

Grid-Supporting HVDC System With Low-Voltage Energy Storage for Renewables Integration

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The increasing integration of renewables has driven a rising demand for large-scale, long-distance transmission and power interconnection. In response to this, the paper proposes a grid-supporting HVDC system centered on MMC with partly low-voltage energy storage (MMC-PLVES). The submodules with energy storage are integrated into the containerized valves, while those without energy storage are installed in the base-supported valve towers. The topology of the system is analyzed, and a corresponding mathematical model is developed. Grid support and DC fault handling control strategies are provided. System parameter design methodologies are studied. Finally, a modified two-area Kundur system is built in PSCAD/EMTDC to verify the feasibility of the proposed topology and the effectiveness of the control strategies. The results demonstrate that the grid-supporting HVDC system with low-voltage energy storage can be applied to the grid with different short circuit ratios (SCR). The separate installation scheme addresses key challenges, such as large size, heavy mass, and integration difficulties of energy storage. Additionally, it reduces insulation requirements and complexity, offering significant potential for renewables transmission applications.