Power Quality Control of Smart Hybrid AC/DC Microgrids: An Overview

Farzam Nejabatkhah, Yun Wei Li, Hao Tian

Abstract— Today, conventional power systems are evolving to smart grids, which encompass clusters of AC/DC microgrids, interfaced through power electronics converters. In such systems, increasing penetration of the power electronics-based distributed generations, energy storages, and modern loads provide a great opportunity for power quality control. In this paper, an overview of the power quality control of smart hybrid AC/DC microgrids is presented. Different types of power quality issues are studied first, with consideration of real-world hybrid microgrid examples, including data centers, electric railway systems, and electric vehicles charging stations. It shows that compared to traditional centralized power quality compensations, smart interfacing power converters from distributed generations, energy storages, and loads, and the AC and DC subgrids interfacing converters are promising candidates for power quality control. To realize the smart interfacing converters' power quality control, both primary converters control and secondary system coordination are required. In this paper, a thorough review of the primary control of interfacing converters to integrate the power quality compensation are presented, with a focus on the hybrid AC/DC microgrid harmonics compensation and unbalance compensation. For multiple interfacing converters, the secondary control with system-level coordination and optimization for harmonics and unbalance compensation (considering both unbalance and harmonics in single-phase and three-phase systems) are also presented. Challenges like low switching frequency of interfacing converters, parallel interfacing converters operation, and interfacing converters communications are discussed, and typical solutions for primary and secondary controls to deal with them are presented. The paper also includes rich case study results.

For the published version of record document, go to:
http://dx.doi.org/10.1109/ACCESS.2019.2912376