POTENTIAL OF WAVE ENERGY POWER PLANTS ALONG MAHARASHTRA COAST

SUDHIR KUMAR
Maharashtra Energy Development Agency
191-A, MHADA Commercial Complex,
Yerawada, PUNE - 411 006, INDIA.
Tel.No. :020-683633/4, Fax : 683631
E-Mail : inetmeda@giaspn01.vsnl.in
Website : http://www.mahaurja.com

ABSTRACT

Sea waves are the result of transfer of mechanical energy of wind to wave energy. The wave quality varies for different periods and seasons. It is possible to have a realistic formula to calculate the overall wave energy potential. A general study of the wave nature has shown that there is potential of 40,000 MW along the Indian Coast. Similar study along the coast of Maharashtra State has shown that there are some potential sites such as Vengurla rocks, Malvan rocks, Redi, Pawas, Ratnagiri and Girye which have the average annual wave energy potential of 5 to 8 kW/m and monsoon potential of 15 to 20 kW/m. Considering this, the total potential along the 720 KM stretch of Maharashtra Coast is approximately 500 MW for wave energy power plants. Fortunately, after the decades of research and development activities all over the world, now some technologies are available commercially. Taking advantage of the situation, we need to exploit the possibility of the wave energy power plants at the identified sites by inviting the proposals from private investors / promoters / technology providers from all over the world. Approximately, they attract the private investment to the tune of Rs. 3000 crores. The Govt. of Maharashtra and Govt. of India, plans to announce the policies to attract private investors in this field on BOO (build own operate) basis.

1.0 INTRODUCTION :

The thermal gradient created in atmosphere due to solar energy, creates the wind energy. The blow of wind on sea surface transfers the mechanical energy of wind to sea water and the waves are generated. Seawaves are originated at mid of sea and water acts like conveyor belt through which the waves travel to the coast line in the form of breakers as seen on most of the sea beaches. If this wave thrust is utilised to generate energy, it can solve the energy crisis of this world. Maharashtra has the coastal line of 85 Kms. and it has good wave potential which needs to be exploited through suitable technologies. In fact, the technology of power generation through wave energy has been tried mostly in European Countries. Many of the plants have been reported to be successful. In India, this programme is still under developmental stage. Some of the plants have been run commercially abroad and as a result, there are some organisations ready to supply the technology on commercial basis. It is worth exploring the possibility of involving the private parties to take up such projects by providing them infrastructural facilities and other governmental supports. A suitable policy also needs to be announced by the State and Central Governments. Some sites have been already identified by a study carried out by Centre for Earth Science Studies, Thiruvananthapuram, under the aegis of Maharashtra Energy Development Agency (MEDA). The present paper is devoted to explain the further possibilities in this

direction. If materialised, such projects will be definitely supporting the industrial development of Konkan Region.

2.0 ENERGY POTENTIAL OF SEA WAVES :

Wave energy is in fact the storage of mechanical energy of wind in the sea water. Sea waves are variable in nature and their height and width changes with time and season. The available power in a sea wave is expressed as the following formula :-

$P = 0.55 H^2_s T_z$ kW per metre length of wave crest.

where H_s = average of one-third of the highest waves in metre

T_z = zero crossing period in seconds.

That means a significant wave height of 3 mtr. with a zero crossing period of six seconds will have the wave power of 29.7 kW per metre length of the wave crest.

The average potential along the Indian coast is around 5 to 10 kW /m. Indian has a coast land approximately 7500 Km. Thus the total potential is 40,000 MW approximately. Even 15% utilisation of the above potential would mean the availability of approximately 6000 MW. As per the wave data collected along the Indian coast, generally it has been observed that the western coast is more useful than that of Eastern Coast. This is because the western coast has more stable waves and is less vulnerable to cyclones which can damage the power plant.

3.0 AVAILABLE TECHNOLOGIES :-

World over many types of technologies have been tried way back since seventies, they are :-

(a) Cockerel Raft

(b) Flexible Bag energy Converter

(c) Submerged circular cylinder converter

(d) Clamp Wave Energy Converter

(e) Oscillating water column Converter

(f) Ocean Swell Powered Renewable Energy Converter

Out of these, the oscillating water column converter (OWC) has been found to be more dominant due to its simplicity and adaptability to use the existing coastal structure of sea harbours. The OWC system consists of a chamber in the sea exposed to wave action through an entrance at the bottom or on the side. The air inside the chamber gets pressurised or expanded owing to the wave action. Air movement through a small opening from or into the chamber, depending on the pressure inside, is used to drive an air turbine. This technology has been even tried at Vizhinjam along the Kerala coast near Thiruvananthapuram by National Institute of Ocean Technology, Chennai.(150 kW).

