Scientific Journal Impact Factor (SJIF) : 1.711
International Journal of Modern Trends in Engineering and Research
ISSN (ONLINE) : 2349 - 9745 ISSN (PRINT) : 2393 - 8161

SMART GRID PROTECTION

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Abstract— A smart grid is a modernized electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviours of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics. Smart grid technology is an extended form of analog technology that has also been introduced for controlling the use of appliances by employing two-way communication. However, the prevalence of Internet access in most homes has made the smart grid more practically reliable to implement. Smart grid devices transmit information in such a way that enables ordinary users, operators and automated devices to quickly respond to changes in smart grid condition systems. The entire smart grid system is automated for tracking the electricity consumption at all the locations. Grid architecture is also combined with energy management software for estimating the energy consumption and its associated cost for a specific enterprise. Generally, electricity prices increase along with demand. By providing consumers with information about current consumption and energy prices, smart grid energy management services help to minimize the consumption during high-cost, peak-demand times.

Keywords- smart grid, Power grid dispatching, intermittent resources, interruptible load, supporting technology

I.INTRODUCTION

Smart grid is the term generally used to describe the integration of the elements connected to the electrical grid with an information infrastructure to offer numerous benefits for both the providers and consumers of electricity. It is an intelligent future electricity system that connects all supply, grid, and demand elements through an intelligent communication system [1]. It is an electrical power distribution network that includes two-way, digital com- munications between suppliers & consumer0s (Department of Energy, USA). Electricity is lost or where the system is not in balance or optimized. Such optimization can save 3% or more of overall electric demand without requiring any change in consumer behavior [2]. A common element to most definitions is the application of digital processing and communications to the power grid, making data flow and information management central to the smart grid.

Smart Grid Network is an intelligent, managed, con-trolled and ultimately self-healing electric distribution network capable of closely matching supply with demand while improving efficiency and reliability. Sensors and control devices on the grid, combined with integrated high- speed. Communications and advanced analytic software, provide utilities with actionable intelligence reports and information. Such tools make the electric utility more efficient and reliable, and in turn reduce the need for coal burning power plants that generate high levels of green- house gases.

II. DIFFERENCE BETWEEN TRADITIONAL POWER GRID AND SMART GRID

A. Improving the acceptability of intermittent renewable energy source and enabling power grid to adapt different power source structures.
B. Nearly eliminating the risk of large-area and longtime blackout, except being caused by large-scale Physical damages.
C. Markedly promoting economy and reducing cost, energy consumption and emissions.

Power grid dispatching is an essential factor of safe and stable operation of power system, as well as optimal allocation of resources. With the large-scale access of distributed generation (DG) and

intermittent renewable energy source and higher requirements to power supply reliability and economy, traditional power grid dispatching cannot meet the demand presented by smart grid development. Therefore, smart grid dispatching would be different from traditional power grid dispatching.

III. SMART GRID CONCEPT

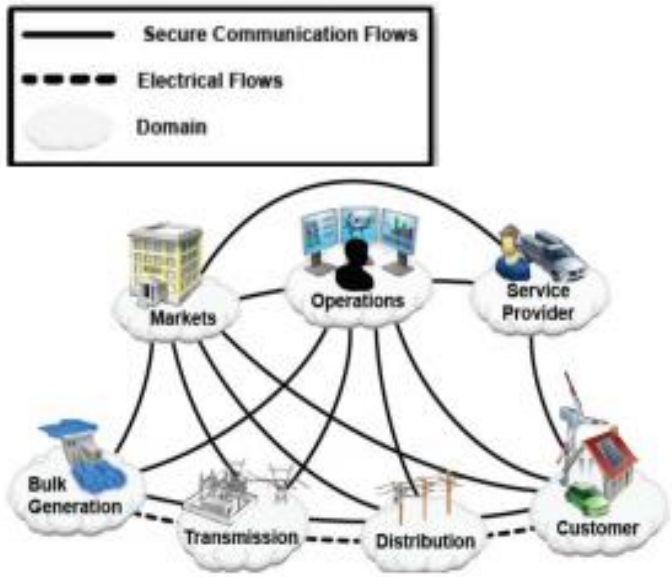

Figure1. The Conceptual Model For SG [6]

A smart grid is a modernized electrical grid that uses analog or digital information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.

