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A MULTI-PORT CONVERTER BASED ON DIFFERENT TOPOLOGIES USING RENEWABLE ENERGY SOURCES FOR APARTMENTS

Dr.C.Rajesh Kumar
Head of The Department / EEE
Jeppiaar Institute of Technology,
Chennai-9840112675
crajeshkumar@jeppiaarinstitute.org

Sushmitha
Department of EEE,
Jeppiaar Institute of Technology,
Chennai-9840112675
sushmithalakshmanan03@gmail.com

Alphonse Jewelshy Simirna
Department of EEE,
Jeppiaar Institute of Technology,
Chennai-9840112675
alphonsejsimirna@gmail.com

Abstract-In this project is presented the design and operation of a multiport power converter. Multiport converters occupy an increasingly important role in energy conversion systems. A proper design of these converters according to the needs of the energy system leads to lower costs with energy conversion and increase the energetic efficiency. The designed multiport converter is of two inputs and one output. The structure of multiport power converter contains two DC-DC buck converters. Experimental results lead to improved electronic converter circuit. Multi-port dc-dc converter is employed to integrate the renewable energies and supply the residential load via an inverter. The proposed system is able to operate in both grid connected and islanded modes for different energy management scenarios. The Renewable Energy System (RES) consists of solar PV panel and wind turbine and battery as storage devices. The proposed project is hybrid of solar and wind energies for the usage of apartments. The proposed system is simulated for a solar PV panel, wind energy residential load considering an energy saving scenario. Through this hike in power demand can be easily faced solving the problems.

Keywords: Multiport converter, bidirectional inverter, hybrid model.

I.INTRODUCTION

In the last decades, there has been a great interest in renewable sources of energy as feasible solution to mitigate environmental issues and reduce the dependence on traditional sources of energy for electrical generation. The need of technology for integrating these non-traditional types of energy into the existence grid has motivated the development of new smart grid concept. The Smart Grid is recognized as feasible solution to the new challenges of existence grid network such as increasing energy demand and penetration of renewable energy sources at the consumer end. On the other hand residential consumers as an important part of future networks should be able to integrate their renewable sources such as wind turbine and PV into the grid . Based on this there is a need for design and development of smart converters to mitigate the new concepts. These converters have to meet higher efficiency and power density standards, fastest power flow control among the ports, data communication with micro grid center, bidirectional power flow capability, more flexibility and reliability. Multi-port converters (MPCs) are able to integrate multiple energy sources and storage devices into a single power processing unit. Various topologies of MPCs are proposed in the literature survey. The converter includes four ports connecting to the solar PV panel, wind turbine, battery storage and the load. The residential load and grid are connected to the converter via an inverter. The proposed RES is designed to be used in a residential load as a part of smart grid. India is reported to have 300 clear, sunny days per year on an average, which makes solar energy one of the most efficient power sources in Today's world, by eliminating the need of fossil fuels. Thus, a solar panel is used to charge the battery, which powers up the system. The whole system is automated by using an advanced electronic prototyping platform called Arduino. Arduino is opted for its simplicity, small size and ease of interfacing with other peripherals.

II.MULTIPORT CONVERTER

In recent years, the progress in power electronics has facilitated the development of

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integrated power converters that are capable of interfacing with and controlling energy sources concurrently. Emerging multiport topologies are based on a unified converter topology with multiple inputs that are capable of interfacing with different sources, storages and loads. Instead of using separate power electronic converters for each energy source, multiport converters have the advantages of requiring fewer components and having a low cost, more compact size and better dynamic performance.Many topologies have been proposed to create a multiport interface. Among them, one simple topology is to interface several converter stages to a common DC bus based on buck, boost and buck-boost structures with interleaved modulation that reduces the total current ripple.Multiport converters are also constructed from half-bridge or full-bridge topologies with magnetic coupling via high-frequency transformers and soft switching modulation. They can meet isolation requirements and also have bidirectional capabilities. They offer high power density and more flexible output voltage level. Other topologies with zero-voltage switching or zero-current switching can be implemented for all main switches to allow higher efficiency at higher switching frequency, which will lead to a more compact design.Other topologies with zero-voltage switching or zero-current switching can be implemented for all main switches to allow higher efficiency at higher switching frequency, which will lead to a more compact design.

In all these topologies, the use of new semiconductor devices - such as silicon carbide and gallium nitride semiconductors - is rapidly advancing. Devices made out of these materials can be operated at much higher frequencies, leading to compact multiport converters, which can enhance the overall performance of an HPS.

