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A Review on Multi Solar Grid Connectivity

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Abstract: Photo voltaic systems are widely operated in grid-connected and a stand-alone mode of operations. Power fluctuation is the nature phenomena in the solar PV based energy generation system. In the grid-connected condition when solar radiation is insufficient and unable to meet load demand, the energy is accessed from grid via net meter which makes more reliability in the consumer ends. Some renewable energy projects are large scale, but renewable technologies are also suited to rural and remote areas in developing countries, where energy is crucial to human development. Microgrids are the frameworks that incorporate distributed generation (DG) units, energy storage systems (ESS) and loads, controllable burdens on a low voltage system which can work in either stand-alone mode or grid-connected model. In grid-connected mode, the microgrid alters power equalization of free market activity by obtaining power from the main network or offering energy to the grid to boost operational advantages. The advantage is reduction of cost with respect to generation-based subordinate administrations including decreased requirement for electricity storage equipments, and power generation cost, for fuel and wear. Furthermore, energy storage can give the greater part of the subordinate administrations and the same energy storage unit can be utilized for other purposes. This paper discusses various studies on the impacts of connecting PV system to grid are studied.

Keywords: Solar, Grid Connectivity, Power, PV System

I. Literature Survey:

Madhuri Namjoshi (2013) et al. proposed a photovoltaic system is a device that is capable of converting the energy contained in photons. With the increasing concern about the global demand for Renewable Energy (RE) energy, it is very much important to reduce the cost of the whole solar photovoltaic (PV) system. Till now most of the solar photovoltaic (PV) systems are highly expensive. In this paper we have proposed study of a photovoltaic (PV) solar power system which can be operated by feeding the solar power to the national grid along with the residential load. An extensive literature review of solar PV systems with a special focus on grid-connected systems was conducted. A comparison of Grid connected and off grid system ha been carried out.

Ebenezer Nyarko Kumi (2013) et al. proposed at developing a standard procedure for the design of large-scale institutional grid-connected solar PV systems using the roofs of buildings and car parks. The standard procedure developed was validated in the design of a 1MW grid-connected solar PV system for Kwame Nkrumah University of Science and Technology (KNUST), Ghana. The performance of the 1MW grid-connected solar PV system was also simulated over the guaranteed life of the system using RETScreen Clean Energy Project Analysis software, designed by Natural Resources Canada. The project began with a prefeasibility study of a 1MW grid-conducted solar PV system using RETScreen software which has a broad database of meteorological data including global daily horizontal solar irradiance and also a database of various renewable energy systems components from different manufacturers. An extensive literature review of solar PV systems with a special focus on grid-connected systems was conducted after which the procedure for the design of institutional large-scale grid connected solar PV systems was developed. The developed procedure was used in the design of a 1MW grid-connected solar PV system for KNUST-Ghana. The technical and financial performances of the 1MW grid-connected solar PV system were simulated using the RETScreen software. The preliminary analyses of the simulation results showed that the project is socially beneficial to the community in this case the university with an annual energy yield of about 1,159MWh, which is about 12% of KNUST's annual electricity consumption. The process of electricity generation from solar PV saves about 792 tonnes of CO2. The yield factor, performance ratio and capacity factor were other technical performance parameters considered. Under the prevailing tariff conditions in the country, the project is not financially viable without incentives such as grants and feed-in tariffs.

Om Prakash Mahela (2013) et al. proposed the sale of electric energy generated by photovoltaic plants has attracted much attention in recent years. The installation of PV plants aims to obtain the maximum benefit of captured solar energy. The different techniques of modeling and control of grid connected photovoltaic system with objective to help intensive penetration of photovoltaic (PV) production into the grid have been proposed so far in different papers. The current methodologies for planning the design of the different components of a PV plant are not completely efficient. Therefore lot of research work is required for overall configuration of the grid connected PV system, the MPP tracking algorithm, the synchronization of the inverter and the connection to the grid. This paper focuses on the solar energy, grid connected photovoltaic system, modelling of photovoltaic array, maximum power point tracking, and grid connected inverter. This paper helps the researchers to know about the different methods presented so far for modelling and control of grid

connected photovoltaic system so that further work on integration of solar energy with grid can be carried out for better results.

