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Modelling Of Mppt Based Pv System For Small Scale Utility Grid Connected System

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Abstract: This paper presents a The micro grid concept introduces the power is generated from the renewable energy sources like P.V Wind, Fuel Cell, micro turbine etc will give signifying moment in near future. These power generating stations interconnected for consumer applications this results increase circuit complexity, cost and system have less reliability. To regulate the dc-link voltage, a modified voltage controller using feedback linearization scheme with feedforward PV current signal is presented. The real and reactive powers are controlled by using dq components of the grid current. A small-signal stability/eigenvalue analysis of a grid-connected PV system with the complete linearized model is performed to assess the robustness of the controller and the decoupling character of the grid-connected PV system

Index Terms—Grid-tied mode, coordination control operations, PV system, Distribution System, MPPT Controller.

1. INTRODUCTION

Renewable energy is currently widely used. One of these resources is solar energy. The photovoltaic (PV) array normally uses a maximum power point tracking (MPPT) technique to continuously deliver the highest power to the load when there are variations in irradiation and temperature. The disadvantage of PV energy is that the PV output power depends on weather conditions and cell temperature, making it an uncontrollable source. Furthermore, it is not available Combining multiple renewable resources via a common dc bus of a power converter has been prevalent because of convenience in integrated monitoring and control and consistency in the structure of controllers as compared with a common ac type. There are some previous works on similar hybrid systems [2]–[11]. Dynamic performance of a stand-alone solar system with battery storage was analyzed [3]. A Several methodologies for optimal design or unit sizing of stand-alone or grid-connected systems have been proposed using steady-state analysis [4]–[7]. In addition, the steady-state performance of a grid-connected wind- and photovoltaic (PV)-power system with battery storage was analyzed [8]. This paper focused on system engineering, such as energy production, system reliability, unit sizing, and cost analysis, based on long terms of data hourly, daily, and yearly recorded. A simulation package was developed for a PV power system [9]. Most applications are for stand-alone operation, where the main control target is to balance local loads. A few grid-connected systems consider the grid as just a back-up means to use when there is insufficient supply from renewable sources [4], [5], [8]. They are originally designed to meet local load demands with a loss of power-supply probability of a specific period. Such systems, focusing on providing sustainable power to their loads, do not care much about the quality or flexibility of power delivered to the grid. From the perspective of utility, however, a system with less fluctuating power injection or with the capability of flexibly regulating its power is more desirable. In addition, users will prefer a system that can provide multiple options for power transfer since it will be favorable in system operation and management. Control strategies of such a system should be quite different from those of conventional systems. This paper addresses dynamic modeling and control of a grid-connected PV–battery system with versatile power transfer. i this system, unlike conventional systems, considers the stability and dispatch-ability of its power injection into the grid. The system can operate in different modes, which include normal operation without use of battery, dispatch operation, and averaging operation. In order to effectively achieve such modes of operation, two modified techniques are applied; a modified hysteresis control strategy for a battery charger/discharger and a power averaging technique using a low-pass filter. The concept and principle of the system and its supervisory control are described. Classical techniques of maximum power tracking are applied in PV array using MPPT control. Dynamic modeling and simulations were based on Power System Computer Aided Design/Electromagnetic Transients Program for DC (PSCAD/EMTDC), power-system transient-analysis software. The program was based on Dommel's algorithm, specifically developed for the simulation of high-voltage direct current systems and efficient for the transient simulation of power system under power-electronic control of inverter and its control system were developed.

Grid Operation

Wherever the basic main diagram of a AC/DC micro grid shows it will consists two renewable energy sources one is P.V the output of P.V array is connected to the boost converter.

A capacitor is supplies the high frequency ripples of P.V output voltage .the energy storage battery is connected to the D.C bus through DC-DC boost converter. The rated voltage of D.C bus is 400v respectively. Another renewable energy device is wind generation with DFIG is connecting to ac sources through A.C bus. Three phase bidirectional DC/AC main converter wit R-L-C connected between DC bus and AC bus.

