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REVIEW ARTICLE

TIDAL ENERGY- A SOURCE OF CLEAN ENERGY

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ABSTRACT

Tidal power, also called tidal energy, is a form of hydropower that converts the energy of tides into electricity or other useful forms of power. The ocean, covering 70% of the Earth's surface, produces a vast amount of mechanical energy in the form of tides and waves. Tidal power has the potential for future electricity generation. Tidal power is a major growth area, with a global potential up to 100GW installed capacity. As non-renewable energy sources such as coal, oil etc., are being tapped out, new and innovative ways of creating energy of our needs being explored. The extraction and use of fossil fuels are causing many environmental problems of the world, such as climate change, the ozone layer destruction and so forth. The combustion of fossil fuels created an excess of carbon dioxide, an acceptable power generation technology must be mechanically sound, environmentally acceptable, and economically profitable in order to become a real alternative for builders of new capacity. So, renewable energy is the only solution in order to meet up the future crisis. Solar, wind, hydal, wave, tidal, geothermal, biomass, fuel cell etc., are the renewable energy sources. Among them tidal energy is an old but efficient method. Tidal power is classified as a renewable energy source, because tides are caused by the orbital mechanics of the solar system and are considered inexhaustible within a human timeframe. Energy from tidal power is also a form of pollution free energy, which has a lot of potential. Tidal power may be an alternative solution to meet up recent power crisis. Given proper care in design, siiting, deployment, operation and maintenance, ocean wave and tidal power could be one of the most environmentally benign electricity generation technologies yet developed.

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INTRODUCTION

Tidal energy is a form of kinetic energy. The word 'kinetic' comes from the Greek word for 'movement', indicating that tidal energy is all about generating energy from movement. Tidal energy means energy that derives from the earth's tides. Tidal energy, as its name suggests, is the energy that harnesses the power of the tidal movements of water. By harnessing this tidal power, tidal energy can generate electricity. Tidal stream systems make use of the kinetic energy of moving water to power turbines, in a similar way to windmills that use moving air. This method is gaining in popularity because of the lower cost and lower ecological impact compared to barrages Although tidal and wave energy both come from the ocean, there is a distinction between the two forms of technology in both how it is captured and how it is produced. The tide is created by the gravitational effect of the sun and the moon on the earth causing cyclical movement of the seas. Being fully predictable renewable energy source, tidal power has potential to contribute significantly to future energy mix of many countries wanting to benefit from renewable, low-carbon forms of electricity generation. As a renewable energy source, ocean energy has the advantage of reducing society's dependence on fossil fuels. It is a clean source of energy – it produces no liquid or solid pollution – and free beyond initial capital cost and maintenance. Most of the developing countries and industries are still totally relying on the conventional energy resources that are coal, oil and gas. Excessive uses of conventional energy resources are harmful for health of living things, environment and ozone layer. Clean renewable energy is the best alternative to avoid further deterioration of the earth's environment. Hydro power, Wind, Solar and Ocean energy are some of the most common sources of clean renewable energies (Desmukh and Amithkumar, 2015). Energy is a prime factor for economic growth, social and industrial development of a country. The role of new and renewable energy sources has been increasing significantly in recent years due to growing energy demand with minimum environmental impact. Renewable Energy Sources (RES) are clean, safe, easy to maintain and sustainable method of generating power. Renewable energy sources such as wind, solar, biomass and SHP are getting greater recognition in meeting the day-to-day energy requirements for captive power of domestic,

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commercial and industrial sectors (Singh *et al.,* 2009). Tidal current turbines are devices which convert kinetic energy of tidal currents in to mechanical energy and finally generate electricity. These turbines are designed in such a way that it can generate electricity during both flood current and ebb current. Tidal current turbines can be classified according to the direction of flow of tidal current passing over the turbine are as i) Horizontal axis tidal current turbine (HATCT) ii) Vertical axis tidal current turbine (VATCT) (Desmukh and Amithkumar, 2015)

Power generation from renewable energy includes:

Grid-interactive renewable power (Wind Power, Biomass Power, Hydro Power, and Solar Power) India has one of the largest programs in the renewable energy covering wide spectrum of resources such as wind, solar, biomass, SHP, etc.

A. Wind Power

Wind power program is the highly successful in India's and occupies the fourth position in the world having wind power (Pilli, 2006; Singh *et al*., 2009)

B. Biomass Power

The main conversion process for power generation from biomass is thermo chemical or biochemical (Ministry of New and Renewable Energy, Government of India. [Online])

C. Hydro Power

The small hydropower projects can play a critical role in improving the overall energy scenario of the country and in particular for remote and inaccessible areas (Annual Report 2007-08, Ministry of New and Renewable Energy, Government of India. [Online] and Singh *et al.,* 2009).

