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ESTIMATION OF ELECTRICITY GENERATED FROM TIDAL ENERGY IN BEDONO VILLAGE OF DEMAK REGENCY

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Abstract:

In some places in the village of Bedono Demak Regency there is a location with high tidal current velocity, the coordinates of the Location is 6 ° 55'29.0 "S 110 ° 29'11.4" E. In this study estimated the amount of electric power that can be generated from tidal currents in the village Bedono. Estimates are made by modeling the location and the Darrieus turbine using the CFD (Computating Fluid Dinamyc) Software. From the research that has been done to get the results of electric power that can be produced in the village Bedono highest at 14-16 times 3469.413W and lowest 39.002W at 22-24 hours according to the CFD is the highest active power occurred at 14-16 at 3197.064W and the lowest 35.941W at 22-24 hours.

Keywords: *Tidal Current; CFD; Electric Power.*

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1. Introduction

Bedono Village, Sayung Sub-district Demak Regency is one of the abrasion affected villages on the north Coast of Java Island, from Bappeda data of Demak Regency, an area of 582.8 ha for five years is submerged by sea water and then lost [(2]. In this village the rate of land subsidence is fast due to abrasion and rising sea levels. Tidal current cycle occurs 2 times every 24 hours so many houses and fish ponds are submerged and damaged. Tidal currents are very damaging to the ecosystem and the condition of the area. On the other hand the tidal currents that occur potentially generate electricity in that area, since at certain locations have high tidal currents, among others, at the mouth of the river mouth, one of which is used for this research with coordinates of Location 6 ° 55'29.0 "S 110 ° 29'11.4" E as shown in Figure 1.

Figure 1: Research Sites

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Conversion of ocean current energy has a similarity to the wind energy conversion but with some differences between the two. The placement of an underwater energy turbine provides advantages such as noise that does not disturb the public, smaller land use but challenges such as knowledge of technology for seawater resistance, difficulty with maintenance and high cost of work. This study predicts the possibility of construction of tidal power generators for the purposes of the Bedono village community by modeling river estuaries and turbines. Using Computating Fuid Dynamic (CFD) software.

Angular in Froude's momentum theory, the blades are assumed to be the actuator disks that arise bypassing the discontinuity of the field pressure of the propeller. for mechanical power is written down $P = \frac{1}{2} m.(V_a)^2 = \frac{1}{2} \rho.A.(V_a)^3$ According to the law of maximal power betz limits capable of being captured by a turbine is proportional to the aerodynamic coofisen of the turbine blade of 0.59 $P_{Max} = \frac{8}{27}.\rho.A.(V^3)$ according to Guidelines for Design of Wind Turbines - DNV / Risø gearbox loss (mechanical efficiency) at full load ranges from 0.95 to 0.97. While the loss loss generator and other electrical system at full load (electrical effeiciency) ranged from 0.97 - 0.98 sehingga $P = \frac{8}{27}.\eta_{elc}.\eta_{mec}.\rho.A.(V^3)$ by: m = mass flow rate (kg/s), P = kinetic energy (Watt), ρ = Density fluid (kg / m3), A = Area of rotor blade (m2), V = Uninterrupted fluid velocity (m/s), ηmec = mechanical efficiency ηelc = electrical efficiency. As for the calculation of efficiency is the ratio of power produced turbine to total power Hydrolis and maximum power (betz limits η CFD Against Betz limits $\eta = \frac{P_{CFD}}{P_{max}}.100\%$ medium η CFD Against Total hydraulic power is written down $\eta = \frac{P_{CFD}}{P_t}.100\%$. The impact of wave overflow, especially in coastal areas will reduce the accuracy of this tool. To overcome this it is necessary to observe with a longer trajectory, so that the wave effect becomes a minimum due to the averaging process. Current Drouge Type of Screen Sensor uses screens that can be fabricated from ordinary fabrics as current sensors, parasitic fabrics as well as plastic sheets [1 2 5)] .

