TEN REASONS WHY A TIDAL BARRAGE IS BETTER THAN CURRENT DRIVEN DEVICES (20.July.2009)

Why do we need to develop Half-Moon Cove as a tidal barrage if Ocean Renewable Power Corporation (ORPC) will eventually generate electricity from tidal currents?

I have often been confronted with this question because most people believe that the use of hydro-kinetic devices is the clean, renewable method for harnessing the tides. ORPC is a company which has received a great deal of positive feedback from the press and local residents for its efforts in Eastport. In theory, the option of just using tidal currents is appealing since it does not seem to pose the same problems associated with the construction of a visible barrage. Both approaches use a renewable resource for the production of electricity without emissions or a pollution stream and both would displace a considerable amount of fossil fuel. The unique resource of Cobscook Bay and Passamaquoddy Bay refers to the rise and fall of the tides which average around eighteen (18) feet. The currents of the region are a consequence of the tides within a sculptured underwater geology and are highly dependent on the natural tidal cycle.

In trying to gain support for the proposed Half-Moon Cove barrage, a need exists to point out the differences between the two proposals in order to establish a level playing field. Once again, I support the development of all sources of electricity from renewable sources, but the Half-Moon Cove barrage is a better choice for meeting the region's energy and economic development goals. The following arguments are presented from an obviously biased engineer / scientist who welcomes a fair and comprehensive debate on the merits of the two forms of tidal energy generation. Physically, the two projects are compatible; however, conceptually, the inherent objectives and mechanisms are drastically different as outlined below.

1. EXISTING TECHNOLOGY VS. PROTOTYPE CONCEPTS

Modern tidal barrages date back more than fifty years and historical tidal mills which used dams for improving efficiency were in existence centuries ago. Turbines and electrical generation equipment for tidal barrages are available off-the-shelf and have a well documented research and development history. In the case of hydro-kinetic units, many designs and concepts exist which are being developed and tested at different sites. The only hydro-kinetic model which has received in-water testing and common acceptance is a propeller type unit which resembles most conventional wind turbines.

Half-Moon Cove will utilize existing technology for the basic electrical generating equipment. Recent developments in other fields of renewable energy will be applied to a highly refined design at Half-Moon Cove. ORPC has proposed a unique design and is still in the development phase for research and design. ORPC resorted to a wooden blade during a recent investigation of in-water testing of a prototype unit. ORPC is still working on an improved design without fully addressing other engineering features; e.g., mooring.

2. COMMUNITY FOUNDATION VS. CORPORATE INFRASTRUCTURE

Tidewalker Associates, the proponents for Half-Moon Cove, wish to engage local communities into the planning for the project with the hopes of having the local communities actively share in the benefits of the project. Most associates of Tidewalker have lived in the Eastport area and have long commitments to regional economic development. Tidewalker is not driven by corporate economics and has undertaken the project on the premise that it is the best use of a local resource.

ORPC is a corporate entity with similar proposals in Maine, Florida, and Alaska. The prime objective for ORPC is to develop a patented unit for mass production in Eastport and at other sites which include rivers. The corporate objective is aimed at placing as many units as possible at many different sites which are deemed both economically and environmentally feasible. The profit motive is embodied in the return on investment for ORPC. It will be noted later that ORPC proposes the installation of several hundred megawatts of their units in Cobscook Bay in order to meet long-term corporate objectives. In essence, ORPC is using tidal waters off Eastport to develop a unit for countless installations world-wide if the units are proven cost effective and capable of receiving regulatory and stakeholder acceptance.

3. SWEAT EQUITY VS. TAXPAYER GRANTS

Tidewalker Associates has invested their own time and effort to develop the Half-Moon Cove project. It has not received grants from the Maine Technology Institute (MTI) or other organizations to develop equipment and to test and develop prototype units. Our efforts have been placed on formulating plans which optimize production while incorporating community development objectives. Tidewalker Associates filed a pre-license application with the Federal Energy Regulatory Commission (FERC) in March 2009 as the first step in receiving project approval. During the two years since receiving a FERC preliminary permit, Tidewalker has revised plans in order to make the project more economically feasible and environmentally acceptable. The work performed during this period has a market value of between $500,000 to $1,000,000 which has been absorbed by the staff of Tidewalker Associates without placing a burden on taxpayers.

