

The modular multilevel converter (MMC) provides promising development for high-voltage direct current (HVDC) applications, including multiterminal HVDC (MTDC) and renewable energy integration. This paper, considering an offshore wind farm (OWF) integrated MMC MTDC system, investigates its start-up process with three main developments: 1) it further develops the mathematical model of MTDC with active networks and proposes a hierarchical start-up control scheme; 2) for the terminal which connects the OWF, it proposes a reduced dc voltage control scheme of mitigating the current surges with deblocking the converter at zero voltage difference on submodules (SMs) and proposes an overall sequential start-up control scheme for the offshore integrated MTDC; and 3) it analyzes and compares different start-up control schemes. To evaluate the proposed sequential start-up control scheme, an offshore MMC HVDC system is established on the RTDS. The simulation results verify effectiveness of the proposed scheme on the MMC MTDC system with two control paradigms, i.e., master-slave control and droop control, respectively. In comparison with different start-up control schemes, the superiority of the mitigation of voltage spikes and current surges are shown using the proposed scheme with less complexity and easier implementation.