2. Materials and Methods

The research location is located under the bridge of the river bedono estuary, here there are three sides of the bridge with measured current velocity, from the measurement of the current velocity measurement, and this location is very potential to be developed as a powerhouse of ocean current power. The research environment data is as follows Water depth ± 5 meters, bridge length ± 28 meters, gravity pressure 9.8 m / s, sea water weight 1025 kg /m2 .1)

The simulation will use the darrieus type H turbine, this turbine will be simulated at the average current velocity of the location. The use of the Darrieus type H turbine in this simulation is because the darrieus turbine has many advantages such as not taking into account the direction of the flow due to its symmetry, the gravitational pressure cannot reverse in the form of the sheath, able to operate on the head and low speed, while the weakness is the inability to perform self - starting, and high vibration 7). The working principle of Darrieus turbine is due to the velocity of the water flow causing the blades to rotate with a certain rotational speed, then the resultant of the speed will produce a hydrodynamic force. In this study Specification model of darrieus

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turbine, Diameter 1m, Chord length 0,1m, length of turbine 1 m, Solidity Ratio 0,6, amount of blade 3, Type of blade Hydrofill naca 0018 [2 3 4)] as shown in figure 2.

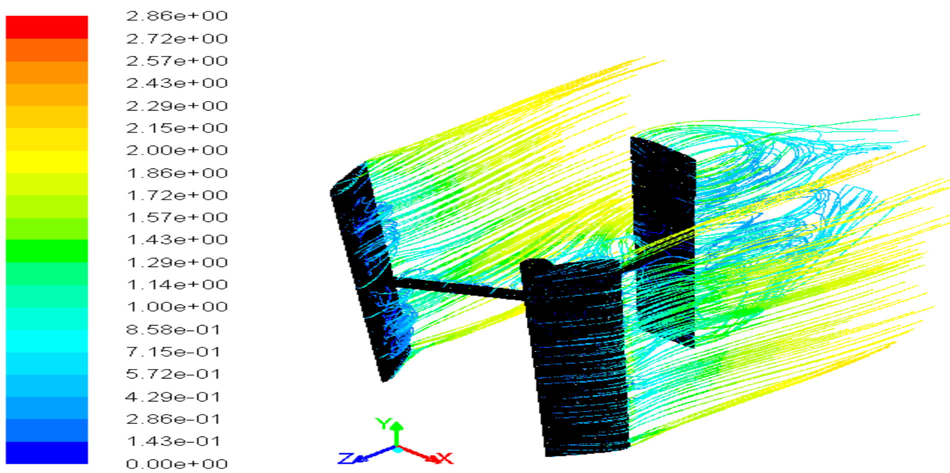

Figure 2: Simulation of Darrieus Turbine [1)]

3. Results and Discussions

The CFD simulation results are then used to calculate the simulated power of CFD, Betz Limits and Active Power. Complete results are presented in Table 1.

Table 1: Observation Results and Speed Calculation Current and Power

Measurement Hour	Average Velocity (m/s)	CFD Power (WATT)	Betz limits Power (WATT)	Active Power (WATT)
08.00 - 10.00	1.407	657.190	845.325	605.601
10.00 - 12.00	1.757	1245.600	1646.335	1147.820
12.00 - 14.00	2.133	2180.281	2948.671	2009.128
14.00 - 16.00	2.500	3469.413	4745.370	3197.064
16.00 - 18.00	0.540	42.121	47.822	38.814
18.00 - 20.00	0.770	118.707	138.651	109.389
20.00 - 22.00	1.070	306.956	372.050	282.860
22.00 - 24.00	0.530	39.002	45.214	35.941
24.00 - 02.00	1.043	280.039	344.921	258.056
02.00 - 04.00	1.537	848.705	1102.019	782.082
04.00 - 06.00	0.547	44.046	49.616	40.588
06.00 - 08.00	0.760	114.112	133.319	105.155

From the observation and calculation, the estimated electricity generated from the ebb and flow of each hour is shown in figure 2. From the graph, the largest power is obtained when the tidal current speed reaches its peak of 2.5 m / s between 14.00-16.00 . This happens with regard to the daily tides that occur in the area. The amount of power produced in the hour is presented in figure 3.

