A Review Paper on Photovoltaic Array Connected Micro Grid System

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Abstract*—India has the tremendous scope of Renewable energy sources. Wind and solar power are the two most started technologies for converting renewable energy sources into electrical energy. Common sources of renewable energy. Many researches has been One of the most efficient technology for converting solar energy to electrical energy is solar Photo Voltaic array (group of PV cells) converting solar energy, but for converting solar power to electrical power the climate change is considered as a subject of high importance. In India currently, many projects are going on with the PV arrays where PV arrays are connected to the grid directly for the distribution of electrical energy. The growing energy demand in developing nations has triggered the issue of energy security. This has made essential to utilize the untapped potential of renewable resources. Grid connected PV systems have become the best alternatives in renewable energy at large scale. The study of grid connected plants could help in designing, operating and maintenance of new grid connected systems.*

Keywords—Matlab,Microgrid,Simulink

I. INTRODUCTION

Due to the concerns of global warming, environmental pollution, and the instability of oil prices, the development of renewable energy based Distributed Generation is moving fast to meet the worldwide urgent needs of utilizing clean energy sources and minimizing costs. Researchers have identified many renewable energy sources. Among these sources, photovoltaic (PV) can be considered the most essential resource because of the ubiquity, abundance, and sustainability of solar radiant energy [1]. This method of utilizing solar energy is through PV cells in the form of electrical energy. A groupof cells forms a PV module and a combination of PVmodules is called a solar panel, while a group of solarpanels is called a PV array which is connected to the grid, India has tremendous scope of generating solarenergy. The reason being the geographical location and it receives solar radiation almost throughout the year, which amounts to 3000 h of sunshine. This is equal to more than 5000 trillion kW h. Almost all parts of India receive 4–7 kW h of solar radiation per square meters (Sudhakar et al., 2013). India has an ambitious plan to build large grid-connected solar power plants, with a cumulative installed capacity of 20,000 MW by 2020, under the National Solar Mission (Ministry of New and Renewable Energy, 2014).

In a past years standalone solar systems are self-containedor portable solar PV systems that are not connected to any local utility or mains electrical grid as they are generally used in remote and rural areas. This generally means that the electrical appliances are a long way from the nearest fixed electrical supply, or were the cost of extending a power line from the local grid may be very expensive.

This paper presents the background and the motivation for the research work, with an overview of Research and Development in the area of solar energy utilization in the past, present and future; the economics of solar PV energy generation; and, lastly the realization of the renewable generation through subsystem approach such as micro-grid while touching upon the technical issues in the control of converters in micro grids.

II. LITERATURE REVIEW

B. Shiva Kumar and K. Sudhakaret.alin the year 2015 published a paper on ELSEVIER states that, the growing energy demand in developing nations has triggered the issue of energy security. This has made essential to utilize the untapped potential of renewable resources. Grid connected PV systems have become the best alternatives in renewable energy at large scale. Performance analysis of these grid connected plants could help in designing, operating and maintenance of new grid connected systems. A 10 MW photovoltaic grid connected power plant commissioned at Ramagundam is one of the largest solar power plants with the site receiving a good average solar radiation of 4.97kWh/m2/day and annual average temperature of about 27.3 degrees centigrade. The plant is designed to operate with a seasonal tilt. In this study the solar PV plant design aspects along with its annual performance is elaborated. The various types of power losses (temperature, internal network, power electronics, grid connected etc.) and performance ratio are also calculated. The performance results of the plant are also compared with the simulation values obtained from PV syst and PV-GIS software. The final yield (YF) of plant ranged from 1.96 to 5.07 h/d, and annual performance ratio (PR) of 86.12%. It has 17.68% CUF with annual energy generation of 15 798.192 MW h/Annum (Performance evaluation of 10 MW grid connected solar photovoltaic power plant in India.[1] ,Vikrant Sharma and S.S. Chandelet.alin the year 2013 published a paper on ECONPAPERS states that, the performance analysis of a 190 kWp solar photovoltaic power plant installed at Khatkar-Kalan, India, is carried out. The final yield, reference yield and performance ratio, are found to vary from 1.45 to 2.84 kWh/kWp-day, 2.29 to 3.53 kWh/kWp-day and 55–83% respectively. The annual average performance ratio, capacity factor and system efficiency are found to be 74%, 9.27% and 8.3% respectively. The average annual measured energy yield of the plant is found to be 812.76 kWh/kWp. The average annual predicted energy yield is found to be 823 kWh/kWp using PVSYST. The estimated energy yield is in close agreement with measured results with an uncertainty of 1.4%. The total estimated system losses due to irradiance.[2]