J Sreedevi (2016) et al. proposed Photovoltaic (PV) energy has a fast growing annual rate and is quickly becoming an important part of the energy balance in most regions and power systems. This paper aims to study the effects of connecting a PV system to the grid through simulation of the system in RSCSD software in real time on the Real Time Digital Simulator (RTDS). Effect of variation of power factor of loads, variation of PV penetration, introduction of harmonics into the system by the PV inverter and anti-islanding effect of the PV system are studied. Finally, the Performance Ratio (PR) of a typical grid connected PV system is evaluated to determine the reliability and grid connectivity of the PV system.

V. Karthikeyan (2017) et al. proposed PV systems are widely operated in grid-connected and a stand-alone mode of operations. Power fluctuation is the nature phenomena in the solar PV based energy generation system. When solar PV system operates in off-grid to meet remote load demand alternate energy sources can be identified, such as hybrid grid-tied or battery storage system for stable power supply. In the grid-connected condition when solar radiation is insufficient and unable to meet load demand, the energy is accessed from grid via net meter which makes more reliability in the consumer ends. Power quality is a major concern, while injecting PV to the grid and mitigating the effects of load harmonics and reactive power in the distribution system is the challenging area. Off-grid solar PV system is independent of the grid and provides freedom from power quality issues and electricity billing. The excess energy can be accumulated in the battery storage units through superior control. The main research challenges in off-grid are to provide support to load when sudden changes happened in a closed network of the load. This chapter deals with the operational behavior of solar PV system in grid-tied and off-grid system. It includes the issues and research challenges during power unbalancing and environmental (solar irradiation) and load conditions, etc. This chapter contains the control strategies of sliding mode control for grid-tied and off-grid system. The simulations have been performed for solar PV fed multilevel inverters for grid-tied and off the grid in islanding regions. Furthermore, the simulations are carried out for load compensation by mitigating the effects of load harmonics and reactive power in the distribution. The results are also presented to provide better insight to reader for understanding grid-connected and off-grid solar PV system.

Dr. Smt. G. Prasanthi (2018) et al. presented Now- a-days solar power generation plays an important role in the power generation for domestic, industrial or commercial purposes. Solar power is very clean and inexpensive. In the grid connected solar power generation system netmetering is a new technique which allows excess solar power generation during summer or bright sunny days which is fed to the utility grid after utilizing for residence. The energy can be imported from the utility grid during night and cloudy days. Netmeter consist of bi directional meter which reads both excess solar power which is sending in to the grid and import energy drawing from the grid. A residence is chosen as a case study. In the present work, solar photovoltaic power generation plant is installed on roof top of residence. Through this installation of solar photovoltaic system on roof top reducing in carbon gas emissions and electricity bill is observed.

A. Sayed (2019) et al. presented solar power generation is significantly contributed to growing renewable sources of electricity all over the world. The reliability and availability improvement of solar photovoltaic (PV) systems has become a critical area of interest for researchers. Reliability, availability, and maintainability (RAM) is an engineering tool used to address operational and safety issues of systems. It aims to identify the weakest areas of a system which will improve the overall system reliability. In this paper, RAM analysis of grid-connected solar-PV system is presented. Elaborate RAM analysis of these systems is presented starting from the sub-assembly level to the subsystem level, then the overall system. Further, an improved Reliability Block Diagram is presented to estimate the RAM performance of seven practical grid-connected solar-PV systems. The required input data are obtained from worldwide databases of failures, and repair of various subassemblies comprising various meteorological conditions. A novel approach is also presented in order to estimate the best probability density function for each sub-assembly. The monitoring of the critical subassemblies of a PV system will increase the possibility not only for improving the availability of the system, but also to optimize the maintenance costs. Additionally, it will inform the operators about the status of the various subsystems of the system.

