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Design and Implementation of a Three Phase Inverter for Renewable Energy Source with Unified Control Strategy

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Abstract

Microgrids are becoming widespread because of their evident benefits which comprise of the improved reliabilities they can operate with and their lower emission levels over the conventional generation. Thus the face of electricity generation is experiencing modifications as technological improvements are emerging to mitigate the problems of increasing cost and the pollution caused due to excessive use of fossil fuel based electricity generation to meet our ever growing demands. Microgrids utilize renewable energy sources (RES) viz. photovoltaic cells, fuel cells, wind etc. instead of using the conventional fuels. As the energy requirement of the world is growing enormously and will continue to rise as year's progress, RES's are surely a solution to the above problems. This paper deals with design of photovoltaic (PV) based three phase grid connected voltage source converter with unified control strategy (UCS). The UCS takes into consideration the general feedback requirements for desired response and performance from the microgrid and at the same time includes a feedforward control for DC bus control. Simulation results attained are been presented in this paper.

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Keywords: Microgrids ; Unified control

Solar power based generation is increasing as days are progressing because it is evidently one of the most abundant sources available in our country. Adding to its advantages are the facts that they can be installed in almost every location and the maintenance required is also less in comparison to other RES's. Grid connected Photovoltaic (PV) systems are gaining more significance over standalone configuration. The evident reason being that there is no longer the unavoidable necessity of an energy storage system (ESS) to nullify the ineffectiveness of the PV source during the nighttime or low insolation period. On the other hand in interconnected systems there always lies a fear of cascaded

tripping and a brownout or a blackout. To solve this problem and thus aid us in at least powering our critical loads in such a crisis situation, the concept of Microgrids [1] was developed.

Microgrids are basically low- or medium-voltage controlled and monitored power systems that can include numerous distributed energy resources (DERs), and local loads. The most captivating feature of a microgrid is its ability to isolate itself from the utility during blackouts or even when the power quality of the grid reduces below certain standards [1]. Thus microgrids can mainly operate in two modes viz. grid-connected and islanded modes. As micro-sources are relatively small in comparison to utility, the voltage and frequency of the microgrid are dictated by the utility in the grid-connected mode and the microgrid act as controllable current source. On the other hand in islanded mode the microgrid should produce a controlled voltage and frequency output. This objective can be realized most successfully and appropriately if the microgrid acts as controllable voltage source. [2]- [3]

The project proposed hereby aims to work on similar lines to design and implement a three phase inverter with unified control strategy for balanced as well as unbalanced ac system conditions. The unified control strategy takes into consideration the general feedback requirements for desired response and performance from the microgrid and at the same time includes a feedforward control for DC bus control. This paper deals with a PV based VSC system feeding the grid in the same context. The current work includes simulation based studies on 2 kVA grid connected VSC system for balanced grid conditions.

1. System Description

The feedback control for interconnection with balanced ac systems is developed taking into account the above mentioned roles the microgrid has to operate in. The dc-link voltage controller helps in balancing system power flow in grid connected mode [2]. Fig.1 represents the block diagram for the proposed grid connected PV system. Microgrid exchanges power with the utility depending on its generation and local load demand.

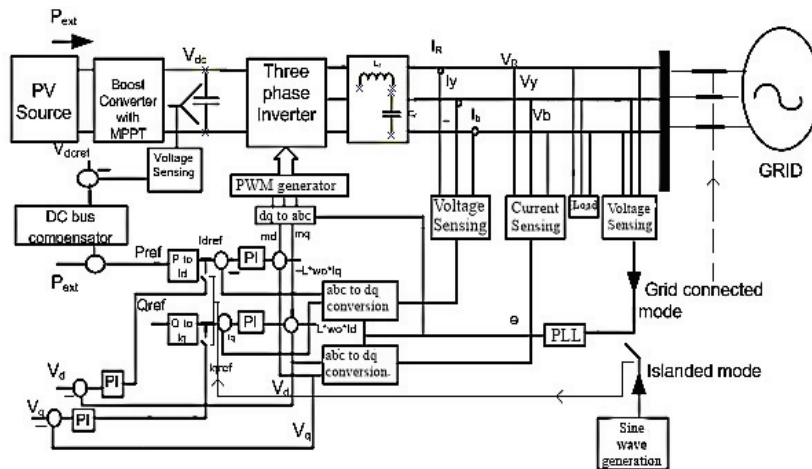


Fig 1. Block diagram for the proposed grid connected PV system

The exchange includes exporting excess power to the utility when power produced by microgrid is greater than that required loads or importing power when microgrid is incapable of producing the required power. Thus the active and reactive power which is to be exchanged with utility needs to be controlled. The active power being shared depends in turn on power available from the source. The microgrid operates in grid connected mode; once the static transfer switch (STS) is closed else it operates in standalone mode or voltage control mode. The micro source which is used

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