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Review on Different Types of Faults on PV System ond Reducing PV Module Mismatch

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ABSTRACT-

Photovoltaic (PV) module faults will not only reduce the power generation efficiency of PV modules, but also cause a series of safety problems. As the most common fault type, current mismatched fault leads to the decrease of the output current of the PV module resulting in a step in the I-V characteristic curves and multiple peaks in the P-V curves, such that the output power of the PV modules will be greatly affected. This paper focuses on current mismatched faults caused by partial shading, hot spot and crack through the investigation of faulty PV modules in actual PV power plants. The I-V characteristics of PV modules with current mismatch type faults are tested, and their fault characteristics are extracted. Not only can the current mismatch make the I-V characteristic curve of the module a step, but also the cause of the I-V curve of each current mismatched fault is analyzed in combination with the reverse bias model of the PV cell. In order to further decouple the features of different faults in the I-V curve step, a numerical analysis and statistical method is proposed for diagnosing PV module

Keywords –DMPPT, PV-Array, Buck- Boost, Module material, THD, SPV cell materials, etc

I. INTRODUCTION

A photovoltaic (PV) system is solid state semiconductor devices which generates electricity when it is exposed to the light. The building of a solar panel is solar cell. A photovoltaic module is formed by connecting many solar cells in series and parallel. To get maximum output voltage, PV modules are connected in series and for obtaining maximum output current they are connected in parallel. Solar PV power systems have been commercialized in many countries due to their merits such as long term benefits and maintenance free. The major challenge which lies in using the PV power generation systems is to tackle the nonlinear characteristics of PV array. The PV characteristics depend on the level of irradiance and temperature. PV array experiences different irradiance levels due to passing clouds, neighbor buildings, or trees. The block diagram of PV generation system is shown in Figure 1. Photovoltaic systems are mainly classified as per their functionality and operation of systems, component configurations, and the equipment connected to electrical loads. They are mainly classified as grid connected and standalone systems which are designed to provide DC and AC power service to operate with independence of the utility grid that are connected with other energy sources and storage systems.

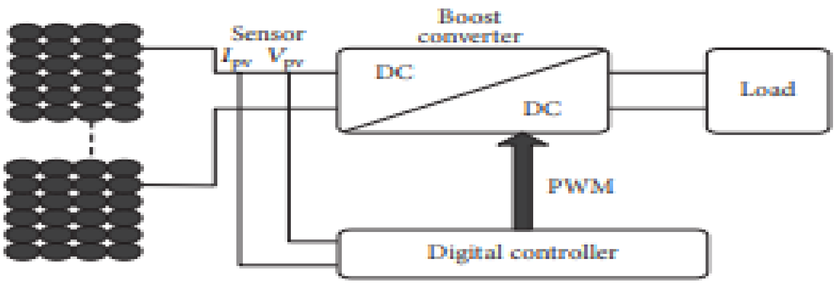

Figure 1: Block diagram of PV generation systems

The grid-connected photovoltaic (GCPV) system has been widely accepted as the most practical and economical method to harvest energy from the sun, Its configuration is very effective; it does not require expensive energy storage components (batteries) to back up the system in the absence of photovoltaic (PV) power. This role is assumed by the electrical grid itself, which can be considered a large energy reservoir that dispatches sufficient power to the load at any instance. For DC-AC conversion, the central inverter is the preferred choice because of its simple installation, low maintenance, and high reliability. Typically, PV modules are connected in a series-parallel arrangement (array), while the power is fed to the grid via the inverter.

The performance of a PV module under actual outdoor conditions depends on several factors like type of PV technology used and the environmental conditions of the site where the module is deployed. Distributed maximum power point tracking (DMPPT) architectures are proposed to decouple each PV unit in the system in order to mitigate mismatch losses. DMPPT techniques mainly include differential power processing (DPP), sub module integrated converters string MPPT, micro inverters, module parallel converters, and module cascaded converters (MCCs).

