Chapter 4

Uninterrupted Power Supply to Micro-Grid During Islanding

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ABSTRACT

The major purpose of uninterruptible power supply (UPS) systems is to supply regulated sinusoidal voltage at constant frequency and amplitude. UPS systems are gaining much popularity as a means of providing clean and continuous electricity to critical loads during any disturbances in main grid. Modern equipment is sensitive to power fluctuation and requires back up power supply for optimal performance. This chapter introduces a set of possible solutions so that uninterrupted power supply can be provided to emergency feeders and critical loads such as hospitals and communication systems. Different network configurations can be applied to micro-grid system for obtaining an uninterrupted power supply. Various hybrid energy and modern UPS systems for micro-grid along with their control techniques have been elucidated. A comparative assessment of all UPS technologies on the basis of cost, performance, and efficiency of the system has been presented.

GENERAL INTRODUCTION

Now-a-days the large advancement and development in the distribution system is only possible due to the integration of small local renewable generation in the distribution level. These small local renewable resources are generally installed below a couple of megawatts and can be photovoltaic, wind farms, micro-hydro turbines etc. Distributed generating resources or dispersed generation can be defined as generation resources other than conventional generating stations, which are nearby to load point usually closer to customer site (Oudalova, 2011). With the help of DG, the cost of distribution, transmission, and
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losses can be reduced. Also, voltage profile, power quality of the distribution system can be improved. However, with the installation of DG different issues related to protection will arise and islanding is one of those issues (Redfern & Usta, 1993; Nale & Biswal, 2017).

Islanding is a condition in which distribution sector becomes electrically isolated from the main supply power but it gets continuously energized by DG connected to it (Oudalova, 2011). During any upstream side fault the main grid completely isolated from the distribution system and complete power interruption condition in distribution system will arise. In the DG connected grid this situation may not arise as under islanding condition the distribution sector will get continuous supply from DG sources. But due to main grid interruption the distribution section with local DG sources will be unsynchronised. The repeated operations of recloser connected between main grid and distribution level during disturbances is also not acceptable for the healthy operation of power system. To mitigate this issue of synchronization during islanding UPS technology is adapted. Common utility power problems are also corrected by the most UPS units such as sustained over voltage, voltage spike, noise, reduction in input voltage, harmonic distortion, the mains supply frequency instability (Dhal & Rajan, 2015).

Also, for the past many years the electric power system is facing shortage of electricity. To overcome, scheduled power cut which has resulted due to this large gap between customer demand and electricity supply, there is a need to install alternate source of energy such as Uninterruptible power supply system (UPSs) and Fossil Fuel Generators to reduce the effects of load shedding (Ali & Arsad, 2017).

Generally, an UPS system requires regulated sinusoidal output voltage with low total harmonic distortion (THD). The variations in voltage or load will not influence the operation of UPS system. For sinusoidal input current, THD is lower and power factor is unity. Higher efficiency, higher reliability, lower cost, smaller size, lesser weight etc. are the advantages of utilization of UPS technology. Generally, batteries and generators are highly used in these uninterruptible power supply systems are batteries and/or generators (Ahmad & Kashif, 2016; Alhelou et al, 2018; Njenda et al, 2018; Makdisie et al, 2018; Fini et al, 2016; Alhelou et al, 2016; Nadweh et al, 2018).

The disadvantages associated with the utilization of battery in UPS systems are large number of charge/discharge cycle, low power and energy density, heavy energy demand and environmental incompatibility. Also, the maintenance and cost of generator are high. Hence, alternative methods of energy storage and generation have been developed such as super capacitor, flywheel, fuel cell and their combinations (Chellappan & Enjeti, 2008).

To mitigate these issues, a new scheme is proposed in this book chapter which provides an alternative solution to be in connection with the main grid even though the main grid is disconnected through the point of common coupling (PCC). During power interruption in main grid, under fault scenario or maintenance period, the PCC breaker will switch off and distribution system gets completely disconnected from main source. This situation develops synchronization issue for DGs integrated distribution network. But with alternative connection from main grid to distribution network such an issue can be avoided. Next, with the help of flywheel we can improve the local storage in distribution network. This will help in providing emergency supply during major power failure in main grid. The proposed solutions are briefly discussed in the subsequent sections.