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Performance analysis of a rice husk power generating system: a case study

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One biomass energy source is rice husk, which is a very promising renewable energy source as it is an indigenous, cheap, and clean source of energy. However, environmental and financial profiles of electricity generation from rice husk must be assessed to ensure reduction in greenhouse gas (GHG) emission and positive cash flow. GHG emission from a rice husk generating system is significantly less than that from fossil fuel power plants. A dual-fuel diesel engine-generator of 800 kW, using a rice husk gasifier, is considered for this analysis. This paper presents a comprehensive analysis of a traditional energy technology in a new perspective. The results of simulation data analysed in terms of pollution through GHG emissions, financial aspects, and suitability of the scheme for underdeveloped villages in economically developing nations are critical contributions of the paper. It also indicates the expected energy generation from the rice husk available in the region.

Keywords: dual-fuel generation; energy model; gasification; greenhouse gas emission; renewable energy; rice husk

1. Introduction

Biomass is one the most important energy sources among renewable energies (REs). It is third among the primary energy sources after coal and oil (Werther et al. 2000). In India, rice is a major cereal, is nearly 40% of the total food grain cultivated, and is cropped in over 30% of its area. India’s share of world rice production is nearly 21%. Rice husk and rice bran are byproducts when its edible form of paddy is processed. Rice bran is used for oil extraction and in feed formulations, whereas husk is generally used as fuel to generate heat for parboiling of paddy and in other applications. The use of husk in industry involves difficult handling and bulky transportation because of its low density of 112–44 kg/m³ (Kandpal and Garg 2003). Onsite use of rice husk in industry may be achieved to avoid transportation and carriage as average husk production from rice mills is 187 kg/tonne paddy (Jain 2006, Ahiduzzaman 2007). Techniques of conversion of husk into electricity and heat energy at relatively higher efficiencies are available.

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CONTROL OF MPPT FOR PHOTOVOLTAIC SYSTEMS USING ADVANCED ALGORITHM EPP

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Abstract— Photovoltaic (PV) offers clean source for the generation of electricity, which is however costly today. The maximum power point tracking (MPPT) of the PV output for all sunshine conditions is a key to keep the output power per unit cost low for successful PV applications. This paper proposes a new method for the MPPT control of PV systems, which uses one estimate process for every two perturbation processes in search for the maximum PV output. In this estimate-perturb-perturb (EPP) method, the perturb process conducts the search over the highly nonlinear PV characteristic, and the estimate process compensates the perturb process for irradiance-changing conditions. The EPP method significantly improves the tracking accuracy and speed of the MPPT control compared to available methods. The paper presents the details analysis of the EPP method.

Keywords— EPP method; Fuzzy Logic; Incremental Conductance Algorithm; Perturb and observe (P&O) Algorithm.

I. INTRODUCTION

Photovoltaic (PV) offers a clean source of electricity, for which the input fuel is sunshine, a vast renewable source of energy. Very often, the success of a PV application depends on whether the power electronics device can extract sufficiently high power from the PV arrays to keep overall output power per unit cost low. The maximum power point tracking of the PV output for all sunshine conditions, therefore, becomes a key control in the device operation for successful PV applications at commercial level [1]. The MPPT control is, in general, challenging, because the sunshine condition that determines the amount of sun energy into the PV array may change all the time, and the current voltage characteristic of PV arrays is highly nonlinear [2].

A PV system for the grid-connected applications is typically composed of five main components: 1) a PV array that converts solar energy to electric energy, 2) a dc-dc converter that converts low dc voltages produced by the PV arrays to a high dc voltage, 3) an inverter that converts the high dc voltage to a single or three-phase ac voltage, 4) a digital controller that controls the converter operation with maximum power extraction capability, and 5) an ac filter that absorbs voltage/current harmonics generated by the inverter. The main technical requirements in developing a practical PV system include a) an optimal control that can extract the maximum output power from the PV arrays under all operating weather conditions, and b) a high performance-to-cost ratio to facilitate commercialization of developed PV technologies. Since the PV array has highly nonlinear characteristic, and if performance changes with operating conditions such as insolation or ambient temperature, it is technically challenging to develop a PV system that can meet these technical requirements.

This paper proposes a new method for the MPPT control of PV systems. The method uses one estimate process for every two perturbation processes in search for the maximum PV output. In this estimate-perturb-perturb (EPP) method, the perturb process conducts the search over the highly nonlinear PV characteristic, and the estimate process compensates the perturb process for irradiance-changing conditions. This paper illustrates that EPP method can significantly improve the tracking accuracy and speed of the MPPT control.

