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Domestic electrical load management using smart grid

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Abstract

Demand side load management is one of the basic features in smart grid, which enable end users to know major characteristics about their energy consumption during peak and off peak hours and encourage the utility to maintain load demand in extreme conditions. This results in more reliable system with overall improvement of efficiency and low CO2 emission in smart grid. Most of the previous techniques used in demand side load management are specific to traditional energy management strategies with limited number of load controlling technologies. In this paper, we focus on operating the system with more efficiency and reliability. Integration of solar PV distributed generation, smart DC storage and smart load is expected to add valuable operations in the smart grid. Direct load control (DLC) and load shifting techniques for overkill load offers various outcomes during extreme conditions.

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Keywords: Smart grid, demand-side load management, distributed generation, direct load control, load shifting.

1. Introduction

About 100 years back, grid was built to provide electricity from power generation plants to end users. Electrical grid is the largest physical network on earth dividing into three major components; generation, transmission and distribution. The basics of electrical grid are explained in Fig. 1.1 Dump grid and its components are operating beyond their life limit, only delivering electricity without any ease of end user, hence, advancing this grid to intelligent, self-healing and communication based utility and consumer friendly system leads to a smart grid.

Power generation system is required without any CO2 emission, tariff reduction and integration of renewable energies which can communicate with end customers, with increasing efficiency and reliable communication for data

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and load management ever before. Distribution generation, home energy management systems, automatic switching, plug-in vehicles leads to an efficient grid. The main goal is to increase throughput without increasing more generation using smart techniques. Saving one watt is better than generating more [1]. In comparison to traditional grid, smart grid offers two way power flow, which open new ways for utilizing DG for individuals in a more effective manner. It enables more services such as charging of plug-in electric vehicles, self-healing capability, reduced tariff, peak- off, peak power consumption and minimizes the environmental discharges.

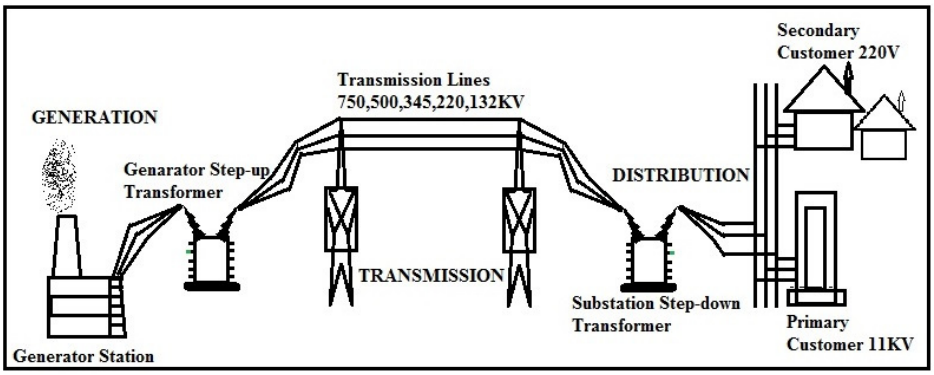

Fig 1. Basic Electricity Structure

2. Basic components of smart Grid

Following are some of the basic components of a smart grid.

a. **Monitoring and control** in traditional grid have no reliability, resistivity as well as capability to repose against the fault, with the incorporation of new sensors, the ability to accommodate real time power flow, improved phasor measurement unit (PMU), Phasor data concentrator (PDCs), accelerates old grid to new grid in the form of smart grid with integration of renewable technologies, enhanced grid capacity with greater productivity and dependability [2].

b. In **transmission component,** load stations and substation are interconnected, which is the main component of power system. Traditional system can be made smart using smart tools like smart sensors, PMU and some communication components. It enhances the system reliability, customer satisfaction and increase the power quality issues. [3].

c. Grid is now more advanced because of the integration of **Information and communication Technology (ICT)**, which allows bi-directional communication, between user and utility. Reliability of consumer and direct feedback to the supplier increases the demand and supply in equal proportion. Definitely no wastage of energy or the saving of power leads to smarter system. Utilization of communication protocols, topologies and wireless network increases reliability and remote control access. Wireless communication system is as helpful as the wired systems. ICT makes it more convenient for both systems equally.

d. **Smart energy meters** offer both way communication between consumer and utility as well as the power flow. In case of individual local distribution generation, if excess power is produced than the consumption, this excess generation could be fed to the national grid. It is beneficial for both the energy supplier and the user. Automatic billing, data logging and many other such incentives can be availed. Advance metering infrastructure (AMI) has more advantages over advance meter reading system (AMR) [4]. AMI gives two way communication for data logging between the central system and the meter, whereas AMR allows one way communication only.

e. **Smart storage** plays an important role for renewable energy such as solar PV systems, and the storage devices commonly used are batteries, capacitors and mechanical fly wheels etc. Batteries are more commonly used for long term storage. Major cost of system depends upon the storage, as the increasing life of batteries reduces the running