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Current Source Converter Based Photovoltaic Synchronous Generator Incorporated with a SMES

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With the increase of the permeability of renewable energy, the equivalent inertia and damping of the power system gradually decrease, which makes the power system stability problem more and more prominent. By emulating the electromechanical transient characteristics of synchronous generators, the virtual synchronous generator (VSG) technology enables the renewable power generator to have the same external characteristics of synchronous generators, such as inertia, damping, frequency and voltage regulation. This paper proposed a novel current source (CS) photovoltaic synchronous generator (PVSG) topology incorporated with a superconducting magnetic energy storage system (SMES). The SMES has the advantage of high efficiency, quick response, and infinite cycling capability and is an ideal energy storage device for high power application. The CS-PVSG utilizes the SMES as an energy buffering device to provide inertial and frequency support to the grid, which makes the photovoltaic generator behave as a synchronous generator. Compared with voltage source PVSG, the CS-PVSG has the advantage of low cost, high stability margin. The parameter design method and control strategy are presented. The feasibility of the proposed CS-PVSG is verified by simulation results.

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