iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** XII **Month of publication:** December 2019

DOI:

www.ijraset.com

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue XII, Dec 2019- Available at www.ijraset.com

Dynamic Power Decoupling Strategy for Three Phase Power System under Unbalanced Grid Voltages

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Abstract: ***The objective of this paper is to suggest a dynamic power decoupling methods for the 3 phase power system during the unbalanced grid fault condition. Basically it includes a dc-dc converter and a 3- phase dc-ac inverter is used for the PV power system. During the normal condition or during the normal operation the system will capture the maximum power and also transfer the energy to the grid. If any unbalanced fault takes place in the grid, then the output power also contain the double line frequency oscillation. The only way to deal with this trouble is to increase the dc-hyperlink capacitance, but the main problem is that the cost of the circuits and the size of the circuits is also increase mean while there is a decrement in the reliability of the system.***

Keywords: Dynamic power decoupling, MPPT, Converter, Inverter, MPP

I. INTRODUCTION

In the present scenario, the invention and the usage of new energies are increasing day by day in a large scale. Many new energies like solar energy, tidal energy, wind energy and many more are used by many countries such as US, china, Europe and many more, in which the disbursed photovoltaic strength generation technology are rather worried. As we all know that the global warming problem is increasing day by day so it is necessary to generate or produce pollution free power due to the generation of pollution free power the level of global warming will decrease automatically. The PV system is the most easy and best renewable energy resources present to fulfill the requirement. The PV arrays are connected with the grid with the help of many equipment such as inverter and converter. The medium voltage micro grid plays a very important role in controlling the distribution network. When we considering many issue such as environmental issue, dynamical issues and many more issues then the micro grids play a more important role. Dynamic power is consumed while the inputs are active. When there is an any AC activity on the input side then the capacitances starting charging and discharging then the power start increasing. There is both AC and static component is present in the dynamic power.

There are many new control methods has been used for enhancing the quality of power operation and also many methods are there which are used for better load sharing. There is a one method of load sharing which is used in very scale because of its simplicity and that method is droop characteristics. The desired real and reactive power to the system is controlled by the parallel converter. For the feedback process, the local signals are used to control the converter at various stages. We can get the controlled real and reactive power by controlling two distinct quantities i.e. the fundamental voltage magnitude & the power angle.

II. CONNECTIONS

The system which is able to flow the power in the flexible network topology as per the international council on large electric system can be defined as the active distributions systems. The flexible network topology is basically the combination of the different DER's, different loads, and different type of storage units.

The connection between the different parts of the system is shown below.

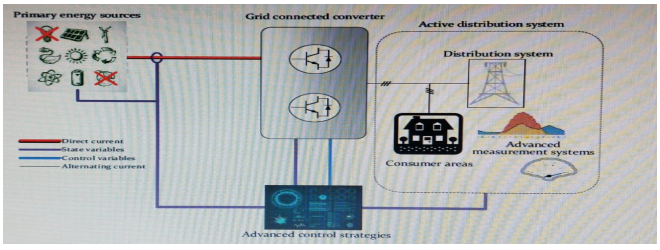

Fig. Connection of PV system

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
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The primary sources such as solar energy, wind energy and many more are connected to the grid connected converter with the help of the various different transmission line, then the grid connected converter system is further connected to the active distributions system. The primary energy sources, grid connected system and the active distribution system is connected with the advance control strategies as shown in the diagram. The advance control strategy basically contains various type of latest equipment which is able to give us sufficient information and also increase the distortions in the supply and many other factors which are very beneficial for the power system.

III. DIFFERENT STRATEGIES

As we know that the main objective of this particular paper is to develop a dynamic power decoupling strategy for a 3 phase PV power system to reduce the oscillation of the dc link produced by the unbalanced grid fault without increasing the level of dc link capacitance.

A. Existing Methods

The power (active & reactive) ripple occurred due to the unbalanced grid fault can be suppressed by the double loop feed forward decoupling method. But in this method the active & reactive power ripple can't be removed both at a time. The main drawback of this method is not eliminating power ripple at a time. This particular drawback is removed in the proposed drawback is removed in the proposed method discussed below.

B. Proposed Method

This paper proposed a DPD (dynamic power decoupling) method strategy for the 3 phase PV power system without increasing the level of the dc-link capacitance. During normal operation, the converter (interleaved boost converter) will get the maximum power point (MPP) from the PV array and a 3 phase inverter will give the power to the grid. During the abnormal condition, the current and the power of the boost converter will be handled by the proposed dynamic power decoupling to get the power decoupling capability and also to remove the dc link voltage oscillation. The block diagram of the three phase PV system shown below.

