Chapter 5
Energy Management on Distribution System With Distributed Generation Integration in Smart Grid Technologies

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ABSTRACT

Energy management in distribution systems has gained attention in recent years. Coordination of electricity generation and consumption is crucial to saving energy, reducing energy prices, and achieving global emission targets. Due to the importance of the subject, this chapter provides a literature review on recent research on energy management systems and classifies the works based on several factors including energy management goals, the approaches taken for performing energy management, and solution algorithms. Furthermore, the chapter reviews some of the most proficient techniques and methodologies adopted or developed to address energy management problem and provides a table to compare such techniques. The current challenges and limitations of energy management systems are explained, and some future research directions have been provided at the end of the chapter.

1. INTRODUCTION

The most practical and practical source of energy in modern society is electricity. Globally, the per capita use of electricity is rising, which is indicative of rising living standards. An efficient distribution system can guarantee this type of energy's best use by society. The three components of an electric power

DOI: 10.4018/979-8-3693-7663-8.ch005

system are distribution, transmission, and generation (Turhan, 2019). Typically, distributed generation and distribution systems are regarded as the last resort for releasing electric power to consumers, while primary generation and transmission are referred to as bulk power supplies.

The majority of distributed generation (DG) comes from nearby renewable resources. When compared to traditional thermal generation, this reduces environmental degradation. Due to their ability to offset the drawbacks of centralized generation dispatch, small-scale generators have become more prevalent in distribution networks throughout the past ten years. Known by another name, distributed generation, these generators are inserted into the network to provide electricity at or close to the location where they will be utilized. A variety of resources and technologies, including hydrogen, fuel cells, wind, solar, and biomass, can power the (Turhan, 2021).

The system has several technical problems as a result of the addition of DG units. Numerous technical impacts of distributed generators on the distribution system have been documented in the literature. These include protection, power quality (including flickers and harmonics), power losses, line drop compensation, stability, reverse power flow capabilities of tap changers, system fault levels, thermal rating of equipment, and protection (Quezada et al., 2006). Based on their qualities, locations, and operational conditions, distributed generators can have either beneficial or negative effects on the system.

The smart grid is a novel idea for a next-generation electric power infrastructure. Through automated control and contemporary communications technology, the smart grid is a contemporary electric power grid infrastructure that improves efficiency, reliability, and safety while seamlessly integrating renewable and alternative energy sources (Gungor et al., 2010; Cecati et al., 2011). According to Kanchev et al. (2011), renewable energy generators appear to be a promising technique to lower fuel consumption and greenhouse gas emissions. Crucially, new network management techniques made possible by smart grids enable efficient grid integration in DG for Demand Side Management and energy storage, as described in Palensky et al. (2011) for DG load balancing, etc. Many researchers have studied renewable energy sources (RESs) (Cecati et al., 2011). The integration of RES, lowering system losses, and improving the dependability, efficiency, and security of customers' electricity supply are some of the advancements that smart grid systems will bring about (Vaccaro et al., 2011).

2. LITERATURE REVIEW

Solar energy is employed in developing nations to address the energy needs of both individuals and society as a whole in order to promote progress and balance. Electric vehicles and renewable energy resources (RERs), as discussed in Khan et al. (2022), are key components of electricity transmission for a sustainable energy future. It is necessary to modernize the distribution and transmission grids to increase dependability, economy, security, and efficiency. Both the distribution and transmission grids become more efficient when an efficient communication and control technology is implemented on the conventional grid. The traditional grid is being transformed by smart metering, quicker problem diagnosis, and better network management and administration as described in Fan et al., 2021.

Recent increases in renewable energy power have made renewable energy a key component of the energy of the future. It can be challenging to integrate various renewable energy sources (RESs), such wind and solar photovoltaic (PV), into the electrical grid. The electric market structure must coordinate the RESs management approach outlined in Feng et al. (2021) due to recent changes in the pricing components of energy marketing and designs. However, energy from renewable sources like sunlight,

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