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Stability Analysis of DC Microgrid with Varying Supercapacitor Operating Voltages

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Abstract : Microgrid (MG) is a self-governing miniature section of the power system. Nowadays the majority of loads and energy storage devices are inherently in DC form. This necessitates a greater scope of research in the various types of energy storage devices in DC microgrids. In a modern power system, DC microgrid is a manageable electric power system usually integrated with renewable energy sources (RESs) and DC loads with the help of power electronic converters. The stability of the DC microgrid mainly depends on the power imbalance. Power imbalance due to the presence of intermittent renewable energy resources (RERs) is supplied by energy storage devices. Battery, supercapacitor, flywheel, etc. are some of the commonly used energy storage devices. Owing to the high energy density provided by the batteries, this type of energy storage system is mainly utilized in all sorts of hybrid energy storage systems. To minimize the stability issues, a Supercapacitor (SC) is usually interfaced with the help of a bidirectional DC/DC converter. SC can exchange power during transient conditions due to its high power density. This paper analyses the stability issues of DC microgrids with hybrid energy storage systems (HESSs) arises from a reduction in SC operating voltage due to self-discharge. The stability of DC microgrid and power management is analyzed with different control strategies.

Keywords : DC microgrid, hybrid energy storage system (HESS), power management, small signal modeling, supercapacitor
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