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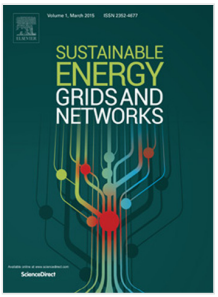

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A Probabilistic Framework for Evaluating Voltage Unbalance Mitigation by Photovoltaic Inverters

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Abstract

***Abstract*—In three-phase Low Voltage (LV) networks, distributed photovoltaic (PV) units can contribute to voltage unbalance mitigation in case they are connected with the use of three-phase inverters integrating unbalance mitigation control schemes. This paper presents a probabilistic framework that simulates the time-varying action of voltage magnitude and unbalance mitigation schemes, locally implemented by PV inverters in LV feeders. The scope includes evaluating the effect of such strategies in the context of a long term techno-economic planning of the LV network and characterizing LV network operation for increasing the observability of state estimation techniques applied in the Medium Voltage level. The presented framework evaluates the action of four distributed control schemes in an extensive range of possible network states assembled with the use of feeder-specific smart metering (SM) data. The simulation of a real LV feeder with distributed PV generation and long term SM measurements is presented. A control strategy that acts resistively towards the negative- and zero-sequence voltage components without modifying the total nodal injected power (three-phase damping control strategy) results to be more efficient compared with traditionally applied voltage control schemes.**

Keywords: Low Voltage; Photovoltaic; Distributed Generation; Probabilistic state estimation; Voltage Control; Voltage Phase Unbalance; Three phase inverter; Smart meters.

Nomenclature

CDF: Cumulative Distribution Function

DER: Distributed Energy Resource

DPC: Damping Control

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