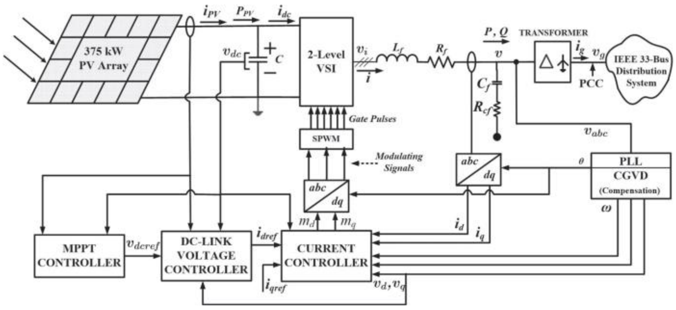

Fig.1. Block diagram of PV System with Distributed Grid

The hybrid grid can operate in two modes one is grid-tied mode and isolated mode the present work is did in grid-tied mode the boost converter and WTG are controlled to provide the maximum power. The main converter is to provide stable dc bus voltage and required reactive power and to exchange power between the ac and dc buses. When the output power of the dc sources is greater than the dc loads, the converter acts as an inverter and injects power from dc to ac side. When the total power generation is less than the total load at the dc side, the converter injects power from the ac to dc side. When the total power generation is greater than the total load in the hybrid grid, it will inject power to the utility grid.

2. MODELLING OF P.V SYSTEM

Generally, a PV module comprises of a number of PV cells connected in either series or parallel the classical equation of a PV cell describes the relationship between current and voltage of the cell (neglecting the current in the shunt resistance of the equivalent circuit of the cell) as

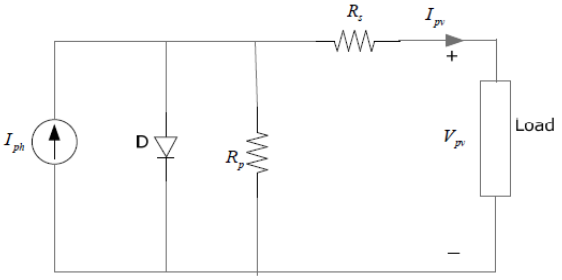

Fig.2. Equivalent circuit of PV cell

$$I_{ph} = I_L - I_O\left[\exp\left(\frac{V_{ph} + R_{se} I_{ph}}{A}\right) - 1\right]$$

$$I_O = n_p I_{ph} - n_p I_{rs}\left[\exp\left(\frac{K_o V}{n_s}\right) - 1\right]$$

Where *I*o denotes the PV array output current, *V* is the PV output voltage, is the cell photocurrent that is proportional to solar irradiation, is the cells reverse saturation current that mainly depends on the temperature, is a constant, *n* and are the numbers of series strings and parallel strings in the PV array, respectively.

MPPT (P&O method)

Define Perturb-and-observe (P&O) method is dominantly used in practical PV systems for the MPPT control due to its simple implementation, high reliability, and tracking efficiency. Shows the flow chart of the P&O method [4-5]. The present power *P (k)* is calculated with the present values of PV voltage *V (k)* and current *I (k)*, and is compared with the previous power *P (k-1)*. If the power increases [6-7], keep the next voltage change in the same direction as the previous change.

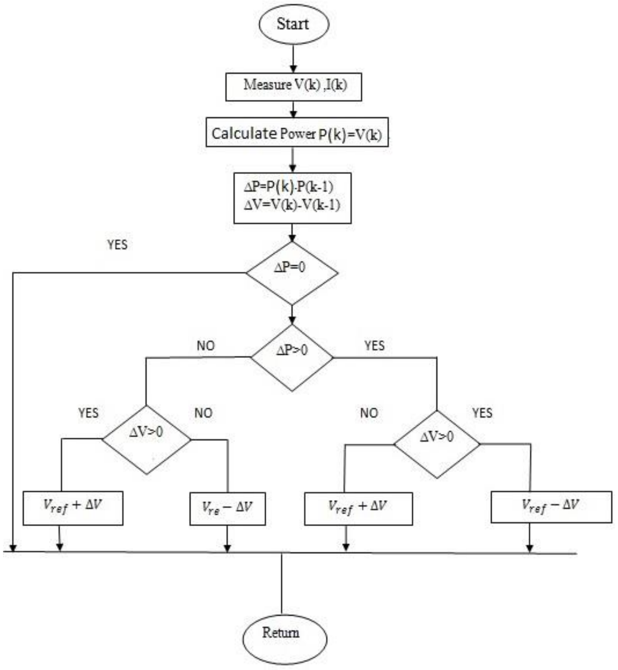

Fig.3. Flow chart for MPPT algorithm.

