(1)

ANALYSIS OF CORONA DISCHARGE IN ELECTROSTATIC MOTOR GAPS

Mazen Abdel-Salam, Adel Ahmed, Hamdy Ziedan and Fahd Diab

Abstract:

This paper is aimed at calculating corona current-voltage characteristics of a new design of an electrostatic motor with a cylindrical rotor made from aluminium foil and multi stator copper electrodes. The stator electrodes are alternately stressed positively and negatively. The corona currents emitted from positively and negatively-stressed electrodes are calculated being dependent on the applied voltage and motor geometry. The method of calculation is based on simultaneous solution of Poisson's equation, current density equation and continuity equation for current density. This calls at first for calculation of the spatial distribution of electric field within the motor volume using the accurate charge simulation technique. The calculated current-voltage characteristics of the motor agreed reasonably with those measured experimentally for three motors built-in the laboratory.

Keywords:

Electrostatic motor, corona-discharge, electric field, corona current.

Published In:

Journal of Engineering Sciences, Assiut University, Faculty of Engineering , 41-5 , 1842 - 1856

(2)

Analysis of a Corona-Discharge Based Electrostatic Motor

Mazen Abdel-Salam, Adel Ahmed, Hamdy Ziedan and Fahd Diab

Abstract:

This paper is aimed at proposing a new design of a corona-discharge based electrostatic motor with a cylindrical rotor made from aluminum foil and multi copper strip stator electrodes. The stator electrodes are alternately stressed positively and negatively. The onset voltage of corona discharge is calculated based on the condition of discharge sustenance at stator electrodes. The corona currents emitted from positively and negatively stressed electrodes are calculated being dependent on the applied voltage and motor geometry. This calls at first for calculation of the spatial distribution of electric field within the motor volume using the accurate charge simulation technique. The calculated corona onset voltage and current-voltage characteristics of the motor agreed reasonably with those measured experimentally for three motors built-in the laboratory. The dependency of the motor speed on the applied voltage is reported for the different investigated motors.

Keywords:

Electrostatic motor, ionic wind, corona-discharge, field mapping, corona current, motor speed

Published In:

International Journal of Plasma Environmental Science and Technology, Japan , 8-1 , 60-69

(3)

An environmentally friendly factory in Egypt based on hybrid photovoltaic/wind/diesel/battery system

Fahd Diab, Hai Lan, Lijun Zhang, Salwa Ali

Abstract:

The potential for using clean energy technologies in Egypt is good given the abundant solar insolation and wind resources. In contrast, many factories have suffered significant losses due to frequent blackouts in Egypt, especially at peak times of load demand. Moreover, the aim of this paper is to provide a detailed feasibility and a techno-economic evaluation of using hybrid photovoltaic/wind/diesel/battery system to satisfy the electrical energy needs for an environmentally friendly factory in New Borg El Arab city, Egypt and the city surrounding the factory. Utilizing the well-known Hybrid Optimization of Multiple Electric Renewables software to get the optimal configuration of a hybrid renewable energy system, based on the user inputs of loads, components costs, components technical details, solar and wind resources availability. The hybrid renewable energy system consisting of 60 kW of photovoltaic arrays, 100 kWof wind turbines, 40 kW of diesel generators, 50 kW of power converters and 600 batteries is found to be the optimal hybrid configuration in accordance with the system net present cost and cost of energy. The net present cost of this system is $1,684,118 and the cost of energy is $0.19/kWh. Additionally, the optimum system is the most environmentally friendly system in comparison with the other systems configurations specifically the diesel only system, because it is able to reduce a significant amount of greenhouse gases emissions. Strive to achieve the plan to become New Borg El Arab city, the first environmentally friendly Egyptian city in the near future by increasing the applications in this city that depend on the clean energy. Additionally, the same work could be applied to any other site in the world. Finally, an accurate separate techno-economic analysis of each component in the optimum hybrid renewable energy system is carried out in this study.