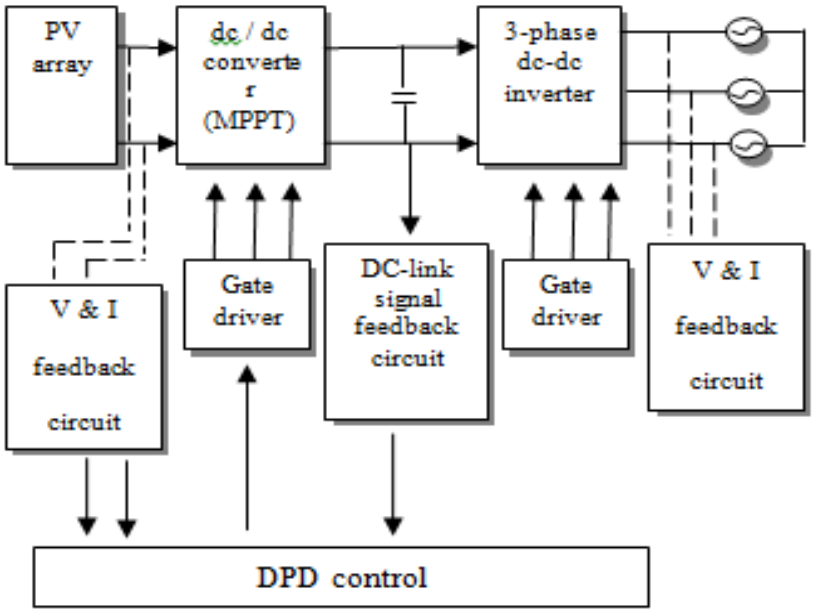

Fig. Three phase PV system

The PV system contains many parts such as PV array, Converters, inverters, feedback circuit, gate driver, dynamic power decoupling (DPD) control and many more. Every part perform a specific work and that work help in reducing the oscillation in the dc-link voltage without increasing the dc-link capacitance. The Dynamic power decoupling method is better than the other method, but the main effect is that the cost of the circuit and the size of the circuit will increases.

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IV. PV OUTPUT POWER FLUCTATIONS

The expressions of the voltage fluctuation for the DC-link in fluctuating PV power terms is give by—

$$\Delta V_{dc,fluct} = \frac{T_{ac}\Delta P}{C_{dc}V_{dc}} \quad \text{..... (i)}$$

Where,

$\Delta V_{dc,\,fluct}$: the average value of change in the DC-link capacitance.

V_{dc} : Voltage of AC- main supply.

C_{dc} : DC-link capacitance.

T_{ac} : Time period.

ΔP : PV output power fluctuation.

The boost converter mainly performing the MPPT task (i.e. maximum power point tracking). If any change is occurred in the radiation then the MPPT slowly changes its operating point to another new maximum power point (MPP). The fluctuations in the PV output power can be reduced by using the large dc link. But we can't use the large dc capacitance because of the point of view of the reliability of the system. This can be seen from the above equations (i), the relation between the $\Delta V_{dc,\,fluct}$ is inversely proportional to the term C_{dc} from the above equations we observed that when we increases the value of the DC-link capacitance the voltages decreases.

V. EFFECT OF DC-LINK VOLTAGES RIPPLE ON THE PHOTOVOLATIC SYSTEM

When we allow the dc-link voltage with the ripple then it will impose ripple at the terminal of the PV array, due to this the instantaneous power at the both end (i.e. input & output) of the boost converter is same.

There is no any effect of the ripple on the panels but the obtain output power from the modules or panel will be less or in other word we can say that if the magnitude of the ripple is high in the photovoltaic voltage and current, the average power obtained from the panels would be less than the MPP power which is available as shown in the figure below.

