Potential Evaluation of Vertical Axis Hydrokinetic Turbine Implementation in Equatorial River

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Abstract. In rural areas, small villages are often disconnected from the electrical grid because of lack of economic resources. Long extensions of the grid, only contributing small rural areas with electricity, are not economically beneficial. The temporary solution for the disconnection is to contribute with diesel-generators. These have become common for remote electricity distribution because of their quick installation and mobility. However, the high expenses of the fuel for the diesel generators, along with the challenging fuel transportation because of the scarce to non-existing infrastructure, are not a sustainable solution for electricity distribution in the rural areas. Hydrokinetic turbine is an attractive option for harnessing energy from natural flow of rivers where no static head exists. However, equatorial river system is subjected to high amount of sediment and flowing objects due to the large quantity of vegetation in the area. This leaves the turbine exposed to a higher degree of erosion on the blades and a higher risk of getting clogged. A field study was conducted to attain the velocity and characteristics of sediment in the Niah River located in Miri of Sarawak state, Malaysia. The collected data was analyzed and used as input values during simulations of a turbine model by the Computational Fluid Dynamics. Areas on the turbine exposed to the water with a high velocity and containing a high concentration of sediment were examined. The investigation states that areas on the blade's outer sides are most exposed to erosion and will be in need of protection in form of a harder surface. Adaptation of hydrokinetic turbine for the conditions prevailing in the equatorial river is essential to improve the efficiency and lifetime of the turbine.

Keywords: hydrokinetic turbine, equatorial river, sediment, erosion

1. Introduction

Electrification is generally seen as one of the key indicators that can reduce poverty. Thus, rural electrification is an essential element in bringing about the social and economic development of the underprivileged rural populations. Nevertheless, considering the high cost of distribution and associated transmission loss, grid power supply in rural areas is not economically viable. For most of rural community in Malaysia, the source of power comes from a diesel generator, which operates for about 2 to 3 hours a day. However, the cost of running the generator is relatively expensive as the price of diesel as well as the cost of bringing the fuel to the longhouse can be very high. The off-grid electricity, which can be generated by solar, wind or hydro technology, provides the opportunity to expand the capacity of rural electrification and has distinct advantages for the community as a cost-effective strategy and reliable source of energy.

Photovoltaic solar energy conversion systems have been used to supply electricity for isolated locations in equatorial region. However, the system installed in this area is found to be seriously hampered by tropical weather-related problem. The intense heat and humidity in this region corrode and crack electrical connections and electronic components and encourage mold growth on panels. Tropical