Analysis of Power Quality Improvement Scheme for a PVECS using Dynamic Voltage Restorer

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Abstract

This work investigates the critical aspects of power quality and the role of the Dynamic Voltage Restorer (DVR) in mitigating common power disturbances. It begins by defining key power quality issues such as voltage sag, swell, flicker, and harmonics, including Total Harmonic Distortion (THD), and highlights their detrimental effects on electrical equipment and system efficiency. Dynamic Voltage Restorer its importance, principle of operation, and essential components including the Voltage Source Inverter (VSI), injection transformer, energy storage unit, harmonic filter, bypass switch, and control system is discussed. Various modes of operation, compensation methods (pre-sag, in-phase, energy optimization, reactive power), and diverse DVR topologies (based on DC-link/ energy storage, power converter structure, and connection method) are discussed. The advantages and disadvantages of DVRs, along with their practical applications in sensitive industries like semiconductor manufacturing and data centers, are also presented. Simulation is carried out in MATLAB Simulink environment. Standalone DVR system and PV inverter system integrated with a DVR is simulated for both R and RL load to check the effectiveness in voltage disturbance compensation and THD reduction.

Keywords

PV inverter system, DVR, power quality, THD, voltage sag, voltage swell.