Chapter 10

Issues Associated With Microgrid Integration

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ABSTRACT

Microgrid (MG) is the vital technology that can be utilized to supply electricity to rural areas by fulfilling various aspects of electricity such as sustainability and reliability. Further, MG technology can also be used as localized generation sources and back up supply source. As MG can be worked in interconnected mode, various issues related to interconnection with utility grid are raised. Several issues such as technical, regulatory, and operational are associated with grid integration. Therefore, this chapter deals with the issues that are associated with the grid integration of microgrid.

INTRODUCTION

Traditional electricity grid is converted into the smart structure. The key feature of this smart system is the incorporation of the renewable energy sources at different levels such as distributed level and bulk level. International energy agency predicted that the energy generation from the renewable energy sources is increased up to three times till 2035 (Khan and Singh, 2017; Mulualem and Khan 2017). Further, the total energy production from the renewable energy sources will be increased to 31%, in which hydro, wind and solar will provide 50%, 25% and 7.5%, respectively. The two major issues with renewable energy generation are intermittency and climate dependency of renewable sources. These problems make integration of these sources with conventional grid more difficult and complex. The above discussed problems can be minimized with the help of energy storage devices. These devices incorporated various storage systems such as batteries, heat buffers along with advanced generation techniques such as

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fuel cell technology, electric vehicle technology etc. Therefore, there was a necessity to develop such a system, which incorporates different renewable energy sources with energy storage options to mitigate the issues related with renewable energy sources. This necessity is fulfilled with the development of Microgrid system (Khan and Singh, 2017; Fanuel et al. 2018). It is the combination of different type of loads (domestic, commercial, industrial) with various renewable energy sources such as solar photovoltaic, wind, micro turbine and small hydro along with energy storage devices such as battery energy storage, heat buffer, flywheel storage, and electric vehicle technology system. In smart grid structure, micro grid technology provides a holistic approach for the integration of renewable energy sources. It has several benefits over the conventional grid system as it’s minimise energy losses, improve reliability and enhance energy management. Further, at distribution level, micro grid technology provided better solution of energy scarcity, generation coordination and control problems due to its better performance with respect to distributed generation technology (Khan and Singh, 2017; Kifle et al. 2018).

Microgrid is not designed to handle the large power being fed by the utility distribution feeders. Further, the characteristics of micro grid components possess big challenges. The issues related to the integration of microgrid raises the challenges to operation and control of main utility grid. Out of various interfacing issues, load frequency control is also one of the important issue. It can be treated as single objective or multi objective load frequency control problem. A comparative analysis of single and multi objective load frequency controllers is presented by Fini et al. (2016). Haes et al. (2015) presented a multi agent primary frequency supporting controller which is based on electric vehicle control. This controller is very useful for future smart micro grid. Alhelou and Golshan (2016) presented a controlling scheme for plug-in electric vehicle to control primary frequency response in interconnected smart grid. Alhelou et al. (2018) presented a comprehensive review on challenges and opportunities for load frequency control in traditional, modern and future smart systems. Other than load frequency control, fault detection and isolation of faulted section is also very important. Alhelou (2018) presented a fault detection and isolation overview in power systems by using unknown input observer. Further, Alhelou et al. (2018) proposed a robust sensor based outage detection and isolation technique by using unknown input observer. This technique is utilized for renewable energy sources and electric vehicle integrated smart power system. Lastly, Makdisie et al. (2018) discussed the photovoltaic conversion system in an optimal way for futuristic smart grid systems. Therefore, this chapter deals with the various micro grid integration issues face by the utilities in the practical power system.

**MICROGRID STRUCTURE**

It is a distribution network which supply through low and medium voltages distribution lines. Various self sufficient and independent distributed energy sources i.e. PV, wind, Fuel cell, micro hydro etc. and storage devices such as battery storage, flywheel storage etc. along with demands are incorporated and grouped insides micro grid structure. Figure 1 presented a typical overview of micro grid structure. Different distributed energy sources are integrated with in micro grids by its corresponding bus bars equipped with power electronics converter. Point of common coupling (PCC) is the point where micro grid is connected to the upstream network.

There are two modes in which micro grid operate. The first one is the grid connected mode and another one is the stand alone mode or islanded mode. In grid interfaced mode of operation PCC is closed
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