D. Solar Power

India receives solar energy equivalent to over 5,000 trillion kWh per year. The daily average solar energy incident varies from 4-7 kWh per square meter depending upon the location. The annual average global solar radiation on horizontal surface, incident over India is about 5.5 kWh per square meter per day. (Annual Report 2007-08, Ministry of New and Renewable Energy, Government of India [Online] and Singh *et al.,* 2009).

TIDAL ENERGY

Tides are the result of the interaction of the gravity of the sun, earth, and moon. The rise and fall of the tides – in some cases more than 12 m – creates potential energy (Ruud Kempener and Frank Neumann, 2014). Tidal energy can be utilized mainly in three forms Potential energy, wave energy and tidal current energy. Tidal barrages have been used for many years to utilize tidal energy in the form of potential energy to generate electrical energy with the help of turbines. There are two types of tidal barrages – single basin tidal barrages and double basin tidal barrages (Desmukh and Amithkumar, 2015). There are three types of tidal energy technologies. The first category tidal range technologies, the second category tidal current or tidal stream technologies, and the final category hybrid applications.

Tidal Range Technology

The first tidal barrage was completed in the Rance River in north-western France (Brittany) in 1966, but due to plans for greater use of nuclear energy, the further pursuit of tidal energy was abandoned. Between 1966 and 2011, a number of small tidal plants were built in countries such as Canada, China (Lu *et al.,* 2010), Iran (Gorji-Bandpy, Azimi and Jouya, 2013) and Russia, where tidal energy resource is abundant (International Energy Agency implementing agreement on Ocean Energy Systems (IEA-OES), 2014). Tidal range technologies harvest the potential energy created by the difference in head between ebb tide and flood tide. Such resources exist in locations where due to geological and ecological conditions, large water masses flow into compounded areas or bays and estuaries (Ruud Kempener and Frank Neumann, 2014).

Tidal Current Technologies

Tidal current or tidal stream technologies convert the kinetic energy into useable energy. Three main categories are there in Tidal Current Technologies

i) Horizontal-axis axial and vertical-axis cross flow turbines.
ii) Reciprocating devices
iii) Rotating screw-like devices and tidal kites that carry turbines below their wings.

Hybrid applications

The hybrid applications are forms of tidal range technologies that have great potential if their design and deployment can be combined with the planning and design of new infrastructure for coastal zones. There are plans for a hybrid form of tidal range and current power generation called 'dynamic tidal power'.

Hybrid Forms

Hybrid forms of tidal energy can be found in the form of multi-purpose platforms where both tidal current and tidal range technologies are used for electricity generation. These platforms are in an early developmental and innovative stage. A recent development is called "dynamic tidal power" (DTP). It consists of a 30-60 kilometer (km) long dam that runs perpendicular to the coast line. At the end of the dam, there is a barrier forming a large "T" shape. The dam interferes with the oscillating tidal waves on either side of the dam, and creates a height difference between the water levels. This height difference creates potential energy, which can be converted into electricity using the low-head turbines that are being used in tidal ranges (Ruud Kempener and Frank Neumann, 2014).

Advantages of Tidal Energy:

1. Tidal energy is a cleaner and safer form of energy generation.
2. It is a natural form of energy which harnesses the power of the earth's natural resources and is a reliable source of energy.
3. It is a sustainable energy source and it is an energy efficient.
4. The electrical energy generated by the tides can be stored for future use.

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Disadvantages of Tidal Energy:

1. The Tidal energy sources cannot be easily transported for long distances.
2. Energy can be produced within short time periods and Energy generation can get disrupted by extreme weather events.
4. Tidal power can disrupt the habitats of plants, fish, water birds and water mammals.
5. Tidal energy is only suitable for communities that live within easy reach of a tidal body of water.

Future Prospects

- The tidal range and current energy are highly predictable with daily, bi-weekly, biannual and even annual cycles over a longer time span of a number of years.
- Tidal stream is slightly more affected by the weather, but the fluctuations in the long run are lower than, for example, wind and solar.
- The tidal stream energy is that the impact upon the landscape in the coastal zones is relatively small.

Conclusion

The tidal energy is a clean, green, renewable and efficient way of generating energy for communities that live close to tidal bodies of water. Tidal energy is promising, predictable and very clean source of energy. There is abundance of potential sites which need to be explored world over for setting up of tidal current turbines. India has huge potential for producing power from Renewable Energy Sources (RES). At present the contribution of renewable energy is small, but future developments might make RES technology more competitive to displace conventional energy sources. The strategy for achieving these enhanced goals will mainly depend on the active participation of all players i.e. from government agencies to NGO's, from manufactures to R&D institutions, from financial institution to developers and of course a new breed of energy entrepreneurs.

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