III. BIDIRECTIONAL INVERTER

The design was specified to use the same hardware in two modes of operation and thus have bidirectional power flow functionality. The discharge mode was specified as the process of extracting energy from the battery bank and using it to supplement the grid. This was accomplished by boosting the battery bank voltage to the necessary level and then converting it to ac with the proper frequency and phase needed in order to inject current into the grid. This mode required a way to synchronize the inverter output current with the grid voltage in order to ensure a near unity power factor and thus minimize reactive power. Alternatively, the charge mode of operation utilizes the grid to recharge the battery bank and store energy. This is accomplished by rectifying the grid voltage and regulating the amount of current flowing into the batteries.

IV. SOLAR PHOTOVOLTAIC

The solar power conversion is the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaics convert light into an electric current using the photovoltaic effect. The International Energy Agency projected in 2014 that under its "high renewables" scenario, by 2050, solar photovoltaics and concentrated solar power would contribute about 16 and 11 percent, respectively, of the worldwide electricity consumption, and solar would be the world's largest source of electricity. Most solar installations would be in China and India. Photovoltaics were initially solely used as a source of electricity for small and medium-sized applications, from the calculator powered by a single solar cell to remote homes powered by an off-grid rooftop PV system. As the cost of solar electricity has fallen, the number of grid-connected solar PV systems has grown into the millions and utility-scale solar power stations with hundreds of megawatts are being built. Solar PV is rapidly becoming an inexpensive, low-carbon technology to harness renewable energy from the Sun.

V. WIND TURBINE FOR ELECTRIC APPLICATION

A wind turbine is a device that converts the wind's kineticenergy into electrical power. Wind turbines are manufactured in a wide range of vertical and horizontal axis types. The smallest turbines are used for applications such as batterycharging for auxiliary power for boats or caravans or to power traffic warning signs. Slightly larger turbines can be used for making contributions to a domestic power supply while selling unused power back to the utility supplier via the electrical grid. Arrays of large turbines, known as wind farms, are becoming an increasingly important source of intermittent renewable energy and are used by many countries as part of a strategy to reduce their reliance on fuels. The amount of power produced will be based on the number of rotations of the wind turbine blades. The main advantages of this energy source is, it is a

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clean fuel source. It does not require water unlike the conventional energy sources.

VI.CONVENTIONAL SYSTEM

In recent years, the progress in power electronics has facilitated the development of integrated power converters that are capable of interfacing with and controlling energy sources concurrently. Emerging multiport topologies are based on a unified converter topology with multiple inputs that are capable of interfacing with different sources, storages and load.

Instead of using separate power electronic converters for each energy source, multiport converters have the advantages of requiring fewer components and having a low cost.

Many topologies have been proposed to create a multiport interface. Among them, one simple topology is to interface several converter stages to a common DC bus based on buck, boost and buck-boost structures with interleaved modulation that reduces the total current ripple.

Solar power is mainly used in a renewable energy system as it is abundantly available. The Renewable Energy System includes solar PV panel and fuel cell stack as renewable sources and battery and hydrogen tank as storage devices. Solar power is mainly used in a renewable energy system as it is abundantly available. The Renewable Energy System includes solar PV panel and fuel cell stack as renewable sources and battery and hydrogen tank as storage devices. The proposed system is able to operate in both grid connected and islanded modes for different energy management scenarios.

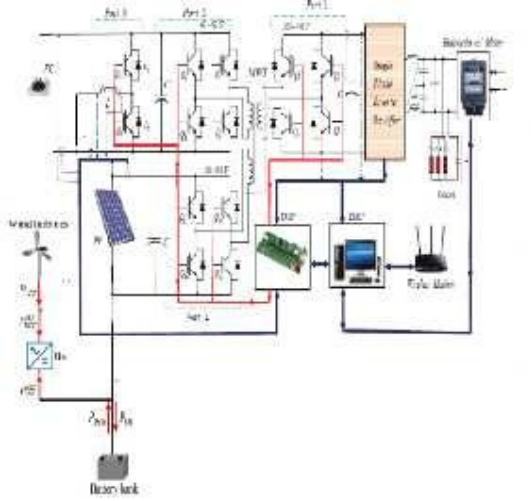

Fig. 6.1 Conventional system

CIRCUIT DIAGRAM

The main intention of the project is to avoid the emission of harmful gases into the atmosphere and to reduce the usage of fossil fuels. By using these solar and the wind energy sources, the above two consequences can be easily avoided.