Table 1 Modular Cascaded Converter topologies

DC Converter Topology	No. of Modules	Topological Constraints	Bypassing Ability	Voltage/Current Limitation
Buck	High	$I_{string}>I_{PV}$ $V_{OUT}<V_{PV}$	Free wheeling	Switch current limitation
Boost	Low	$I_{string}<I_{PV}$ $V_{OUT}>V_{PV}$	Body diodes in main and rectification MOSFETS	Output voltage limitation
Four Switch buck boost	Moderate	Flexible	Body diodes in main and rectification MOSFETS of the boost legs	Switch current limitation Output voltage limitation

II. POWER NORMALIZING HYSTERESIS CONTROL

The VSC is a sophisticated dynamic system that communicates with the grid. The model of VSC coordination in DG systems must incorporate all of the converter dynamics in the frequency range of interest. This model should then include both the LC filter in the interface between the converter and the grid, as well as the control system for the converter circuit. A non-linear controller loop with hysteresis comparators is used in the Power Normalizing hysteresis controller. Switches are turned on and off, forming voltage vectors on which the current error is compared to a reference band. The benefits of using a hysteresis control are primarily its simplicity, robustness, independence of load parameters

III. FAULT DETECTION TECHNIQUES

Conventional fault detection and protection uses ground-fault detection interrupters (GFDI) and over current protection devices (OCPD), A PV array ground fault is an electrical pathway between one or more array conductors and earth ground. Such faults are usually the result of mechanical electrical or chemical degradation of photovoltaic (PV) components, or mistakes made during installation. Fault types are defined by the location in the array and the impedance of the fault and can vary widely in the severity of their impact on array operations depending on these two factors. In order to protect the array during a ground fault event, a ground fault protection device (GFPD) is used to detect ground fault currents. If the GFPD or another device also interrupts the fault current, the protection system is called a Ground Fault Detector/Interrupter (GFDI). The 2014 National Electrical Code (NEC) 690.5 specifies ground-fault protection requirements for grounded direct current (DC) photovoltaic arrays while NEC 690.35 defines the requirements for ungrounded systems. Both of these sections require ground faults are detected and their presence is indicated.

IV. MISMATCH FAULT

Mismatches in PV modules occur when the electrical parameters of one or group of cell are significantly changed from other. In addition, mismatch faults are caused by interconnection of solar cells or modules, which experience different environmental conditions (i.e. irradiance or temperature) from one another. Mismatch faults are the most common type of fault compared with Earth fault and bridging faults, among PV arrays. Mismatch faults may lead to irreversible damage on PV modules and large power loss. However, they are difficult to detect using conventional protection devices, since they generally do not lead to large fault currents. These faults can be categorized into two groups, permanent and temporary. Their causes are listed below:

a) Temporary Mismatches: are divided in two groups:

• Partial shading: Shading effect occurs when a part of the panels array are shaded which can be caused by a number of different reasons, like shade from the building itself, light posts, chimneys, trees, clouds, dirt, snow and other light blocking obstacles. Non- uniform temperature: Snow covering,

b) Permanent Mismatches:

Hotspot: Hot spot heating occurs when a module's operating current exceeds the reduced short circuit current of a shadowed or faulty cell or group of cells within the module. To create a Hot spot fault, a variable resistor in series with the Rsn of each defective cell could be added in Simulink. Value of this resistor is considered approximately one until five ohm.

• Soldering: this defective appears in resistive solder bond between cell and contacted ribbons.

• Between cells and contact ribbons, Degradation:

V. CONCLUSION

This paper discussed about the different faults in PV system, there causes and detection technique. GFDI and OCPD are the conventional fault detection technique has some draw back with system changes. Existing fault detection technique overcome these draw back with little extend. But also there is some protection gap. It reveals that need of better technique to overcome this protection gap. This paper will help the researchers and practicing engineering to understand the faults occurring in PV arrays and the use effective fault detection techniques to deal with them.

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