Keywords:

Hybrid PV/wind/diesel/battery system, Feasibility study of the optimum system, Greenhouse gases (GHG) emission, Cost of energy (COE), Net present cost (NPC)

Published In:

Journal of Cleaner Production , 112 , 3884-3894

(4)

An economic and environment friendly solution for the rural households' energy crisis in Egypt

Fahd Diab, Salwa Ali

Abstract:

The demand for the electrical energy increased drastically due to the exponential growth of the world population. In the last decade, owing to environmental issues and decay of non-renewable energy resources, the development of power generation from the hydrokinetic energy has grown considerably. Many individuals and companies are looking at the hydrokinetic power as the better solution to the prevailing energy crisis. However, there is paucity of published literature that shedding the light on the economic and environmental sides of the hydrokinetic turbines (HKT) in the hybrid renewable energy systems (HRES). The prime objective of this study is to provide an economic and environmental assessment of a HKT in combination with other renewable energy resources for cost-effective, reliable, and sustainable electrical energy supply for the rural households in Naga Hammadi, Egypt, where adequate water resources are available from the Nile River. The HKT is simulated together with photovoltaic (PV), diesel generator (DG) and battery (B) using the well-known HOMER software to optimize the HRES. The net present cost (NPC) of the optimum HRES is $12.7 million with minimal cost of energy (COE) of $0.158/kWh. The optimum system is capable of saving approximately $9.7 million during the project lifetime (25 years) in the form of NPC as compared to the diesel generator system. In addition, the system is capable of saving 28.971 million liters of fuel with cost of $5.11 million during the project lifetime. Finally, it is concluded that the hybrid PV/HKT/DG/B is the more economic and environment friendly system as compared to other systems configurations especially the diesel generator system, because it is able to reduce 76.29 million kg of the amount of CO2 emissions during the project lifetime.

Keywords:

Hydrokinetic power policy; Rural household in Naga Hammadi, Egypt; Hybrid PV/HKT/DG/B system; Cost of energy (COE); CO2 emission

Published In:

Journal of Renewable and Sustainable Energy , 8 , 045904-1:045904-18

(5)

Feasibility Study of Smart Monofloat Hydrokinetic Power for the Rural Households in Naga Hammadi, Egypt

Fahd Diab, Hai Lan

Abstract:

Hybrid Renewable Energy System (HRES) is an attractive system for stand-alone electrification in remote areas. The hydrokinetic power avoids all the disadvantages of hydropower, unlike dams that have obstructed the natural water flow and ended up displacing animals and people. The main objective of this work is to provide a feasibility study of using SMART MONOFLOAT** hydrokinetic power in hybrid photovoltaic (PV)/HKT/diesel/battery system to satisfy the electrical energy needs for the selected rural households in Naga Hammadi, Egypt in this study. The SMART MONOFLOAT hydrokinetic turbine has been used as it was developed to produce a maximum amount of electrical power with the kinetic energy of flowing water. The well-known Hybrid Optimization of Multiple Electric Renewables (HOMER) software is used as a software tool in this study. The 22-year monthly average solar radiation data of the selected rural households in Naga Hammadi, located at latitude of 26.013 and longitude of 32.32 was obtained from National Aeronautics and Space Administration (NASA) database. The monthly average current velocity data in this study, was collected for a single year during 1991 after the construction of the Aswan Dam in 1904. According to the simulation results in this work, it was found that the optimum HRES consisting of; 90 kW of PV panels, 90 kW of HKTs, 22 kW of diesel generators, 60 kW of power converters and 225 batteries. In addition to, a great reduction in greenhouse gases emission during the project lifetime could be achieved in the optimum system.

Keywords:

NULL

Published In:

Proceedings of the ASME 2016 Power and Energy Conference PowerEnergy2016 June 26-30, 2016, Charlotte, North Carolina, USA , USA , POWER2016-59540, pp. V001T10A005; 9

(6)

Novel comparison study between the hybrid renewable energy systems on land and on ship.

Fahd Diab, Hai Lan, Salwa Ali

Abstract:

