Fault Ride-Through of Grid Connected Photovoltaic Solar System

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Abstract

Contribution from the photovoltaic solar power plants has significantly increased in supplying the power demand to the power system. The occurrence of a short time fault in the power system trips the solar power plant from the grid and it takes a long time to reconnect. This outage time causes a big loss to the solar power generating industries while disturbing the power system. This paper presents a Fault Ride-Through (FRT) operational technique, based on the switching control of the Insulated Gate Bipolar Transistors (IGBTs) of the Voltage Source Inverter (VSI). This will minimize the outage time. The solar system is designed in such a way that it will detect the fault, by measuring the grid voltage. If grid voltage is getting significantly low (for example <50%) due to a fault, the DC link voltage is set to the open circuit voltage of the solar module. This is achieved by controlling the pulse to the IGBTs. This makes sure that the power supplied by the solar cells, during the fault time, is kept to zero. In other word, the power blocking operational mode is achieved by the VSI control. After the fault is cleared, the VSI control technique is set in such a way that the solar system gets back to the Maximum Power Point Tracking (MPPT) operational mode. The voltage control of the system was designed using Sine-triangle Pulse Width Modulation (SPWM). A comprehensive system includes (i) solar cells, (ii) VSI, (iii) power system grid and (iv) proposed control technique, is modelled using PSCAD software. Performance of the system is studied by applying a short time ground fault for 150 ms period. The voltage and current wave forms of the system were analysed. In normal manual control operations, it takes more than 10 minutes to recover. With the proposed automated control technique, it is proven in simulations that it reduces the outage period to be less than 0.3 seconds.