The Ministry of Electricity and Renewable Energy (MERE) et.al in the year 2012 publisheda article which

began promoting the system of ‗Feed-in Tariff' in billing. The introduced system allows the user to generate electricity through solar panels mounted on the roofs of residential buildings and governmental organizations and tied to the grid. To benefit from MERE's approach, the National Water Research Center (NWRC) (Qanatir, Egypt) set up a pilot rooftop 91 kW PV system. All the generated electricity is fed into the 220 V, 50 Hz low voltage grid serving NWRC premises. In this manuscript a MATLAB Simulink model is constructed mimicking a detailed representation of the system tied either to the local low voltage grid or to the national high voltage grid. The aim of such modeling effort is to provide early evaluation of the system performance. The economical savings of both scenarios are compared based on the new billing system. Results show that the current system saves 100 thousand L.E./year, while tying the system to the national grid will save 235.8 thousand L.E./year.© 2017 National Water Research .[3]

L.M. Ayompe et.al in the year 2011 published a paper on ELSEVIER states that this paper presents results obtained from monitoring a 1.72 kWp photovoltaic system installed on a flat 24 roof of a 12 m high building in Dublin, Ireland (latitude 53.4N and longitude 6.3E). The system was 25 monitored between November 2008 and October 2009 and all the electricity generated was fed into 26 the low voltage supply to the building. Monthly average daily and annual performance parameters of 27 the PV system evaluated include: final yield, reference yield, array yield, system losses, array capture 28 losses, cell temperature losses, PV module efficiency, system efficiency, inverter efficiency, performance 29 ratio and capacity factor. The maximum solar radiation, ambient temperature and PV module tempera- 30 ture recorded were 1241 W/m 31 2 in March, 29.5 C and 46.9 C in June respectively. The annual total energy generated was 885.1 kW h/kWp while the annual average daily final yield, ref- 32 erence yield and array yield were 2.41 kW h/kWp/day, 2.85 kW h/kWp/day and 2.62 kW h/kWp/day 33 respectively. The annual average daily PV module efficiency, system efficiency and inverter efficiency 34 were 14.9%, 12.6% and 89.2% respectively while the annual average daily performance ratio and capacity 35 factor were 81.5% and 10.1% respectively. The annual average daily system losses, capture losses and cell 36 temperature losses were 0.23 h/day, 0.22 h/day and 0.00 h/day respectively. 37 Comparison of this system with other systems in different locations showed that the system had the 38 highest annual average daily PV module efficiency, system efficiency and performance ratio of 14.9%, 39 12.6% and 81.5% respectively. The PV system's annual average daily final yield of 2.4 kW h/kWp/day is 40 higher than those reported in Germany, Poland and Northern Ireland. It is comparable to results from 41 some parts of Spain but it is lower than the reported yields in most parts of Italy and Spain. Despite 42 low insulation levels, high average wind speeds and low ambient temperature improve Ireland's 43 suitability. Temperature, module quality, array mismatch, ohmic wiring and inverter, are found to be 31.7%. The study shows that energy generated is maximum during March, September, and October and minimum in January. The performance of the system is compared with PV systems installed worldwide and found comparable. The results presented provide insight to the long-term performance of the solar power plant under actual operating conditions in India. The need for optimizing solar panel inclination is emphasized for maximizing power generation. Further, follow-up research studies are also identified power load. The results were claimed to be suitable for further experiments of inverters and the maximum power point tracking in the PV system.[4]

Tsai et.al. in the year 2010 presented in their paper a novel model of photovoltaic (PV) module which is implemented in Matlab/Simulink. The effect of irradiance and temperature is taken into account for the proposed model. The output current and power characteristics are simulated and analyzed using the proposed PV model. The model verification has been confirmed through an experimental measurement.[5]

Di Piazza et al. in the year 2010discussed a simulator of a photovoltaic (PV) field in which the I-V characteristic is obtained either with a fully analytical model or with a numerical model. The power circuit used is a dc-dc buck converter controlled by the I-V relation of the PV array. The new algorithm for the PV array modelling is as follows: A continuous surface in the irradiance domain is considered and a relation between temperature and irradiance is obtained by least square regression method, and a thermal constant of the PV field is introduced. A PV simulator prototype is experimentally tested.[6]

Yuan Li et.al in the year 2009 presented an article states that the hybrid control strategy for photovoltaic (PV) emulator. The mathematic modelling of the I-V curve of PV arrays is presented and the emulator can work in four different modes. The control unit of the emulator is designed using TMS320LF2407 DSP. A 2-kW prototype is reported to be built and tested with a variable resistive load and a constant.[7]

Atlas &Sharaf et.al in the year 2007 presented a simulation model for photovoltaic array (PVA) inMatlab-Simulink. The model is developed using basic circuit equations of the photovoltaic (PV) solar cells including the effects of solar irradiation and temperature changes. The testing of the model is done with dc as well as ac loads. The test results were also presented.[8]

