbine technologies
- The Contractor must have developed and validated the Effective Turbine Models for river hydrokinetic turbine array applications
- The Contractor must have access to the river bathymetry and flow measurement data from CHTTC for modeling and model validation
- The Contractor must own, operate or have access to IT infrastructure, having at least two hundred (200) computer cores
- The Contractor must have a minimum of five (5) years of experience in developing codes and standards on IEC-TC114: Marine energy - wave, tidal and other water current converters

6. Trade Agreements

No trade agreements apply to this requirement.

7. Set-aside under the Procurement Strategy for Aboriginal Business

Not applicable

8. Comprehensive Land Claims Agreement(s)

Not applicable

9. Justification for the Pre-Identified Supplier

We intend to deal directly with the supplier mentioned in section 10 below as it is the only known supplier that meets the mandatory criteria set out in section 5 above.

Should Canada receive a statement of capabilities from a supplier that contains sufficient information to indicate that it meets the requirements set forth in this ACAN, a competitive process will be triggered with a technical and financial evaluation methodology of the bids proposed by the potential bidders.

10. Exception to the Government Contracts Regulations

The following exception to the Government Contracts Regulations (GCR) is invoked for this procurement under subsection – (d) only one person or firm is capable of performing the contract.

The identified provider, Mavi Innovations Inc., is the only one able to meet all of the criteria identified in Section 5 above.

11. Exclusions and/or Limited Tendering Reasons

Not applicable

12. Ownership of Intellectual Property

Ownership of any Foreground Intellectual Property arising out of the proposed contract will vest with Canada.

SACC Manual clause 4007 – Canada to Own Intellectual Property Rights in Foreground Information (2010-08-16).

13. Contract Period

The contract period is from the date of Contract to March 31, 2018 inclusive.

14. Estimated Cost

The estimated maximum value of the contract is $71,190.00 CAD inclusive.

15. Name and Address of the Proposed Contractor

Mavi Innovations Inc.
Suite 127-887 Great Northern Way
Vancouver, BC V5T 4T5

16. Suppliers' right to submit a Statement of Capabilities

Suppliers who consider themselves fully qualified and available to provide the services/goods described herein, may submit a Statement of Capabilities in writing, preferably by e-mail, to the contact person identified in this Notice on or before the closing date and time of this Notice. The Statement of Capabilities must clearly demonstrate how the supplier meets the advertised requirements.

17. Closing Date

Closing Date: January 6, 2016
Closing Time: 2:00 p.m. EDT

18. Contract Authority

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Contracting Officer
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