The development of the marine industry led to an increasing amount of fuel consumption and greenhouse gases (GHG) emissions. However, it is hard to evaluate the payback and profitability of a hybrid renewable ship without preparing a complete investigation. A dearth of studies compares between the hybrid renewable energy systems (HRES) on land and on ships. Therefore, the main objective of this research work is to provide a novel comparison study for the differences between HRES on land and on ships, utilizing the well-known Hybrid Optimization of Multiple Electric Renewable (HOMER) software. To the best knowledge of the authors, this study is the first to do comparison regarding the HRES on land and on ships. This study is based on the project titled Study on the Application of Photovoltaic Technology in the Oil Tanker Ship in China. The load profile data used is real and accurate, depending on the ship navigation route from Dalian in China to Aden in Yemen. The hybrid photovoltaic (PV)/diesel/battery system is found to be the optimum system regardless if it is on land or on ships with annual capacity shortage of 0%, which means this system is a 100% reliable system. The optimal system on land consists of 10,000 kW of PV system, 2000 kW of diesel generators, 500 batteries and 2000 kW of power converters. The optimal system on ship consists of only 300 kWof PV system, 2000 kW of diesel generators, 10 batteries and 200 kW of power converters. The optimal system on ships is able to decrease the amount of GHG emissions by 9,735,632.5 kg during the project lifetime (25 years). In addition, it has capability to decrease the fuel-consumption amount by 2,010,475 L during the project lifetime. This represents an incentive factor to increase the installed capacity of the PV system on the ships that consequently decreases the fuel-consumption amount and the total fuel cost.

Keywords:

Hybrid renewable ship; Ship navigation; Novel comparison study; Greenhouse gases emission; Cost of energy; Net present cost

Published In:

Renewable and Sustainable Energy Reviews , Vol. 63 , pp.452463

(7)

An Environmentally-Friendly Tourist Village in Egypt Based on a Hybrid Renewable Energy System□□Part One: What Is the Optimum City?

Fahd Diab, Hai Lan, Lijun Zhang and Salwa Ali

Abstract:

The main objective of this study is to discuss the economical and the environmental analysis of a net zero energy (NZE) tourist village in Alexandria, Egypt, by maximizing the renewable energy fraction and minimizing the greenhouse gases (GHG) emissions. The hybrid photovoltaics (PV)/wind/diesel/battery system is found to be the optimum hybrid renewable energy system (HRES) for the proposed tourist village under the study. The optimum HRES consists of 1600 kW of PV panels (58.09% solar energy penetration), 1000 kW of wind turbines (41.34% wind energy penetration), 1000 kW of power converters,200 kW diesel generator (only 0.57% diesel generator penetration) in addition to 2000 batteries with the capacity of 589 Ah each. The levelized cost of energy (COE) from the optimum HRES is $0.17/kWh and the total net present cost (NPC) of this system is $15,383,360. Additionally, the maximum renewable energy fraction is 99.1% and the amount of GHG emitted from the optimum HRES is only 31,289 kg/year, which is negligible in comparison with the other system configurations, therefore the optimum HRES can be considered as a green system. In addition to this, the achieved percentage of the capacity shortage and the unmet load in the optimal HRES is only 0% for both.

Keywords:

an environmentally-friendly tourist village; the effects of ambient temperature; GHG emission penalties; cost of energy (COE); net present cost (NPC)

Published In:

Energies , Vol. 8 , pp. 6926-6944

(8)

An Environmentally-Friendly Tourist Village in Egypt Based on a Hybrid Renewable Energy System□□Part Two: A Net Zero Energy Tourist Village

Fahd Diab , Hai Lan, Lijun Zhang and Salwa Ali

Abstract:

The main objective of this work is to select the optimum city from five touristic Egyptian cities (Luxor, Giza, Alexandria, Qena and Aswan) to establish an environmentally-friendly tourist village. The selection of the city, according to the economic cost (cost of energy (COE), net present cost (NPC)) and the amount of greenhouse gases (GHG) emitted, is carried out with respect to four cases, based on the effects of ambient temperature and applying GHG emission penalties. According to the simulation results, using the well-known Homer software, Alexandria is the economic city for hybrid photovoltaics (PV)/wind/diesel/battery and wind/diesel/battery systems, while Aswan is the most economic city for a hybrid PV/diesel/battery system. However, for a diesel/battery system there is no significant economic difference between the cities in the study. On the other hand, according to the amount of GHG emitted from a hybrid PV/wind/diesel/battery system, Qena is the optimum city if the effects of ambient temperature are considered. However, if the GHG emission penalties are applied, Aswan will be the optimum city. Furthermore, Alexandria is the optimum city if the effects of ambient temperature are considered and the GHG emission penalties are applied. Additionally, the effects of ambient temperature and applying GHG emission penalties are studied on hybrid PV/diesel/battery, wind/diesel/battery and diesel/battery systems in this study.

Keywords:

An Environmentally-Friendly Tourist Village in Egypt Based on a Hybrid Renewable Energy System□□Part Two: A Net Zero Energy Tourist Village

Published In:

Energies , Vol. 8 , pp. 6945-6961