Commentary

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Performance Enhancement of a Hybrid AC-DC Microgrid Operating

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Abstract

An additional set of power electronic converters is necessary to connect these DC loads to the AC-dominant power network, due to the considerable rise in DC loads such as data and communications centres at the power distribution level. In particular, hybrid AC/DC microgrids (MGs) are promising options for meeting both AC and DC loads with a less number of converters installed. Because DC loads may be spread randomly in the MG, determining where to deploy DC feeders to meet the economic and security needs of MG operations remains a difficult task. DC feeders with the goal of lowering the total cost of distributed energy resources (DERs), the functioning of DERs, as well as the use of converters and AC/DC distribution lines. The power flow of the hybrid AC/DC MG, in particular, is derived in a unified manner before being incorporated into the planning model. Finally, the suggested model is sufficient for determining the best number and placement of both DERs and DC feeders while maintaining DC feeder continuity. The suggested model is evaluated in two MG-based distribution systems, and the results of numerical trials confirm its efficacy.

Keywords: Fuel Cell; Fuzzy logic controller; Hybrid AC-DC microgrid; Power management; Super capacitor

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Introduction

The necessity to use non-conventional sources of energy in power systems has increased as a result of rising pollution, dwindling fossil fuel resources, and rising energy demand. Natural resources such as sunlight and wind are abundant and may be utilised to generate electricity. A microgrid is made up of energy sources and storage devices that provide load to loads that are either off-grid or on-grid (MG). The MGs are dynamic systems that experience constant changes in load and generation. Many researchers are working on renewable-energy-powered microgrids [1]. MGs are available in three different configurations: DC MG, AC MG, and HMG. In DC MG architecture, the energy sources and storage devices are integrated into a DC bus, while in an AC MG structure; they are integrated into an AC bus. The HMG is made up of DC and AC subgrids. This setup is both dependable and efficient.

A microgrid (MG) is a small-scale localised power system that is primarily made up of distributed energy resources (DERs), loads, converters, and monitoring and protection devices [2]. MGs are classified as AC, DC, or hybrid AC/DC according on the power supply method of the internal network. Due to the direct connection of DC-based sources and loads to DC buses, DC MGs have lower power losses than most common AC MGs. DC MGs, on the other hand, must rely on large-capacity inverters at their common points of coupling when linked to the utility grid [3]. Furthermore, connecting AC-based sources and loads in a DC MG demands the use of extra AC-DC converters, which results in unavoidable power losses during the conversion process. As a result, a hybrid AC/DC MG is a more cost-effective and flexible way to integrate both AC and DC-based DERs and loads within well-defined electrical limits [4]. This is a standard AC/DC hybrid MG. Energy storage systems (ESSs), wind turbines (WTs), photovoltaic arrays (PVs), diesel generators, micro turbines (MTs), and AC and DC loads are all examples of DERs interfaced with AC or DC buses through pertinent converters. The advantages of AC and DC MGs are effectively combined in this hybrid network design to improve the efficiency, flexibility, and sustainability of energy provision. However, in a hybrid AC/DC MG, deploying DERs and AC/DC network components at the same time remains a difficult problem.

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