Active and reactive power support of MV distribution systems using battery energy storage

Adoption of Battery Energy Storage Systems (BESSs) for provision of grid services is increasing. This paper investigates the applications of BESS for the grid upgrade deferral and voltage support of Medium Voltage (MV) distribution systems. A BESS is modelled in Matlab/Simulink to perform peak load shaving and voltage support service from the perspective of Distribution System Operators (DSOs). An active power support algorithm is implemented and the effects of various load profiles as well as different Photovoltaic (PV) penetration scenarios on the operation of BESS and the optimal BESS converter size for peak load shaving are investigated. The BESS annual lifetime degradation is also estimated using a rainflow counting algorithm. A reactive power support algorithm embedded with Q-U droop control is proposed in order to reduce the voltage drop in a part of 10 kV distribution network of Nordhavn in Copenhagen, and the effects of active and reactive power support by BESS on the grid voltage are investigated.