II. PERTURB-AND-OBSERVE (P&O) METHOD

A number of MPPT algorithms have been proposed in the literature, such as open- and short-circuit method [3] incremental conductance algorithm [4]-[5]. Perturb and observe method [6]-[9], fuzzy logic based methods [10] [11]. The perturb-and-observe is the most commonly used method. It is basically a “trial and error” method. The PI controller increases the reference for the inverter output power by a small amount, and then detects the actual output power. If the output power is increased, it will increase again until the output power starts to decrease; after that the controller decreases the reference to avoid collapse of the PV output due to the highly non-linear PV characteristic.

Although the P&O algorithm is easy to implement, it has number of shortcomings, such as 1) the PV system cannot always operate at the maximum power point due to the slow trial and error process, and thus the solar energy from the PV...
Optimal hybrid renewable energy systems for energy security: a comparative study

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A hybrid power system may be used to reduce dependency on either conventional energy or renewable systems. This article deals with the sizing, generator running hours, sensitivity analysis, optimisation, and greenhouse gas emission analysis of hybrid renewable energy systems (HRES). Two locations have been selected where the feasibility of using different hybrid systems is studied for the same load demand. One site is the small remote community of Amini in the Lakshadweep Islands, located in southern India in the Arabian Sea, where solar and/or wind energy is always available throughout the year to provide energy security. Another place is the rural township of Hadiras, in the northern Indian state of Uttar Pradesh, where agricultural biomass is found in abundance for the whole year. A comparative study has been made for the two locations for the same load demand by simulating HRES. To achieve the goal of simulation, the hybrid optimisation model for electric renewables (HOMER) software of the National Renewable Energy Laboratory, USA, is used. An optimisation model of a hybrid renewable system has been prepared which simplifies the task of evaluating the design of an off-grid/standalone system. After simulating all possible system equipment with their sizes, a list of many possible configurations may be evaluated and sorted by net present cost to compare the design options. An elaborate sensitivity analysis has been used for each input variable; the whole optimisation process is repeated to get simulated system configurations.

Keywords: emission; energy security; hybrid energy; optimisation technique; renewable energy integration; sensitivity analysis

1. Introduction

Energy is the ultimate factor responsible for industrial, agricultural, and living-standard growth. Its consumption is a parameter for judging the living standard and prosperity of a community or country, which depend upon different factors, namely, access to energy sources, prices, climate, income, and urbanisation level (Jiang and O'Neill 2004). The use of renewable energy (RE) technology has been rapidly increasing to meet growing energy demand. However, the main disadvantage associated with standalone RE systems (RES) is their inability to provide energy security and reliability due to their unpredictable, seasonal, and time-dependant natures. A standalone solar photovoltaic (SPV) system cannot provide reliable power during non-sunny days, whereas
Three-Phase High-Power Soft Switched DC/DC Converter for Low Voltage Fuel Cell
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Abstract — An efficient dc/dc converter is needed as the interface between a low-voltage fuel cell source and a high-voltage bus for inverter operation. In this paper, a three-phase transformer isolated dc/dc converter utilizing phase-shift modulation is proposed. The converter must be able to boost the voltage significantly and operate at current levels above 240 amps on the source side. Key features of the proposed converter include: reduced transformer turns-ratio by a factor of two while maintaining the same output voltage, reduced the size of passive components including output filter and input dc bus capacitor using three-phase interleaving, and achieved soft switching over a wide load range without auxiliary circuitry. The proposed converter has been analyzed, and simulated. An efficiency of above 92% was achieved using the prototype unit.

Keywords- phase-shift, soft-switching, ZVS, ZCS, converter, dc/dc converter, multi-phase.

1 INTRODUCTION

A fuel cell is an electrochemical energy conversion device that continuously converts chemical energy of a fuel directly into electrical energy. Continuous operation requires supply of fuel and oxidant and removal of water vapor, spent fuel, spent oxidant, inert residue and heat etc. It is known as a cell because of some similarities with a primary cell. Fuel cells are considered to be the future energy generation device due to their energy efficiency and environmental friendliness. As per the specifications of 2003 International Future Energy Challenge, the nominal fuel cell dc output voltage is 22V and ac load is 120/240V at 5kW continuous and 10kW peak. To get a dual ac output, an isolated dc/dc converter is required to convert low voltage dc to a dc voltage higher than 400V, sufficiently for a 240V ac output.

