ELECTRICAL LOAD MANAGEMENT USING SMART GRID

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Introduction. Energy is the primary factor of human existence. Naturally, global demand for electricity is growing every year. Unfortunately, generation of electricity is the largest source of CO_2 emissions and it is making a large contribution to climate change. Our electric infrastructure is nearly 100 years old and it cannot meet modern requirements, so we need to upgrade it and make it "smarter".

Objective. The objective of the present research is to consider the smart grid technology, its advantages and disadvantages, and security threats it poses.

Methods. The conventional power systems are being upgraded worldwide to deliver many advantages, which include reliability, security and flexibility in energy distribution, power consumption monitoring, demand side management, enhanced optimized network traffic, shorter downtimes, minimized failures, reduced grid losses, regulated supply and demand, and generally improved grid operations and services. With the increased availability of sophisticated computing, communication and measurement technologies, the system's emergency response will be greatly improved. In fact, smart grids also provide protection which is not provided by the central control systems or the protection schemes for the power infrastructure from the utility end and for smart homes.

First of all, we need to define what "smart grid" is. According to Wikipedia, smart grid is an electrical grid which includes a variety of operational and energy measures including smart meters, smart appliances, renewable energy resources, and energy efficient resources. It allows two-way communication between the consumer and utility and also sensing throughout the transmission lines, making the grid more intelligent due to much more sensing and embedded automatic control [3; 4].

Communication system is the main component of the smart grid communication infrastructure. New technologies and applications allow for advanced smart grid infrastructure and ability to analyze huge amounts of data for deep system control and real time pricing. Wireless and wired are the two basic types of communication that can be used to transfer information between the smart grid components.

Privacy is the main concern when it comes to using smart grid technologies, especially for corporate users. Vulnerabilities could be explored by adversaries to cause system failures in form of possible transmission sequence failure, terrorism, cyber-attacks, vandals, theft, etc. Other possible threats include those of natural disasters and possibly, from some identified system disturbances such as voltage and frequency instability issues, or even due to inconsistencies in government policies and implementations among other factors.

Improvements of the operational securities are very important since the system is complex and the associated infrastructural resources are very expensive. Moreover, heavy investments are being committed worldwide and hence, necessary security

measures must be taken to prevent damages which may in turn pose danger to either the infrastructures or personnel.

Results. According to United States Department of Energy, smart grid must meet the following requirements:

- ability to self-repair after power failures;
- network stability to physical and cybernetic interference by intruders;
- ensuring the required quality of transmitted electricity;
- providing the synchronous operation of generation sources and energy storage units;
- the emergence of new high-tech products and markets;
- increasing the efficiency of the energy system in general [2].

In addition to this, smart grid will add resiliency to electric power system and make it prepared to emergencies. For example, in case of equipment failure our current grid might not be able to handle it and blackout can occur. Smart grid, on the other hand, allows for automatic rerouting, which can minimize outages [5].

Furthermore, smart grid can work not only on a large scale, but also on a small scale, such as individual household. In fact, it can automatically select the mode of operation of the most energy-intensive equipment, taking into account the optimal commercial tariff and consumer needs. Accordingly, the energy company, having current data on the planned energy consumption of individual buildings, can optimally adapt its capacity. The entire grid constantly exchanges information that is actively used by control elements to ensure a balanced schedule of consumption/ generation and safe transformation and transmission of electricity [1].

Conclusions. In conclusion, it is necessary to upgrade the existing grid to reduce electrical losses and maintenance costs. Smart grid is able to provide more control and more electricity in order to meet rising power demands and increase energy efficiency and reliability. Moreover, the main benefit of smart grids is reduced carbon dioxide emissions, so we must make grids smarter to save our planet from pollution.

References

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