Voltage Sag Detection in Grid-Connected Photovoltaic Power Plant for Low Voltage Ride-Through Control

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Abstract

***Background*:** Due to the high level of photovoltaic power plants (PVPPs) penetration into power grids, disconnections of these plants during faults are no longer possible as it may cause prob-lems concerning stability, quality, and operation of the power system. Therefore, new grid codes have been established with low voltage ride-through (LVRT) capability standard requirements for grid-connected PVPPs that should be met. Therefore, for an efficient LVRT control, the fast and precise sag detection strategy is essential for the system to switch from normal operation to LVRT mode of operation.

Methods: For this purpose, this paper presents a two automatic fault detection methods which are RMS-based (d-q) components of grid voltage and positive sequence voltage. These methods were utilized to determine the beginning and end of a voltage sag and to determine the sag depth to regu-late the required reactive current that should be injected according to the LVRT standard require-ments. The operating method depends on calculating present grid voltage under faults to the nominal voltage that identifies the sags' depth and therefore inject the required amount of reactive power ac-cordingly. Also, a comparison between the two proposed methods regarding response speed and ac-curacy was made. The effectiveness of these detection strategies is that it can be integrated into the voltage source inverter (VSI) without utilizing additional external hardware or software program-ming.

Results: The simulation results demonstrated a good precision and how straightforward the proposed methods' usage is, proving that the RMS method is faster and more accurate than positive sequence method.

Keywords: Photovoltaic power plant, Sag detection, Grid faults, Low voltage-ride through, PV inverter.