3.1 Key Component of Smart grid:

A. Power Quality and Monitoring System.
B. Security
C. Smart Consumption.
D. Smart homes.
E. Smart meters.
F. Substation automation and Protection.
G. Local Production.
H. Information and Communication Technology
I. Distributed management system.
J. Distribution automation and protection

3.2 Objectives of Smart Grids

A. To develop a shared vision for the future which encourages the engagement of multiple, independent parties;
B. To identify research needs and build support for an increased public and private research effort on electricity networks;
C. To align ongoing RTD projects and national and regional programmes on electricity transmission and distribution systems;
D. To draw conclusions and recommendations for follow-up actions and implementation of the strategic research agenda and deployment plan.

3.3 Setting of Smart Grids:

Electricity grids of the future are Smart in several ways. Firstly, they allow the customer to take an active role in the supply of electricity. Demand management becomes an indirect source of generation and savings are rewarded. Secondly, the new system offers greater efficiency as links are

set up and beyond to draw on available resources and enable an efficient exchange of energy. In addition, environmental concerns will be addressed.

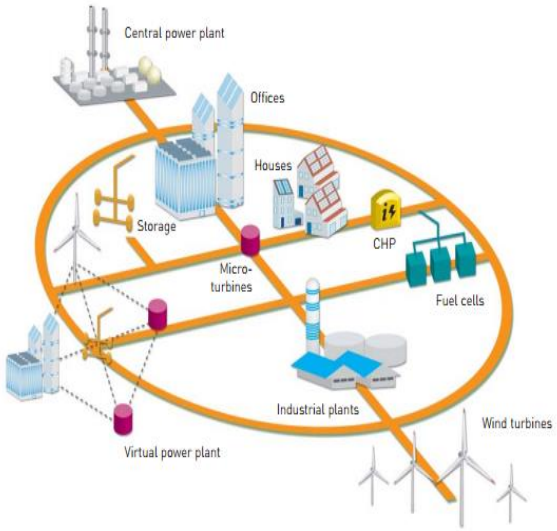

Figure: 2 Setting of Power Grid

The process of liberalization of their electric systems, opening access to transmission and distribution grids. The process has been accompanied by a rapidly growing Presence of DG of various technologies, some of it in the form of RES. This responds to the climate change challenge, the need to improve fuel diversity and provide affordable electricity with high quality of supply. There has been rapid development of renewable energy technologies and co-generation and increased interest in other distributed energy resources and energy storage technologies. Smart metering, with two way communications capability and greatly improved user information, is now a reality and deployment is already taking place in some European countries.

3.4 Function of Smart Grids:

According to the United States Department of Energy's modern Grid Initiative report a modern smart grid must:

A. Be able to heal itself
B. Motivate consumers to actively participate in operations of the grid
C. Resist attack
D. Provide higher quality power that will save money wasted from outages
E. Accommodate all generation and storage options
F. Enable electricity markets to flourish
G. Run more efficiently
H. Enable higher penetration of intermittent power generation sources.

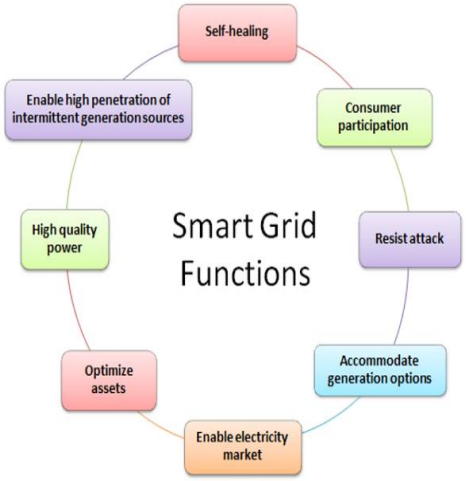

Figure:2 Smart Grid Functions

Self-healing:
As applied to distribution networks, there is no such thing as a "self healing" network. If there is a failure of an overhead power line, given that these tend to operate on a radial basis (for the most part) there is an inevitable loss of power. In the case of urban/city networks that for the most part are fed using underground cables, networks can be designed (through the use of interconnected topologies) such that failure of one part of the network will result in no loss of supply to end users.