Martin-Segura et.al in the year 2007 published in their paper proposed a PV arrayemulator with new model forPV array. The proposed system consists of a 4.4 kW AC/DC power converter based on a DC/DC full-bridge structure and High Frequency (HF) transformer, that allows testing PV inverters'.[9]

EftichiosKoutroulis, et.al.in the year 2006 proposed a novel real-time PV simulator using FPGAs. It consisted of a Buck converter controlled by an FPGA generating the PWM pulses. The user can select the type of PV module and the ambient conditions. It can be used in the prototype development of power converters. The experimental results showed an accuracy of 1.03% for the emulated I-V characteristics performance up to 4 kW with a 650 V and 7 A input.[10]

III. PROPOSED METHODOLOGY

A. Work Description

Previous work and foundation of work is described in our minor project report.In this report we are going to explain the further work in this regard.

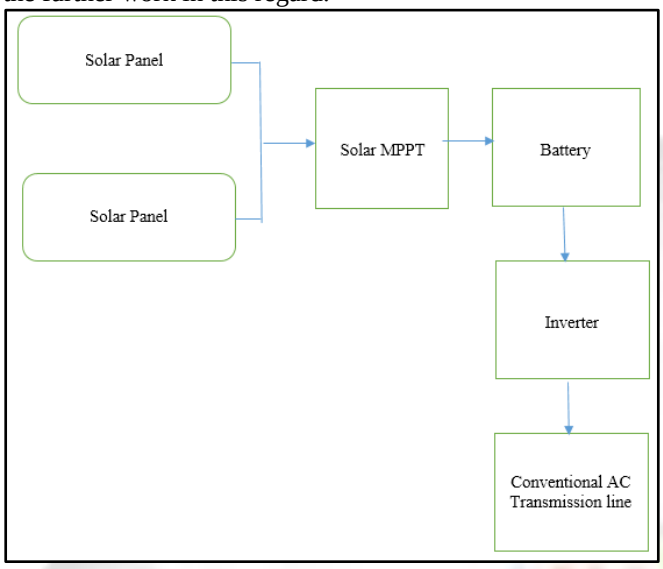


Fig. 3.1: Block diagram of Solar powered Micro grid (Capacity 10 Kw)

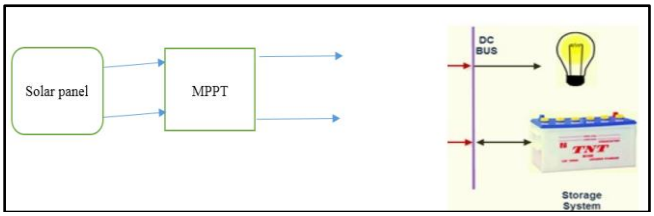
Nowadays, renewable energy is frequently used. Distributed energy sources such as solar power and so on that can be operated in parallel with a wider utility. Nowadays, most of peoples interested to use renewable energy sources such as tidal energy, solar energy, wind energy, geothermal energy, wave energy, and so on. Generation of DC power is done by a micro grid. This block diagram illustrates the storage and utilization of DC power by using a micro grid. These all renewable energy source generates DC power. By generating these DC power we are utilizing by microgrid.

B. Microgrid

A Microgrid is a discrete energy system that consists of distributed energy sources and loads capable of operating in parallel. Thus, the generation, storage and demand management of power becomes easy. The primary purpose is to ensure local, reliable and flexible power for urban and rural communities, at the same time, providing solutions for commercial, industrial and federal government consumers. A microgrid also consists of distributed energy resources like solar PV systems that have several electrical loads

C. Microgrid Architecture

The proposed microgrid system designed with solar renewable energy sources solar power systems which are interfaced to the DC bus with the help of the power electronic components which is called a microgrid. The microgrid generates one output from the different available input power sources to control electrical loads. We can directly give supply to the DC loads using the power generated from a solar electric system generating stations or we can store the DC power in batteries.



Micro grid Architecture

IV. CONCLUSION

Increases the efficiency of energy from the source of generating electricity in accordance to the users' needs. So very little energy is distribution and transmission. Nowadays with fewer load sources, the demand on the microgrid infrastructure is less than the microgrid. The proposed work in which we were going to work is described in the above block diagram. This block represents the solar panel used for required 10 KW capacity micro grid. After that MPPT is connected so that we get maximum energy from solar panel. The battery here use to store the solar energy in form of DC power. The battery is further connected to inverter to supply power to ac transmission line. And battery is can also be directly utilised for other Dc power application. This block diagram describe solar power by interconnecting it to the micro grid that stores and transforms DC power. The matlab simulation is proposed to study the performance

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