

Voltage source converter (VSC)-based high voltage DC (HVDC) transmission is considered the future of offshore power transmission. This paper aims at providing a reliable VSC-HVDC transmission system architecture between offshore wind farms and onshore grids. In this paper, a large-capacity, low-speed flywheel energy storage system (FESS) based on a squirrel cage induction machine is applied in parallel with the VSC-HVDC at the grid side converter. The FESS is dedicated for surge power (due to power flow imbalance during fault) absorption instead of being dissipated in the form of resistive losses. Since the duration of these surges is relatively small, it has been shown that the flywheel can effectively mitigate this problem. In addition to the fault ride-through support during fault conditions, the FESS is employed for power leveling functionality during normal operation. The performance parameters of the proposed approach are investigated via both simulation and experimental results. A 132-kV, 100-MW HVDC system is simulated using MATLAB/Simulink during normal and fault conditions. The proposed architecture is substantiated experimentally through a scaled down test rig with a 2-kW FESS.