4.0 STATUS IN MAHARASHTRA :-

Maharashtra Energy Development Agency (MEDA) sponsored a study on finding out wave energy potential along the Maharashtra coast. This study was completed by Centre for Earth Science

Studies, Thiruvananthapuram, in the year 1994. Their study has shown that the Maharashtra coast has the annual wave potential ranging between 4 to 8 kW per metre of the length of the wave crest. In the Monsoon season i.e. from June to August, the potential is quite high i.e. 12 to 20 kW/m. The wave energy potential of the most feasible selected sites in Maharashtra are given in the following Table :-

Table - 1: Wave power at selected sites along Maharashtra coast

OFF SHORE			**COASTAL**		
Avg.Wave Power kW/m			Avg.Wave Power kW/m		
Site	Annual	(Jun-August)	Site	Annual	(Jun-August)
Vengurla Rock	8.01	20.61	**Girye**	5.90	14.21
Square Rock	6.79	16.64	**Vijaydurg**	5.86	13.58
Redi	6.35	16.57	**Ambolgarh**	5.74	13.48
Malvan Rock	6.91	16.73	**Kunkeshwar**	5.64	13.35
Kura Inset	5.79	13.74	**Pawas Point**	5.36	13.10
			Wagapur	5.70	13.10

Based on the results available the Maharashtra coast can be divided in to three zones :-

Zone I	Redi-Jaigarh	High power
Zone II	Jaigarh-Arnala	Medium power
Zone III	Arnala-Deheri	Low power

The general studies of all the sites shows the following trend :-

(A) Offshore locations:

Among the five offshore islands/rocks examined the Vengurla rocks or Burnt islands provides maximum power. Incidentally, this is the location with maximum power in Maharashtra. Here an annual average of 8.01 kW/m and a seasonal (June-August) average of 20.61 kW/m were obtained. The corresponding seasonal averages for Square rock, Malvan rock and Kura islet are 16.64, 16.73 and 13.44 kW/m respectively. The 10 m depth at Redi is at a distance of more than one kilometre from the shore and hence considered as an offshore location. Redi provided a corresponding power value of 16.57 kW/m.

(B) Coastal Locations:

The coastal locations in this sector provide an annual wave power in the range 4.17 to 5.90 kW/m For June to August the values are mainly between 9.00 and 14.21 kW/m. The highest values are seen near Girye (14.21), followed by Vijaydurg, (13.58), Ambolgarh (13.48) Kunkeshwar (13.35), Wagapur point (13.10), etc.

However, just having the wave potential data is not sufficient. For the selection of suitable site for the wave power plant, the following criteria needs to be examined to determine the cost operation and utility of wave power development :

a. Power availability

b. Proximity of shore to deeper waters,
c. Availability of electrical infrastructure,
d. Requirement of power at the location
e. Other technical and civil infrastructures

After applying the above criteria, the **Vengurla** and **Malvan rocks** and **Redi** are on the top among the offshore locations. In the other group **Pawas** and **Ratnagiri** top the list followed by **Girye** and **Miyet point**.

Considering that Maharashtra has the length of coastal area of 720 Km. and annual average of wave potential 6.0 kW/m, the total potential along the Maharashtra coast for the wave energy power plant is around 4000 MW. After applying the selection criteria, only 10- 12 % of the potential can be practically utilised which turns out to be practical potential of 500 MW.

5.0 IMPLEMENTATION STRATEGY:-

It is obvious from the above discussion that, Maharashtra has reasonably good potential for wave energy power plants. However, the average wave energy is comparatively less than the best potential sites in the world such as in Europe (30 to 40 kW/m). Therefore, it appears that small scale and decentralised power plants will be more suitable in the present case. The Govt. of Maharashtra may provide infrastructural facilities such as land, power for construction, power evacuation system at the site etc., to the private parties interested to run such projects on BUILD, OWN & OPERATE (BOO) basis. We propose to advertise the invitation for the proposal on wave power plant from private investors / promoters / technology providers from all over the world. Cost of such project is expected to be approximately Rs.6 Crores per MW which is slightly higher than the power plants based on conventional fuels. This can attract the private investment to the tune of Rs. 3000 crores. To make such proposals more attractive, the Govt. of Maharashtra and Govt. of India plans announce attractive policies for private investors especially for providing fiscal/financial incentives, power purchase guarantee at attractive rate, wheeling and banking facility, third party sale etc.

6.0 CONCLUSION :

It is obvious from the above discussions, that the Maharashtra coast has an average potential for exploiting wave energy power plant. Especially the decentralised of power plants of small scale will be more suitable to solve the local power problem. The power industry and other industrial development due to locally available power will help in the growth and employment generation in the coastal area. Such projects need to be taken up on priority basis since they will effect a development without any harm to local environment. Organisations having successful technologies and strong financial back-up need to contact M.E.D.A. at Pune.

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