Efficient Control of Energy Storage for Increasing the PV Hosting Capacity of LV Grids

Photovoltaic (PV) systems are among the renewable sources that electrical energy systems are adopting with increasing frequency. The majority of already-installed PV systems are decentralized units that are usually connected to low-voltage (LV) distribution grids. The PV hosting capacity of an LV grid is usually limited by overvoltage, and the efficient control of distributed electrical energy storage systems (EESSs) can considerably increase this capacity. In this paper, a new control approach based on the voltage sensitivity analysis is proposed to prevent overvoltage and increase the PV hosting capacity of LV grids by determining dynamic set points for EESS management. The method has the effectiveness of central control methods and can effectively decrease the energy storage required for overvoltage prevention, yet it eliminates the need for a broadband and fast communication. The net power injected into the grid and the amount of reactive power absorbed by PV inverters are estimated using the PV generation forecast and load consumption forecast, and the dynamic operating points for energy storage management are determined for a specific period of time by solving a linear optimization problem. Simulations performed on a realistic LV feeder of the Danish island Bornholm verify the performance of the proposed method.

General information
Publication status: Published
Organisations: Department of Electrical Engineering, Center for Electric Power and Energy
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Pages: 2295 - 2303
Publication date: 2016
Peer-reviewed: Yes

Publication information
Journal: IEEE Transactions on Smart Grid
Volume: 9
Issue number: 3
ISSN (Print): 1949-3053
Ratings:
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 7.92 SJR 2.73 SNIP 2.837
Web of Science (2016): Impact factor 6.645
Web of Science (2016): Indexed yes
Original language: English
Keywords: Energy storage, Overvoltage prevention, Photovoltaic, Reactive power, Dynamic set point
Electronic versions:
energy_storage.pdf
DOIs:
10.1109/TSG.2016.2609892
Source: PublicationPreSubmission
Source-ID: 126761923
Research output: Contribution to journal › Journal article – Annual report year: 2016 › Research › peer-review