Solar panels are placed,so as to produce power through the conversions that take place in it. And wind turbines are placed, where power is produced in it based on the number of rotations of the wind mill's blades. The exact amount of power produced cannot be calculated, as these energy sources work depending upon the environment or the condition where it is planted. In sunny areas, solar will be richer. And in the regions where sea shore is present, wind will be flowing likely much, and it causes the blades of the wind mill to rotate several times thus producing more energy to supply the loads in demand.

Since, wind is always available, the lack of power through the solar source can be balanced through this.With the help of the multi-port converters it is much easier to integrate these sources and with the bi-directional inverter.Bi-directional inverters are present where more than two renewable energy sources are present.

The modes of operations are:

1.The solar panels receive sunlight with the help of the photovoltaic cells and the wind turbines rotate in such a way that it absorbs atmospheric air.

2.The input which is dc is converted to ac with help of inverter.

3.The ac supply is given to multi winding transformer.

4.The multiport is connected to the transformer.Among them, one port has diode rectifier which converts ac to dc and this dc supply is given to non linear loads.

5.The other port has dc link and inverter which converts dc to ac .This ac supply is given to three phase induction motor.

6.Thus,multiport converter has three ports. One port is connected to input and the other two ports are connected to two loads which are linear and non linear loads**.**

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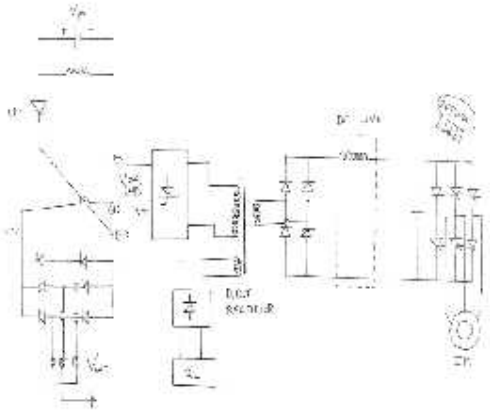

Fig. 7.1 CIRCUIT DIAGRAM FOR PROPOSED MODEL

VIII. SIMULATION RESULTS

The simulation models are obtained for various parts of the proposed system. Solar PV, wind turbine, three phase inverter (Using Space Vector PWM) and the motor load are simulated in MATLAB and the results are analyzed.The simulation results for this model are given below.

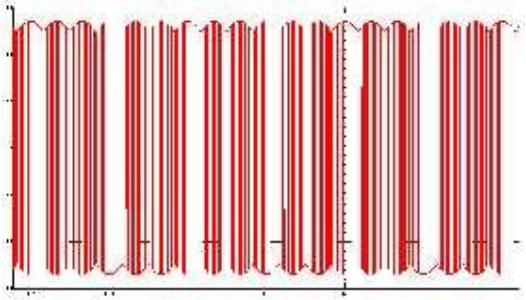

Fig. 8.1 Voltage waveform

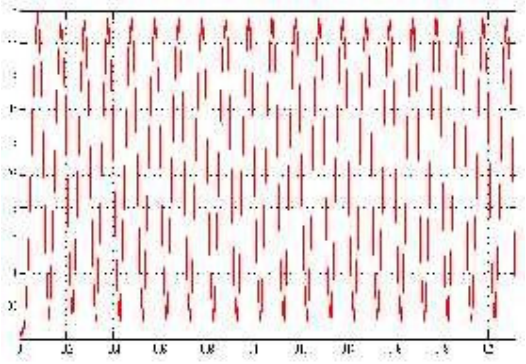

Fig.8.2 Rectifier Current Waveform

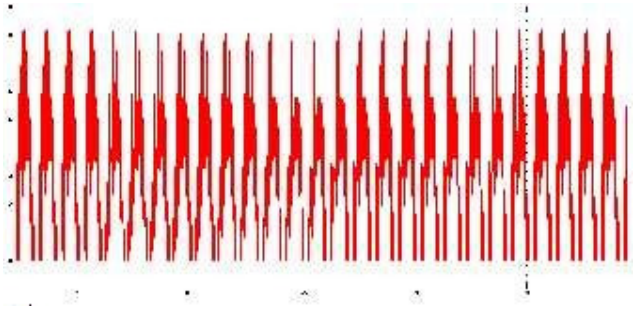

Fig. 8.3 Rectifier Voltage Waveform

IX. CONCLUSION

Thus in our project we reduced the amount of emission of greenhouse gases and the demand in power supply for large loads has been reduced. The multi-port converter thus helped in the integration of the two renewable energy sources for getting the expected output.The amount of power generated will be based on the environment where it is present.The climate condition too plays a major factor.Overall,the project is proposed for the higher power generation with the help of multi-port converters using solar and wind energy sources.

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