ORPC has received nearly two million dollars of State of Maine grants to develop a unit with limited applicability in the coastal waters of Cobscook Bay due to the presence of complex tidal currents which have been described as being “chaotic”. The presence of the “Old Sow” between Eastport and Deer Island characterizes the nature of multi-directional tidal currents of Passamaquoddy Bay. If ORPC had not received MTI support, would ORPC be trying to refine their design in Eastport waters? This is a valid question when viewed in terms of limited resources and from an emerging industry which is still struggling under a mix of development obstacles. If Tidewalker Associates had received millions in the form of institutional support, the Half-Moon Cove project might have received the recognition that it deserves.

4. STEADY PRODUCTION VS. VARIABLE OUTPUT

A tidal barrage operates effectively by controlling the elevation difference (i.e., head) across both sides of the barrage. Mathematically, the energy produced by creating a potential difference is directly proportional to hydraulic head which will range from five feet to approximately eight feet for the Half-Moon Cove Tidal Power Barrage. Production during neap tide conditions will be less than under spring tide conditions due to the reduction in the amount of available tidal waters; however, the ability to control head will result in a relatively minor differential between plant output during neap and spring tide conditions. Half-Moon Cove is being designed to allow production during both the ebbing and flooding tide. Production is also predictable due to the periodic nature of the tidal function. During a twelve hour tidal cycle, production will range from 6-8 hours depending on the presence of either neap or spring tide conditions.

Hydro-kinetic devices derive their energy from tidal currents from water rushing into stationary turbines as opposed to a tidal barrage which funnels available flow towards generating units. Since hydro-kinetic devices have to be spaced fixed distances apart to prevent interference, these units only utilize currents within a well defined, cylindrical volume of influence. From physics, the amount of energy derived from current driven devices is directly proportional to velocity to the third power which emphasizes the importance of velocity in selecting a site. For example, by selecting a site with an average velocity of two knots versus a site with a one knot profile, eight times more energy will be derived from the two knot site.

ORPC states that one megawatt (MW) of power could be derived from their stacked units under a six knot current. A one megawatt array is approximately 80 feet wide and 50 feet tall. A six knot current is not a common event which undoubtedly occurs during a spring tide for a very short period of time. When the current drops to three knots, the energy derived decreases by a factor of eight and the effective capacity drops from 1,000 kilowatts (kW) down to approximately 125 kW. On an average, peak current velocity is typically fifty percent less under neap tide than spring tide conditions which also translates into an eight fold decrease in energy generation. For these reasons, production from hydro-kinetic devices are highly variable due to the natural tidal cycle operating under fluctuating neap tide and spring tide conditions.

In order to produce the same amount electricity as Half-Moon Cove, four hundred hydro-kinetic devices with a diameter of sixteen feet would be needed to replace the output from our tidal barrage. The area needed to place 400 hydro-kinetic devices would extend for several square miles.

5. ENGINEERING EFFICIENCY VS. HIT-OR-MISS

Equipment efficiency for low-head hydro-electric facilities approach ninety (90) percent and are designed to take advantage of available water flow. A tidal barrage depends on an extremely predictable tidal function which further optimizes design specifications. The fact that a major tidal barrage has operated effectively in France more than forty

years re-enforces the argument for hydro-electric efficiency and dependability. South Korea is in the process of completing the construction of a 500 mW tidal barrage with plans to construct two more facilities within the next few years. England, China, and Russia are all considering the construction of a tidal barrage at sites with substantial tidal ranges.

The theoretical efficiency of hydro-kinetic turbines is around forty percent. Shrouds and other velocity enhancement devices are being developed with some limited success; however, the critical engineering feature is the relationship between energy production and velocity cubed. For a tidal environment, the reduction in velocity for neap tides is a major concern in selecting an installed capacity for hydro-kinetic devices a which attempts to weigh the differences in plant output for a selected design which attempts to maximize output will controlling the cost of generating equipment. In essence, a tidal barrage generates potential energy to enhance production; whereas, a hydro-kinetic device is totally dependent on the available current which varies considerably during the twelve hour tide cycle and during the two week lunar cycle.

