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DESIGN OF BUCK BOOST CONVERTER FOR WIND ENERGY CONVERSION SYSTEM

M.Pravin[1], M. Pugazhenthi[2], J.Raj Praphakar[3], V.Sathiyamoorthy[4]

UG Students, Department of EEE, Paavai Engineering College, Namakkal[1-2]

UG Students, Department of EEE, Paavai Engineering College, Namakkal[3-4]

ABSTRACT: This paper presents the “Design of buck boost converter for wind energy conversion system”. The main aim of our project is to giving constant output voltage by using buck boost converter. So the output voltage will be constant throughout generation of electricity. Eventually there have been much advancement in wind technology but the technological advancements are still needed for wind power control for different loading conditions. By using the buck booster convertor, we can keep the voltage constant which is helping for distribution the electricity during any environmental condition. The power is controlled with the help of Buck-Boost Converter connected across the dc link to keep constant voltage supply at output side

INTRODUCTION

Due to the exhaustion of fossil fuel and environmental problems caused by conventional power generation the focus has been shifted to the power generation by renewable energy, among them are the wind generator are most commonly used. Wind turbine are used in many applications such as battery charging, water pumping, home power supply, swimming pool heating system , satellite powering system etc..Wind generators have lower installation costs compared to the photovoltaic; hence the overall system cost can be reduced by using high efficiency power converter. They have advantage of being pollution free and free of cost. Though wind energy has many advantages the development is only in the preliminary stage The wind energy is converted to electrical energy by exacting potential energy from wind to kinetic energy.

Ev-en if there is abundant amount of energy available, there are many researches going on to extract maximum power by wind turbine. This paper deals with small wind turbine which is connected to a battery. Wind power depends purely on the wind speed, as the wind speed is not constant the wind power is always varying. For charging a battery the voltage has to be constant. In an existing system the rectified output is directly used to charge the battery. The battery will not charge even if there is a considerable am+++ount of voltage available. At the most 30 % of output load is wasted due to this problem, due to which the overall efficiency of the system decreases to 20%. There must be a control strategy to get the voltage of the turbine constant as shown in fig 2, hence an cascaded buck boost converter has been designed. When the wind energy is low the converter boost the output voltage and gets to constant voltage similarly when wind speed is high the converter operates in buck mode so as to reduce the voltage to keep the voltage constant and also to protect the system from damage.

In this paper, a DC DC converter has been presented and studied for small scale wind energy system. The DC DC converter consists of Boost converter and a buck converter in series with each other to optimize the wind energy for all specified wind speed.

BLOCK DIAGRAM OF BUCK-BOOST CONVERTER FOR WIND

In this chapter all parts of a wind turbine system are described by mathematical equations. Based on these, models for each part are developed. The modelling is done in the steady state theory, so it is assumed that there are no changes in time and the system operates in stable conditions. These assumptions can be made due to the investigation of the performance factors efficiency and annual energy production do not need a dynamic model. Both performance factors are usually calculated while the wind turbine system is operating stably. The dynamic behaviour of the system is not part of the investigation of the two factors.

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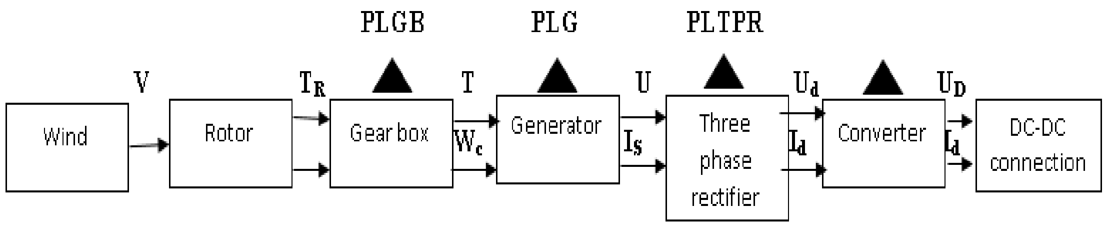

Block diagram of buck-boost converter for wind

Annual energy production and efficiency are related to the losses of the wind turbine system such as friction or ohmic losses due to parasitic elements in circuits. Hence the power losses in total must be estimated and are an important part of the modelling

WIND

The wind is defined by the wind speed v. Sudden changes of the wind speed are neglected. Their investigation is not necessary in a steady state model. Hence it is assumed to have a 10 minutes average value of the wind speed. During the simulation, which is done later, wind speed ramp is used as input for the model of the wind turbine system.

ROTOR

The rotor converts the power of the wind into mechanical power. The wind power harnessed from the wind by the rotor is expressed by the following equation

The power coefficient c_P is delivered by a look up table (Appendix) which shows the relationship between a certain wind speed v and the actual power coefficient c_P.

GEAR BOX

The rotor torque T_R and the rotational speed of the rotor ω_R are the inputs of the gear box which is the mechanical connection of the rotor shaft and the generator. The torque on the generator side T_G, the rotational speed of the generator ω_G and the losses of the gearbox P_{LGB} are the outputs of this model.

2.1.4 GENERATOR

The permanent magnet synchronous generator can be characterized by a one phase circuit represents the induced electromotive force. R_S is the winding resistance and L_S is the inductance of one phase. The output values are the voltage U_S and the current I_S

The relationship of the voltages and the current is explained in a space vector diagram The output power of the generator must be active only due to the used converter concepts are not able to work with reactive power. Hence, the generator operates at unity power factor and the output voltage U_S and current I_S are in phase. This causes a voltage drop along the resistor R_S which is parallel to U_S. The voltage drop along the inductance L_S is perpendicular to the output voltage U_S and current I_S.

DC-DC CONNECTION

The HVDC connection of offshore and onshore is as its name says at high constant voltage level. This constant voltage level is controlled by the converter on the grid side onshore. Hence, the DC-DC connection can be modeled by a constant voltage source at the output of each single turbine unit. The value of the voltage depends on the number of turbines in serial connection. In this thesis a number of 10 turbines connected serial is assumed. With a voltage of 170kV for HVDC transmission a source voltage of 17kV is obtained. U_{DC} is used as a constant input in the converter models due to its value is known.

The model of the DC-DC connection and the generator are the interfaces for the converter models explained in the next sections. The generator provides power and the DC-DC connection acts as a power sink.

AC-DC converters

In this part of the chapter the two selected converter types introduced in chapter 2 are modelled. In a first step the converters are treated to be ideal without any losses. The values for inductors and capacitors are calculated. Depending on these results real electrical devices are chosen. Here the converters must assure that the input power provided by the generator is equal to the sum of output power and losses of the converter. Hence, the turbine is always operating at its maximum power output. The functionality of the configured converters is proved by a simulation in PSIM, which is a real time circuit simulation program.

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In a second step, the converters are modeled including the parasitic elements of the devices chosen during the first step. These parasitic elements which are modeled as resistors are responsible for power losses. Appropriate semiconductors such as diodes and switches are also selected

CONCLUSION

In recent years, the cost of wind energy is close to the traditional thermal power generation. Furthermore, it is a clean energy without any pollution. The wind energy is a common energy in nature. In this paper, a wind generation system is presented and discussed. A high power efficiency converter is designed based on the DC/DC Buck converter topology. Considering the characteristic of wind generation, maximum power point tracking technology is preferred. The experiments results show that the improved Buck converter can work without problem at 2 kW power output level. The maximum efficiency of the designed converter is up to 96%. The proposed converter topology and control method provide a valid solution for wind turbine applications.

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