Dynamic Modeling of Boost Converter

The main objective of the boost converter is to track the maximum power point of the PV array by regulating the solar panel terminal voltage using the power voltage characteristic curve.

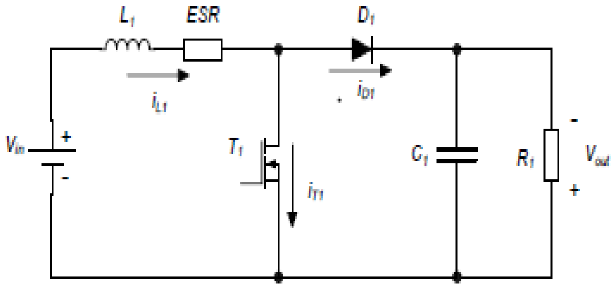

Fig.4. Boost Converter

$$Vin - L\frac{di_1}{dt -}(1 - D)V_C - ESRi_1 = 0$$

$$i_{D1} = i_{C1} + i_{L1}$$

$$\begin{bmatrix} \dot{i}_{L_1} \\ \dot{v}_{C_1} \end{bmatrix} = \begin{bmatrix} \frac{-\mathrm{ESR}}{L_1} & \frac{-(1-D)}{L_1} \\ \frac{1-D}{C_1} & \frac{-1}{R_1 C_1} \end{bmatrix} \begin{bmatrix} i_{L_1} \\ v_{C_1} \end{bmatrix} + \begin{bmatrix} \frac{1}{L_1} \\ 0 \end{bmatrix} [V_{in}]$$

$$[V_{Out}] = [0 \quad 1] \begin{bmatrix} i_{L_1} \\ v_{C_1} \end{bmatrix} + [0][V_{in}]$$

3. DISTRIBUTION SYSTEM:

The transmitted electric power is stepped down in substations, for primary distribution purpose. Now these stepped down electric power is fed to the distribution transformer through primary distribution feeders. Overhead primary distribution feeders are supported by mainly supporting iron pole. The conductors are strand aluminum conductors and they are mounted on the arms of the pole by means of pin insulators. Sometimes in congested places, underground cables may also be used for primary distribution purposes.

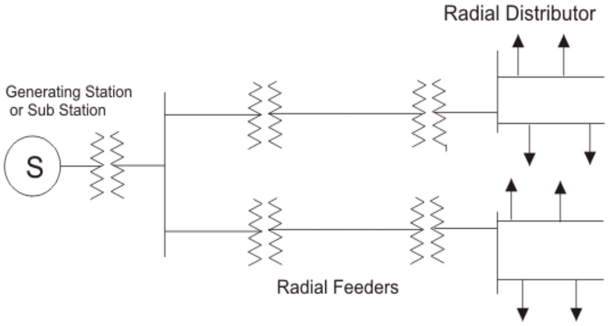

Figure 5: General Distribution System

4. SIMULATION DIAGRAM:

The prosed system shown in figure 6 is simulated and verified in Matlab and presented the system output results.

