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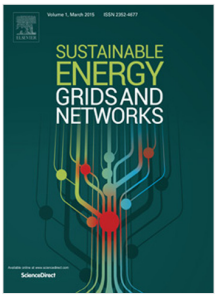

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A Unified Control Strategy for Power Sharing and Voltage Balancing in Bipolar DC Microgrids

Saman Dadjo Tavakoli[a], Mohammad Mahdavyfakhr[a], Mohsen Hamzeh[a], Keyhan Sheshyekani[b,*], Ebrahim Afjei[a]

[a] *Department of Electrical Engineering, Shahid Beheshti University, Tehran, Iran.*
[b] *Department of Electrical Engineering, Polytechnique de Montreal, Quebec, Canada.*

Abstract

This paper investigates the challenges of power sharing and voltage balancing in bipolar dc microgrids equipped with voltage-source-inverters (VSIs) and voltage balancers. This is done by unifying the control systems of voltage balancer and VSI so that the VSI is able to participate in both power sharing and voltage balancing of the bipolar dc microgrid. The VSI operates in dc-link voltage control mode whose reference signal is generated by the control system of the voltage balancer. Two different schemes namely the dynamic reference and the equivalent droop are proposed for the power sharing purpose. These schemes, in contrast with the traditional droop control, do not deteriorate the voltage balancing of the microgrid. In the dynamic reference scheme, the reference voltages generated by the control system of the voltage balancer are transmitted to distributed generations (DGs) using a high-speed master-slave controller area network (CAN). Then, the droop characteristics of DGs and voltage balancer are shifted downwards or upwards according to the voltage references. In the equivalent droop scheme, however, the voltage references are calculated locally by DGs and voltage balancer which share the values of their output currents over a low-speed CAN bus. The performance of the proposed power sharing schemes and the unified control system is verified using MATLAB simulation.

Keywords: Bipolar dc microgrid, droop control, power sharing, voltage balancing.

1. Introduction

DC microgrids are steadily attracting attention mainly due to the proliferation of power-electronic loads and the dc nature of the majority of distributed energy resources (DERs) such as PV, fuel cell, and wind generation systems. In fact, since microgrids are replete with dc loads, it is technically

*Corresponding author
Email address: keyhan.sheshyekani@polymtl.ca (Keyhan Sheshyekani)