MPC based control strategy for battery energy storage station in a grid with high photovoltaic power penetration - DTU Orbit (20/10/2019)

MPC based control strategy for battery energy storage station in a grid with high photovoltaic power penetration

The AGC (automatic generation control) reserve capacity requirement in a grid with high photovoltaic (PV) power penetration is much higher than that in a traditional grid in order to address the rapid PV power fluctuation, which also means a higher operating cost of the power grid. In contrast with the dispersed energy storage units located in PV plants, the integration of battery energy storage station (BESS) in a power grid can effectively mitigate the PV power fluctuation and decrease the AGC reserve capacity, reducing the operating cost from the aspect of the power grid operator. However, currently BESS is still an expensive option in view of the high price per unit size. Consequently, the determined BESS with size-limited capacity needs to be fully utilized to improve the economic performance of both BESS and the power grid. For this reason, a novel model prediction control (MPC) based control strategy for BESS is presented in this paper, aiming to minimize the equivalent operating cost of BESS during each control step. Specifically, the impact of PV power on AGC reserve capacity and the necessity of BESS in a grid with high PV power penetration are firstly discussed. And then, based on the equivalent cost analysis of BESS, an objective function is presented aiming to minimize the equivalent operating cost of the power grid and BESS during each control period, including the AGC payment and BESS operating cost. Besides, to prolong the lifetime of BESS, a protection measure is presented via the adjustment of BESS charge/discharge power. Afterwards, the application steps of the presented control strategy are presented. Finally, the proposed control strategy is verified using actual PV power data in a grid with high PV power penetration.

General information
Publication status: Published
Organisations: Electric Power Systems, Center for Electric Power and Energy, Department of Electrical Engineering, Shandong University
Corresponding author: Ding, L.
Contributors: Zhang, F., Fu, A., Ding, L., Wu, Q.
Number of pages: 9
Publication date: 1 Feb 2020
Peer-reviewed: Yes

Publication information
Volume: 115
Article number: 105448
ISSN (Print): 0142-0615
Ratings:
BFI (2020): BFI-level 2
Web of Science (2020): Indexed yes
Original language: English
Keywords: Automatic generation control (AGC), Battery energy storage station (BESS), Model prediction control (MPC), Photovoltaic power, Ramp-rate
DOI:
10.1016/j.ijepes.2019.105448
Source: Scopus
Source ID: 85070256391
Research output: Contribution to journal › Journal article – Annual report year: 2020 › Research › peer-review