6. SPIN-OFF MERITS VS. TAKE-HOME PHILOSOPHY

Half-Moon Cove has been designed with a consideration of the project's indirect benefits. Attracting tourists, establishing a second access route, utilizing tidal electricity within the local region, and expanding recreational and aquaculture potential are some of the indirect benefits associated with the tidal barrage. The possible breaching of the causeway between Pleasant Point and Carlow Island is a project with mutual benefits to Tidewalker and the local communities as a restoration project. In any event, Tidewalker is committed to fully exploring the community development benefits related to the construction and operation of the Half-Moon Cove tidal power barrage.

On the other hand, ORPC has provided some local employment and commerce by utilizing Maine Technology Institute funds to test and develop their prototype unit in Eastport. ORPC has indicated that they would like to fabricate (not, manufacture) their turbines in Eastport as a way to create employment opportunities once technical and economic feasibility has been demonstrated through research and development efforts. The operation and maintenance requirements for hydro-kinetic devices are much more extensive than a tidal barrage and will result in relatively more employment opportunities. ORPC has estimated up to two hundred arrays in Cobscook Bay which would require major expenditures for the transmission of electricity. The ORPC philosophy is primarily based on creating income to take-home to the corporate home.

7. LOCAL IMPLICATIONS VS. MARKET SHARE

Tidewalker Associates are focused on Half-Moon Cove as a singular site for energy production and economic development. The size and scope of the project is compatible with the local needs of the region. Tidewalker has expressed their intentions to only develop Half-Moon Cove as a way to balance renewable energy production with local demands of Cobscook Bay resources.

ORPC has a corporate philosophy to develop a hydro-kinetic for wide scale implementation in Cobscook Bay, in the United States, and in the global economy. If ORPC successfully demonstrate their technology, they will attempt to secure a substantial percentage of the world market share at both tidal and fresh water sites. In assessing, the benefits of a two hundred megawatt facility in Cobscook Bay, ORPC will have to address conflicts associated with a distorted utilization of local resources.

8. LONG-TERM YEARS VS. SHORT-TERM

Half-Moon Cove will have an estimated lifetime of approximately fifty years as demonstrated by the success at LaRance and other hydro-electric facilities. The cost of operation & maintenance and interim replacement will comprise a small percentage of the annual cost of operation of Half-Moon Cove. This feature of the tidal barrage illustrates the near inflation proof nature of a pure form of renewable energy development. The progressive attractiveness of Half-Moon Cove electricity serves as a stabilization element in regional economic development and in ensuring a reliable source of clean electricity for future generations.

The lifetime of hydro-kinetic devices is difficult to estimate due to the undeveloped nature of industry. As previously, the annual cost for ORPC is comprised of a significant expenditure for operation & maintenance, uncertainty on equipment lifetime, transmission cost related to a major hydro-kinetic farm, and availability of financing for a major project. Except for short-term grants gained through taxpayer grants, ORPC is unable to estimate future gains until economic and technical feasibility has been demonstrated through a rigorous R&D program.

9. BENIGN FOOTPRINT VS. IMPOSING ASPIRATIONS

The footprint of the Half-Moon Cove project is limited to the entrance to the tidal basin. The operation of the project will result in a slight increase in the low water level of the impoundment. Tidewalker believes that these impacts are not significant and will not adversely indigenous resources. For example, scallops and urchins will be virtually unaffected by the modifications and divers / small draggers will be able to harvest commercial species. Once again, Tidewalker is committed to working with the local communities to optimize local benefits and to secure a stable source of energy.

ORPC has a stated objectives to develop several hundred megawatts of tidal power in Cobscook Bay. ORPC as a profit making entity is committed to maximizing profits and secure a significant portion of the global market. There success will depend on being to demonstrate technical and economic feasibility.

10. LOCAL DEVELOPMENT VS. RESOURCE EXPLOITATION

The differences between Tidewalker and ORPC have been detailed in the previous paragraphs. Tidewalker has limited development to Half-Moon Cove while emphasizing

the community development aspect of the project and has performed this work without taxpayer dollars. ORPC has a global objective from a corporate perspective and has depended heavily on taxpayer dollars to consider Eastport as a potential site. Tidewalker has investigates hydro-kinetic devices while concluding that this is not the best use for Half-Moon Cove resources. The ORPC model is highly dependent on massive expansion and development of a design which does not seem particularly well suited to the dynamic waters of Cobscook Bay and Passamaquoddy Bay.

Normand Laberge, PhD, P.E.

Tidewalker Engineering / Trescott, Maine / Tidewalker46@gmail.com