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EVALUATION OF THE HARMONIC PERFORMANCE IN CELL LEVEL PHOTOVOLTAIC INVERTER UNDER PARTIAL SHADING

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The use of renewable energy is both economically and environmentally advantageous in the modern world. Photovoltaic (PV) systems are emerging as one of the most popular renewables. Despite recent advances in PV cell technology, the partial shading impacts on the efficiency of most of the conventional Maximum Power Point Tracking (MPPT) methods. Shading can be caused by any obstacle directly in line of solar radiation resulting in non-uniform irradiance conditions. In a series connected solar photovoltaic module, performance is adversely affected if all its cells are not equally illuminated. All the cells in a series array are forced to carry the same current even though a few cells under shade produce less photon current. Shaded cells may get reverse biased, acting as loads, draining power from fully illuminated cells. The partial shading effect is often minimized by including a bypass diode to a specific number of cells in the series circuit. When a solar cell is shaded, the drop that would occur if the cell conducts any current would turn on the bypass diode, diverting the current flow through the diode, limiting the voltage drop through that cell. In real modules, it would be impractical to add bypass diodes across every solar cell, but manufacturers often provide at least one bypass diode per module and sometimes several around a group of cells within a module. In this paper a possibility of employing a multi-level H-bridge inverter as a solution to partial shading is investigated. The proposed cell-level H-bridge PV inverter allows the maximum power extraction while minimizing shading effects. The proposed approach was demonstrated and evaluated using simulations carried out in the well-known electromagnetic simulation package PSCAD/EMTDC. Two switching sequences for the cell-level H-bridge PV inverters were tested: a base case switching sequence and a rotating switching sequence. Irradiance on each cell was changed from 1000 W/m^2 in steps of 200 W/m^2 and the effect of shading under the two switching sequences were compared by determining the total harmonic distortion (THD) of the output voltage.

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