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Microgrid energy scheduling with demand response

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Abstract. Distributed energy resources (DERs) are essential for coping with growing multiple energy demands. A microgrid (MG) is a small-scale version of the power system which makes possible the integration of DERs as well as achieving maximum demand-side management utilization. Hence, this study focuses on the analysis of optimal power dispatch considering economic aspects in a multi-carrier microgrid (MCMG) with price-responsive loads. This paper proposes a novel time-based demand-side management in order to reshape the load curve, as well as preventing the excessive use of energy in peak hours. In conventional studies, energy consumption is optimized from the perspective of each infrastructure user without considering the interactions. Here, the interaction of energy system infrastructures is considered in the presence of energy storage systems (ESSs), small-scale energy resources (SSERs), and responsive loads. Simulations are performed using GAMS (General Algebraic modeling system) to model MCMG, which are connected to the electricity, natural gas, and district heat networks for supplying multiple energy demands. Results show that the simultaneous operation of various energy carriers, as well as utilization of price-responsive loads, lead to better MCMG performance and decrease operating costs for smart distribution grids. This model is examined on a typical MCMG, and the effectiveness of the proposed model is proven.

Keywords: demand response; operation; microgrid; distributed energy resources

1. Introduction

Over the past decades, there has been an increase in energy consumption corresponding to technology development while the conventional units encountered fossil fuel restrictions, network losses, and high investment costs. In order to transcend the problem, the penetration of renewable energy resources (RERs) such as PV (photovoltaic panel), WT (wind turbine), and SSER has resulted in optimal operation, low network losses, and improved reliability. On the other hand, the higher penetration of SSERs can cause technical/non-technical problems for future networks such as power quality, reliability, energy management, efficiencies, etc. (Saito *et al.* 2009).

A savior solution that not only solves the old distribution network problems but also deals with multiple energy infrastructure integrations is named microgrid (Joseph and Shahidehpour 2006). MGs as an alternate generating system instead of conventional large-scale power plants are trusted

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stb	standby energy losses
inv	invertor