Chapter 8

Transition From Traditional Grid to Smart One

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ABSTRACT

Smart grids have become an urgent need to overcome the challenges of the 21st century. To transit the traditional grid to smart one, there must be a well thought out plan, called road map, which is also being carefully developed by organizations according to standards for deploying smart networks. Most studies focused on modernizing distribution networks because it was passive and technologically poor. Two approaches to developing distribution networks were presented. The smart grid modernization was also presented from social and psychological perspectives.

INTRODUCTION

As we know the electrical system consists of various components: different generating stations, substations, transmission lines and distribution network. Besides that, it involves monitoring and control centers that monitor the operation of the system components and the substation centers near the consumers. In addition, the measurement devices that measure the amount of energy between the system and users.

Good electrical networks may be characterized by four attributes:

1. **Flexibility**: The ability to respond to the rapidly increasing demand for electrical energy and challenges related to the future.
2. The ability to connect electricity between all producers and consumers.
3. **Reliability**: The ability to adapt to unexpected events so as to ensure the continued delivery and maintenance the quality required of electrical energy.
4. **Economic Operation**: The ability to be operated economically.

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Today’s grids are facing many of principal problems, which are growing in severity.

- Global electricity demand is rising faster than demand for any other final energy source. In addition, the electrification of the economy intensifies end-user demand around peak hours, stressing grids and making rapid expansion a necessity.
- Aging infrastructure tends to compromise reliability of power supply and exacerbate energy losses to the detriment of economies undergoing rapid electrification.
- The power grid will need to become more flexible to match supply and demand in real time due to the share of variable renewable energy (VRE) in the energy mix grows.
- Issues relating to power quality and bi-directional electricity flows arise that cannot be properly managed by traditional grids, due to the penetration of distributed generation (DG) rises to very high levels in some areas (Lajoie, Debarre, Fayet, & Dreyfus, 2015; Alhelou, Hamedani-Golshan, Zamani, Heydarian-Forushani, & Siano, 2018).

The major driver for the evolution of the power system is the need to meet rising demand for electricity while reducing carbon emissions to avoid irreversible changes to the earth’s environment. All of this must be achieved in parallel with the reliability of electricity supplies on which the world’s economies are increasingly dependent.

Between 2000 and 2007, global electricity demand rose, on average, by 2.5 per cent annually, and is still on the increase. By 2030, global electricity demand is expected to double to 30,000 terawatthours (TWh) annually. If this level of demand is to be met, we will need to build one gigawatt (GW) power station and its associated infrastructure every week for the next 20 years - a daunting prospect. Where global carbon emissions from power generation will increase significantly, with the knowledge that they are currently 40%, so just increasing today’s operations to meet the increase in demand will not be acceptable. So, how can we meet demand and keep carbon dioxide emissions in check?

According to the International Energy Agency (IEA), which has proposed a number of scenarios for the future of global carbon emissions, annual emissions in 2030 could be reduced from the current prediction of over 40 Gt (gigatons) CO2 to just over 26 Gt by the implementation of a carefully designed set of policies. These policies aim to limit global warming to 2°C above preindustrial levels, which should limit the effects of climate change to an acceptable economic, social and environmental cost. Where the scenario indicates that the savings come from the implementation of energy efficiency measures, and from the increase in renewable energy generation.

The development of more intelligent power systems will directly support these two objectives.

In a smart grid, advanced technologies improve energy efficiency by managing demand so that it matches the availability of electricity, and they feed renewable energy into the network without letting changes in weather patterns affect the stability or reliability of the supply.

At the same time, using satellite, wireless and real-time communication, advanced technologies will enable utilities to pinpoint problems in the grid faster than they are able to today (“An Introduction to Smart Grids”, n.d.).