Bhuwan Pratap Singh (2019) et al. presented Smart grid is the key technology for an effective utilization of the Renewable Energy Sources (RES). The utilization of RES for the generation of electricity is increasingly gaining interest of researchers during the last decades. The main reason behind this is global incentivization, the increasing price of petroleum products, climate issues and deregulations in the energy market. As the Government of India, (MNRE i.e. Ministry of New & Renewable Energy) is targeting to generate 20000 MW power through grid-connected solar PVS by the year 2022 therefore, the main focus in this paper has been presented on power generation through grid-connected PVS. The emerging smart grid technology has enabled the grid-connected PVS as an evolving process in today's world for electrical power generation. However, apart from so many advantages, there are several issues and challenges associated with the integration of PVS to the electric utility grid hence, the investigation to find out available possible solutions to overcome these issues becomes essential in order to enhance the performance of

grid-connected PVS. The most severe constraint associated with this emerging technology is it high penetration level. If during low load conditions there is some mismatch found between the real power output and the load profile characteristics of PVS then it may result into large reverse power flow, high power losses or severe voltage violation. In this paper, several issues and challenges associated with the integration of solar PVS with the electric utility grid are presented.

Mohmmad Ahmad (2019) et al. proposed the performance of Solar Photo Voltaic (SPV) based grid connected multilevel inverter scheme having linear and nonlinear load connected at the Point of Common Coupling (PCC). Initially the analysis was carried out for the complete inverter circuit resulting in a slightly higher harmonics in PCC voltage and current, which can be further reduced to a lower value by connecting a filter. For a linear RL load, due to the filter, the THD in PCC voltage is reduced from 13% to below 5% (IEEE standard) and the THD in grid current decreases to below 5% from 14.8%. Similarly for a nonlinear load at PCC, a Diode Bridge, the harmonics in PCC voltage and the grid current can be further reduced to the lower level by connecting filter. The results obtained from simulation using SIMULINK/MATLAB Software are tabulated for SPV based grid tied system and also explained graphically.

Qais Alsafasfeh (2019) et al. proposed As the unconstrained integration of distributed photovoltaic (PV) power into a power grid will cause changes in the power flow of the distribution network, voltage deviation, voltage fluctuation, and so on, system operators focus on how to determine and improve the integration capacity of PV power rationally. By giving full consideration to the static security index constraints and voltage fluctuation, this paper proposes a maximum integration capacity optimization model of the PV power, according to different power factors for the PV power. Moreover, the proposed research analyzes the large-scale PV grid access capacity, PV access point, and multi-PV power plant output, by probability density distribution, sensitivity analysis, standard deviation analysis, and over-limit probability analysis. Furthermore, this paper establishes accessible capacity maximization problems from the Institute of Electrical and Electronics Engineers (IEEE) standard node system and power system analysis theory for PV power sources with constraints of voltage fluctuations. A MATLAB R2017B simulator is used for the performance analysis and evaluation of the proposed work. Through the simulation of the IEEE 33-node system, the integration capacity range of the PV power is analyzed, and the maximum integration capacity of the PV power at each node is calculated, providing a rational decision-making scheme for the planning of integrating the distributed PV power into a small-scale power grid. The results indicate that the fluctuations and limit violation probabilities of the power system voltage and load flow increase with the addition of the PV capacity. Moreover, the power loss and PV penetration level are influenced by grid-connected spots, and the impact of PV on the load flow is directional.

II. Conclusion:

A grid-connected photovoltaic power system will reduce the power bill as it is possible to sell surplus electricity produced to the local electricity supplier. Grid-connected PV systems are comparatively easier to install as they do not require a battery system. Grid interconnection of photovoltaic (PV) power generation systems has the advantage of effective utilization of generated power because there are no storage losses involved. A photovoltaic power system is carbon negative over its lifespan, as any energy produced over and above that to build the panel initially offsets the need for burning fossil fuels. Even though the sun doesn't always shine, any installation gives a reasonably predictable average reduction in carbon consumption.

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