Pre Feasibility study for Electricity Generation using Ocean Currents In Kirinda Area (Little Basses and Great Basses)

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1 Introduction

In the Sri Lankan context of Ocean Energy arena, there were few attempts made in the History and the reason past to harness the ocean energy in the form of electricity using ocean Waves, Ocean thermal and Tides. Even though the out comes of these attempts were successful They have not played a significant role by giving economically exploitable outcomes. Ocean currents Carry vast amount of energy which can be harnessed by rotating a turbine. Technology of harnessing ocean current energy has evolved rapidly during last few decades and when looking in to global arena number of major companies developed their own technologies including Blue Energy Canada, London Turbines Limited UK, and Florida hydro cooperation. Those companies have developed technologies capable of producing energy from highly dense slow moving currents having speeds range between 2~5 knots.

Kirinda (southern coast of Sri Lanka North east to Hambantota) is very Famous for experiencing strong ocean current Fields. Data in the Admiralty charts and maps (map no .) stated that in some seasons There were currents having speeds up to about 6 knots. Little more further fishermen's in this area have had experiences of severe currents between little Basses and Great Basses Submarine reefs during inter monsoon seasons.

By observing the global energy producing scenarios of ocean currents and the local availability of bathymetry conditions and current speeds we saw a huge power potential in the vicinity of Great Basses and Little Basses. Harnessing the energy from these open-ocean currents requires the use of turbine-driven generators anchored in place in the current stream. Large turbine blades would be driven by the moving water, just as windmill blades are moved by the wind; these blades could be used to turn the generators and to harness the energy of the water flow. By considering the formulaWater currents offer an analogous energy resource to wind; kinetic energy of the moving fluid can similarly by extracted and applied by using a suitable type of turbine rotor. The power available from a stream of water is

$$P = \tfrac{1}{2} c_p \rho A V^3$$

..where ρ is the density of water(1040 Kg/m^3), A is the cross-sectional area of the rotor and V is the free-stream velocity of the current.

The consequence of this "cube law" relationship is that power and hence energy capture are highly sensitive to velocity. This is clearly indicated in Table 1 showing power density

Velocity(m/s)	1	1.5	2	2.5	3
Velocity(knot)	1.9	2.9	3.9	4.9	5.8
Power Density(kW/m^2)	0.52	1.74	4.12	8.05	13.91

Table 1 – Power density variation with velocity

The ocean current has extremely high energy density, low operating cost, zero greenhouse gas emissions and low ecological impact. The key advantage that distinguish ocean currents as a significant and attractive new source of energy is high energy density

Seawater is 832 times as dense as air; therefore ***the kinetic energy available from a 5 knot ocean current is equivalent to a wind velocity of 270 km/h.*** An array of Davis Hydro Turbines can produce approximately 180 times more power than wind or solar technologies in a comparable area

Since the technologies involved with extracting power from currents are at the developing stage there are only few companies who have published their designs. Among them London turbines limited, Florida hydro Cooperation and Blue Energy Inc. have three different types of turbine Designs applicable to different current velocities and environments. The open centred turbine design (fig. 1) by Florida hydro specially designed for slow moving currents have installed in the Gulf stream.

Figure 1 Open centred turbine(courtesy of Florida hydro)

London Turbines limited has developed a turbine just like the normal wind turbine (fig 2) suitable for tidal current applications and it is also expected to develop to the ocean current environments too.

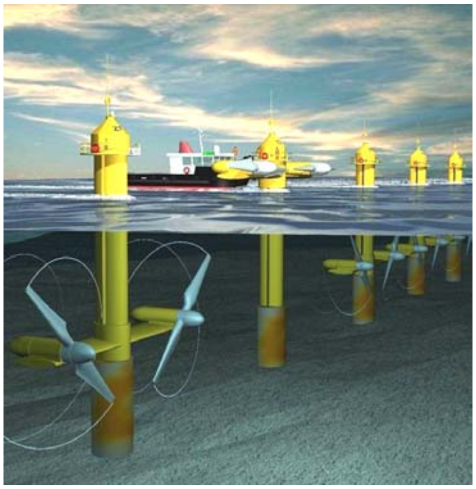

Figure 2. Ocean current turbine
(Courtesy: London turbines limited)

Currently Blue energy cooperation Canada dealing with tidal current applications using their Devis Hydro turbine. Blue energy also going to expand their application in to the slow moving ocean currents which carry vast amount of energy.

How we did

Our study mainly focused on the power generation potential of ocean currents in the Kirinda area by studying the available technologies and required conditions .Then we gathered the existing data records and past data specially Admiralty charts ,Floating buoys data and Ship drift data, In order to have the basic idea of current patterns and relationship with monsoons(north east and south west monsoon).

There are two basic scenarios causes the strong currents between the two reefs (Great basses and Little Basses)

- Currents due to tidal effect and wind friction
- Ocean currents due to thermal effects

The results obtained using MIKE 21 for the simulations of tidal and wind driven currents(fig ,Table) shows a significant component Which must be further enhanced by the addition of thermal current component.