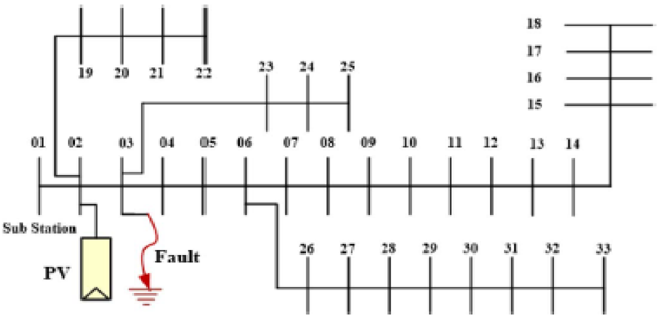

Figure 6: Proposed System

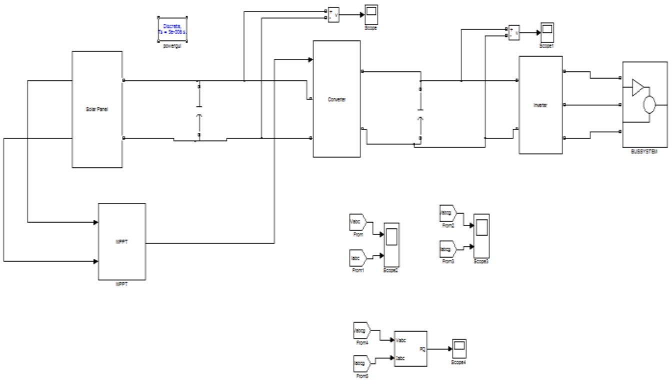

Figure 7: Simulation Diagram for PV System under Utility Grid

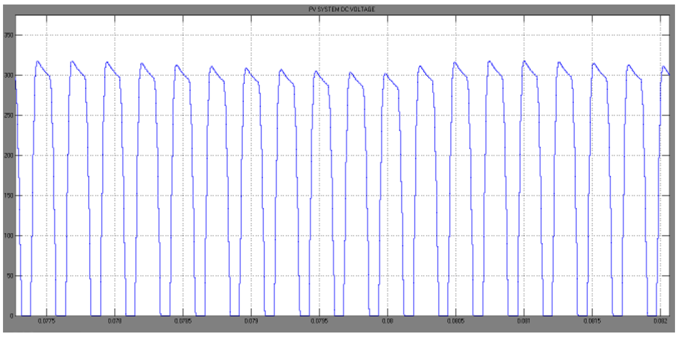

Figure 8: Simulation Waveform for PV DC Voltage

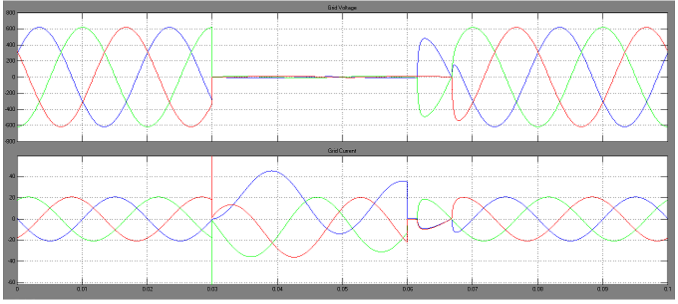

Figure 9: Simulation Waveform for Grid Voltage and Current under Fault Condition

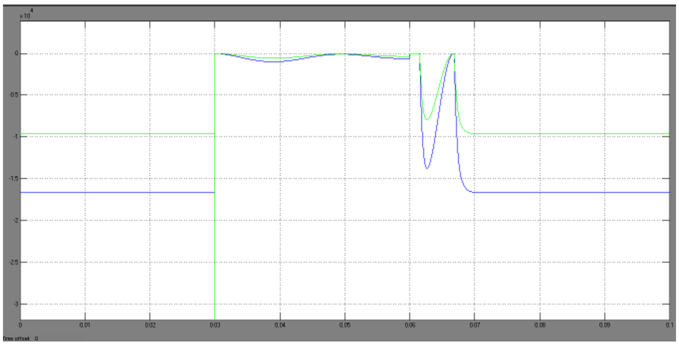

Figure 10: Simulation Waveform Active and Reactive Powers under Fault Condition

5. CONCLUSION

The proposed modified dc-link voltage controller with FBL technique, using INC MPPT, and real and reactive power controls with enhanced filter for compensation for grid voltage dips has been tested at different insolation levels on a real-time digital simulator (RTDS). Small-signal analysis of a PV system connected to an IEEE 33-bus distributed system is performed.

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