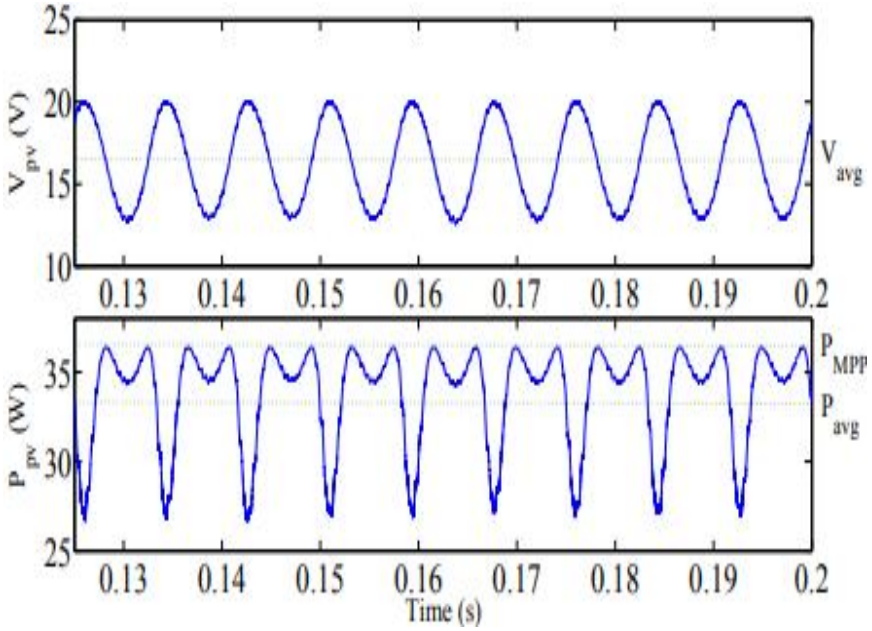

Fig. Voltage ripple and power oscillations

VI. CONCLUSION

This paper basically proposed the method related to reducing the fluctuations in the DC-link. This method is better as compare to the existing method .But the main problem regarding this method is that the size and the cost of the circuit will increase. By using this method the reliability of the system will improved.

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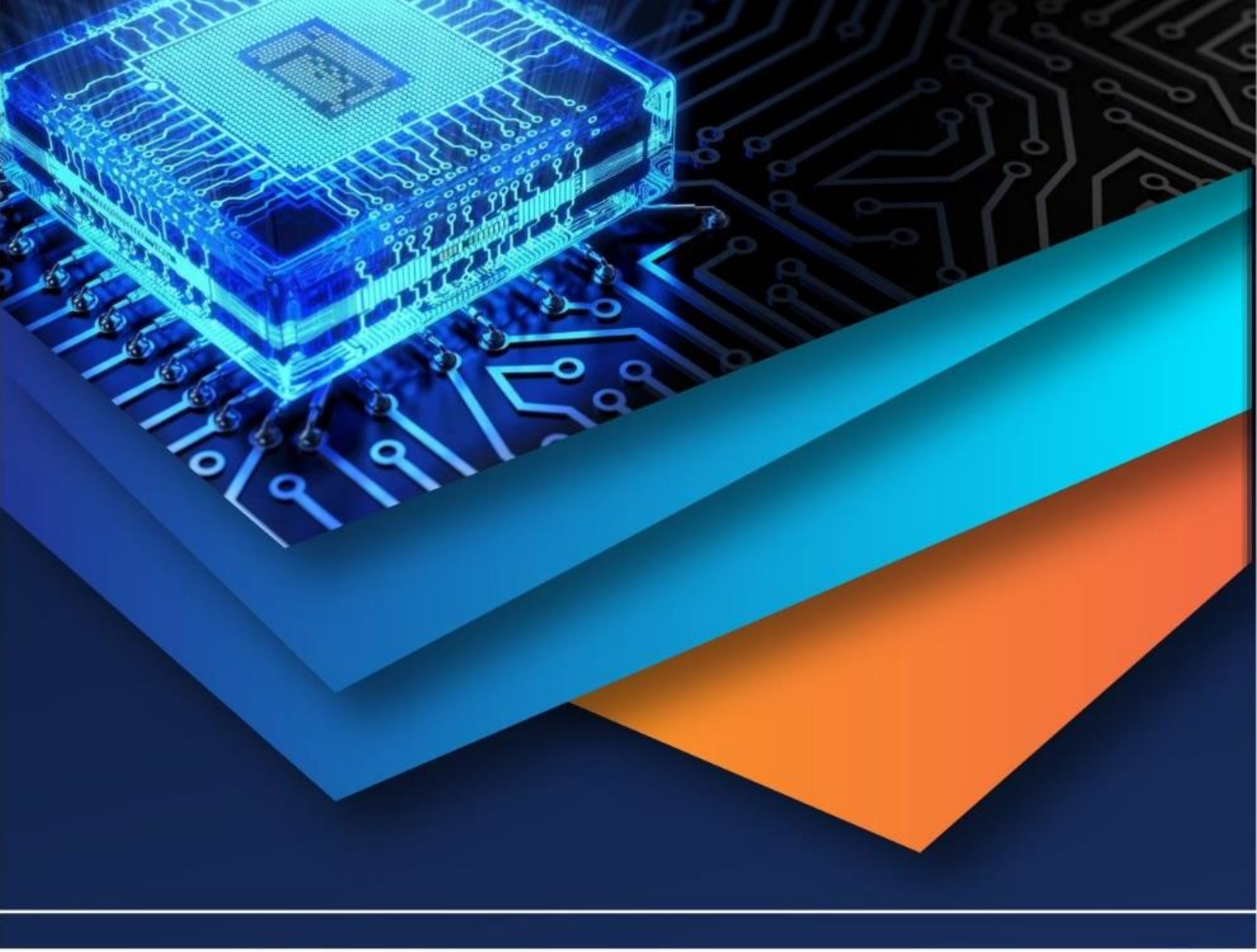

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