

Optimal Charging and Discharging Scheduling of On-Board EV Chargers and ESS Considering Distribution Line Capacity, Building Load Imbalance and Peak Shaving

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Abstract

This paper presents an optimal charging method for energy storage system (ESS) and electric vehicles (EVs) with single-phase on-board chargers that are connected to a large apartment buildings. The objective of the optimal charging is to minimize the total line power loss in a distribution network while taking into account the distribution line capacity, the three-phase building load imbalance and peak shaving of the distribution system. Using the inherent capability of the associated power electronics, the ESS and single-phase EV chargers operating within capacity limits provide reactive power to minimize the power loss. The single-phase charging power is also controlled differently in time to mitigate the three-phase building load imbalance. For the active and reactive power control of the ESS and EV charges, an optimization problem is formulated and solved using a linear programming algorithm with a substantial reduction in the simulation time. Based on a theoretical analysis performed on a simple distribution network, simulation case studies demonstrate that the objectives can be effectively achieved under various grid conditions.