The challenges with dc/dc converter on fuel voltage side are low voltage and high current (240A). The converter needs to be capable of high power operation with high voltage conversion ratio. A transformer is required for both voltage boost and isolation. Furthermore, a high switching frequency is needed to reduce passive component size. For the purpose of high switching frequency with improved converter efficiency, soft switching is needed. Among the soft-switching techniques suitable for high power converter applications, phase shift (PS) control has been the favorite. However, for a single-phase full-bridge phase-shift converter the zero-voltage-switching (ZVS) is achieved over a limited load range. Past efforts have focused on solving this problem. The most popular solutions are to add a saturable core or make some devices switch under zero current-switching (ZCS) condition with added auxiliary circuitry [1-7]
ENERGY ANALYSIS OF SOLAR PHOTOVOLTAIC SYSTEM FOR AN ACADEMIC INSTITUTION IN NORTHERN INDIA

ANIS AFZAL, V. K. SHARMA, AND MOHIBULLAH

Abstract

Energy is essential to our society to provide us good quality of life and economic growth. Renewable energy technology offers promises of clean energy from unending reserve of sun, wind, earth, and plants. Out of all these sources of energy, solar energy may be converted directly into electrical energy using a solar Photovoltaic (PV) system. Its basic conversion device used is known as solar PV cell. Solar PV systems could be applicable to either small or large power plants. For small scale system, local energy generation may be achieved even on roof tops of buildings. PV technology has progressed tremendously – both performance-wise and cost-wise. The main advantages are its modularity, portability reliability and low environmental impact. As there is no moving part in this system, operation and maintenance costs are low. PV system is open to innovation and new technology. It has an extraordinary flexibility that different PV systems can be used in different applications. Selection of appropriate location and suitable PV system, have wider effect on the performance of PV system. The technical status, cost, environment impact, and financial viability of PV technology application will be reviewed here with the help of Renewable Energy Technology Software in North Indian scenario.

Keywords: Photovoltaic, Renewable Energy, Green House Gases, Financial Analysis
PERFORMANCE EVALUATION OF WIND ENERGY CONVERSION SYSTEM AS AN ALTERNATIVE ENERGY SOURCE IN INDIAN CONDITION

ANIS AFZAL, V. K. SHARMA and MOHIBULLAH

1. Introduction

In many developing countries, particularly in the rural areas, wood is the primary source of energy. However, using wood as fuel has its own demerits like difficult collection of fuel, limited availability, continued use may cause desert encroachment, deforestation, drought, and adverse environmental impact. Moreover in many countries, fossil fuel is mainly used in electrical power generating plants. As petroleum resources are being sharply depleted [1], it is necessary to diversify power generation method so as to conserve these fuels for prime applications. Less use of fossil fuels will also reduce the emission of carbon dioxide (CO$_2$) and other green house gases into the environment. Moreover, import of petroleum fuels must be reduced because they are expensive

Key Words: Wind energy, wind turbine, renewable energy and fossil fuel

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ENERGY ANALYSIS OF SOLAR PHOTOVOLTAIC (PV) SYSTEM FOR RURAL APPLICATIONS

HARINDER SINGH,* NITIN KUMAR SRIVASTAVA,* ANIS AFZAL**, and V.K. SHARMA*

Abstract

Availability of energy in adequate quantities and at affordable costs will be a decisive factor for industrial and socio-economic growth. Sun provides energy as a free fuel everyday. The only thing paid for is the solar energy conversion system. Amongst the existing solar energy conversion techniques, Photovoltaic (PV) technology has progressed remarkably in terms of both performance and cost. The main advantage of PV energy system is their modularity, portability, high reliability, and low environmental impact. These systems have no or few moving parts, which result in low operating and maintenance costs. Another distinct advantage is its full compatibility with the upcoming hydrogen energy technologies. PV system is open to innovation and technical change. Its extraordinary flexibility in terms of technological options for different PV devices results in a wide range of applications. Selection of appropriate location for installation of PV has a wider impact on PV system performance. These features led to pre-planning (type) and cost estimation of PV system. In this paper, Renewable Energy Project Analysis software has been used for analyzing PV system at different locations for better technical and financial viability of possible renewable energy project.

Key Words: Performance, Energy Analysis, Solar PV

Introduction

Wood is the primary source of total energy in many developing countries, especially in the rural areas. However, wood fuel collection is difficult, its availability is scarce and its continued use increases desert encroachment, deforestation, drought, and adverse environmental impact. Also, the bulk of electrical power in many countries has been produced mainly from fossil fuel based generating systems. As petroleum resources are being rapidly depleted, it is essential to diversify power production techniques so as to conserve these fuels for premium applications. Minimised use of fossil fuels will invariably reduce the emission of carbon dioxide (CO₂) and other greenhouse gases into the environment. Also, large importation of petroleum fuels that are required for modern technologies and processes must be reduced as they are still generally expensive especially for the non-oil producing nations even at the depressed rate of $20.00/barrel. Consequently, it is essential to plan and analyse energy policies including energy conservation within the framework of the current socio-economic development process. In particular the development and use of new and renewable sources of energy has to be accelerated. The sun provides supply of energy as a free fuel everyday. The only thing paid for is the solar conversion system. Amongst the existing solar energy conversion techniques, Photovoltaic (PV)