



Analysis of Photovoltaic System Integration into Distribution Grid

ABSTRACT
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ABSTRACT: Solar photovoltaic (PV) technology is one of the most popular and prominent techniques in the midst of renewable energy sources. The grid connected configuration of the solar photovoltaic system has been recognised as an alternate source for fulfilling the demand of power. To sustain the dilemma of energy demand, the grid tied solar photovoltaic system has emerged as one of the decent solutions. Most of the loads in the power system architecture are connected on the distribution side either in primary or secondary. Hence, analysis of photovoltaic system integration into the distribution grid becomes a vital subject for accomplishing the ambitious goals in power sectors.

The main objectives of this work are to explore the key components allied with the grid integrated solar photovoltaic system, to address the issues pertaining to the small scale solar photovoltaic plant and to examine the issues pertaining to the grid connected solar PV system so that a robust system can be developed and implemented practically. With this motivation, firstly the identification and exploration of the driving factors for PV system have been done beginning with the modeling of the photovoltaic cell comprising solar module in the continuous variation of environmental conditions, developing and testing of an algorithm for tracing the maximum power point, selection process of DC-DC converter components and classifying the grid tied inverter topologies. All these acts as driving factors and have their own significance in the overall system.

Since, the work focused on the small scale grid integrated solar photovoltaic system that mostly installed on the roof-top, the associated complications of roof-top solar photovoltaic arrangement have been addressed under the second aspect of the study. The foremost designing aspect of any roof-top based PV plant is the optimum utilization of the space for its installation. With the minute changes in the orientation of modules and precise calculations of module placement, the energy generated from

the solar PV system can be escalated leading to more savings in terms of capital and consumption of grid power. This research work proposes the formula for optimum space calculation for PV installation. Also, a novel design of a non-movable tracking system that enhances the power generation of PV modules is also under the scope of this work.

Then the focus shifted towards the issues pertaining to the grid tied solar photovoltaic arrangement. One of the greatest challenges involved in the grid integrated solar PV plant is the islanding. The grid connected inverter should be proficient in determining the islanding circumstances and prevent feeding the generated power to the grid. This islanding detection can be detected easily by comparing the selected parameters of the grid with its threshold value. The passive islanding detection method has been used for identifying the islanding situation in present research work for the multi-DG power system. The two practical scenarios were considered for isolation of the grid, one due to the occurrence of a fault and other intentional disconnection of the grid for schedule maintenance.

Lastly, emphasis has been given towards the vigorous and coherent grid tied solar PV system by improving the designing of power electronics based converter so that the losses across them may be reduced. Keeping this goal, a novel synchronous interleaved boost converter has been proposed for applications of solar photovoltaic sources which have the dual advantages that is interleaving the input current to reduce the ripples and works under the synchronous mode of operation so that the conduction time enhances and loss across the diode gets reduced. The Simulink environment has been used for firstly analysing the system under varying irradiance and temperature conditions and then tested in the hardware prototype. Further, the power quality study has also been done which is essentially required for any grid integrated solar PV configuration. Hence, an attempt has been done for the analysis of photovoltaic system integration into the distribution grid in this research work.