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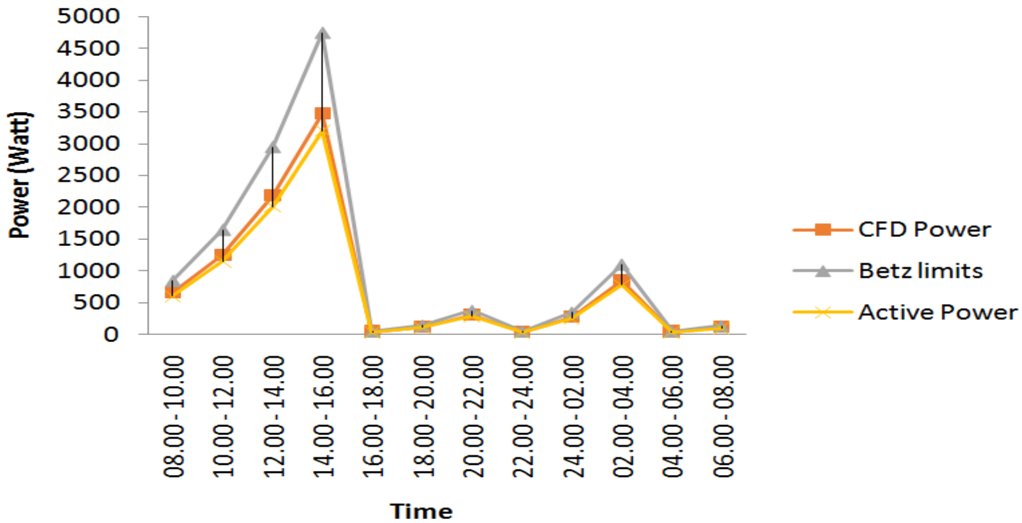

Figure 3: Power per Hour

The power obtained from the tidal current is shown in the figure 4. The CFD power simulation shows that there is a coefficient of -24.78 and at active power simulation -22.84. Physically this means it takes at least 24.78W and 22.84W to drive the turbine.

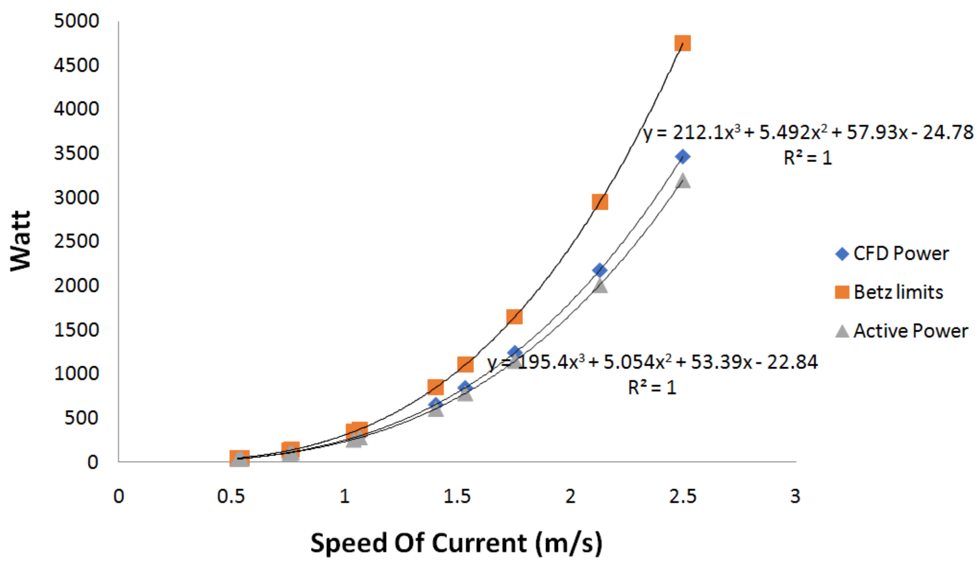

Figure 4: Effect of Tidal Flow Rate on the Generated Power

4. Conclusions and Recommendations

From the calculation results obtained electric power that can be produced in the village Bedono highest at 14-16 times 3469.413W and lowest 39.002W at 22-24 hours according to the CFD is the highest active power occurred at 14-16 times 3197.064W and the lowest 35.941W on 22-24 o'clock.

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