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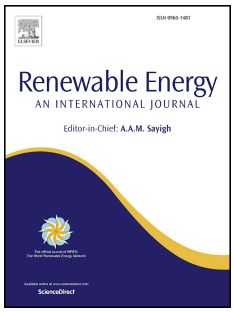

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Impact of Altitude and Power Rating on Power-to-weight and Power-to-cost Ratios of the High Altitude Wind Power Generating System

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Abstract

This paper presents a static comprehensive optimization study and analysis of the high altitude wind power (HAWP) generating system based on the medium voltage AC (MV-AC) transmission. The analytical expressions for weight and cost of the transmission line, the mechanical structures (turbine + frame), the generator, and the blimp/aerostat are derived as functions of output power rating and altitude. The optimal voltages for the MV-AC transmission of the HAWP for various power ratings and altitudes are evaluated using the derived equations. The optimal transmission voltage, thus obtained is used to estimate the weight of the tether wire (transmission line) and the generator. The weight of the mechanical frame, the air-borne wind turbine (AWT), and the light gas (Hydrogen/Helium) filled blimp are also estimated for different power ratings and altitudes. The material costs of each major component of the HAWP generating system are obtained from the manufacturers' datasheets and used to compute the overall material cost. From the estimated weight and cost, the overall power-to-weight (P/W) and power-to-cost (P/C) ratios of the HAWP generating system are evaluated. Finally, the optimal operating altitude for a specific power rating that exhibits the best P/W and reasonably good P/C ratios can be selected for the development and installation of the HAWP generating system.

Index Terms

High altitude wind power generating system (HAWP), P/W and P/C ratios, Optimization