Consumer participation:
A smart grid is, in essence, an attempt to require consumers to change their behavior around variable electric rates or to pay vastly increased rates for the privilege of reliable electrical service during high-demand conditions. Historically, the intelligence of the grid in North America has been demonstrated by the utilities operating it in the spirit of public service and shared responsibility, ensuring constant availability of electricity at a constant price, day in and day out, in the face of any and all hazards and changing conditions. A smart grid incorporates consumer equipment and behavior in grid design, operation, and communication.

Resist attack:
One of the most important issues of resist attack is the smart monitoring of power grids that is the basis of control and management of smart grids to avoid or mitigate the system-wide disruptions like blackouts. The traditional monitoring is based on weighted least square (WLS) that is very weak and prone to fail when gross errors (including topology errors, measurement errors or parameter errors) are present. New technology of state monitor is needed to achieve the goals of the smart grids.

High quality power:
Outages and power quality issues cost US businesses more than $100 billion on average each year. It is asserted that assuring more stable power provided by smart grid technologies will reduce downtime and prevent such high losses.

Accommodate generation options:
As smart grids continue to support traditional power loads they also seamlessly interconnect fuel cells, renewables, micro turbines, and other distributed generation technologies at local and regional levels. Integration of small-scale, localized, or on-site power generation allows residential, commercial, and industrial customers to self-generate and sell excess power to the grid with minimal technical or regulatory barriers. This also improves reliability and power quality, reduces electricity costs, and offers more customer choice.

Enable electricity market:
Significant increases in bulk transmission capacity will require improvements in transmission grid management. Such improvements are aimed at creating an open marketplace where alternative energy sources from geographically distant locations can easily be sold to customers wherever they are located.

Optimize assets :
A smart grid can optimize capital assets while minimizing operations and maintenance costs. Optimized power flows reduce waste and maximize use of lowest-cost generation resources. Harmonizing local distribution with interregional energy flows and transmission traffic improves use of existing grid assets and reduces grid congestion and bottlenecks that can ultimately produce consumer savings.

Enable high penetration of intermittent generation sources:
Climate change and environmental concerns will increase the amount of renewable energy resources. These are for the most part intermittent in nature. Smart Grid technologies will enable power systems to operate with larger amounts of such energy resources since they enable both the suppliers and consumers to compensate for such intermittency.

3.5 Application of Smart Grid:
Smart grid technology changes the way utilities manage infrastructure, resources and data. Intelligent devices such as smart meters and distribution devices monitor the grid, report information and deliver remote access to control a variety of important functions on a minute-by-minute basis.

The value of this technology infrastructure is soon realized in applications that help the utility promote energy efficiency, provide dynamic pricing options, improve reliability of service and reduce costs.

Grid stream applications are successfully demonstrated at utilities around the world, and include:

- Advanced Metering
- Demand Response
- Distribution Automation
- Outage Management
- Prepayment of Service
- Personal Energy Management

VI. CONCLUSIONS

Smart Grid is a concept designed to provide electricity in more efficient way by better allocating electricity according to consumer's wants. It integrated multiple energy sources and avoid over-generation as well. In foreign countries, namely the UK and USA, started to implement as they see it as a solution of energy and environment pressure in their own country.

Smart Grid is worth doing because of the benefits of energy saving, positive environmental impact and long-term economic outcome. Yet, we also discovered the drawbacks of huge expenses in short-term and the difficulties of lack of funding, public support, problem of privacy and effectiveness. Hence, suggestion on government, companies and citizen levels to settle the foreseeable problem to help the successful implementation of Smart Grid.

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