AN OVERVIEW OF OPPORTUNITIES WITH THE SMART GRID - FUTURE ELECTRICAL POWER SYSTEMS

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Abstract: Introduction of Smart Grids makes the operation of grid smarter and astute. An appropriate deployment of smart grid can provide new boulevard and chances for the development of power system in the country like India. The important feature of smart grid system is the implementation of improved technologies (i.e. smart meters) which enables power system with relevant, real-time information. Smart grid is considered as the future generation power grid, which enables the electrical power systems with bi-directional flow of electrical energy as well as information, with improves the security, reliability and ultimately the operational efficiency of electrical power system from generation to transmission and finally to distribution. Smart Grid techniques allow utilities to discern and rectify a different system issues using a single coherent, reliable Smart Grid platform. This paper basically provides an overview of opportunities with smart grid and technologies being used for implementation of smart grid.

Keywords: Smart Grid, Metering, Power System, Information flow and system reliability.

I. INTRODUCTION

The Main aim of Smart Grid Technology is to provide reliable and high quality electric power to digital societies. Smart Grids are introduced to make the grid operation more cleverer and intelligent. Smart grid operations, upon appropriate deployment can open up new avenues and opportunities with significant financial implications. the smart grid system involves transmission, distribution and generation of electricity and major area of Electrical power system are Generators, transformers, transmission lines, motors and etc. we want to generate, transmit and distribute electric power minimally affecting the environment. As smart grid technology will be used throughout the world, realization in smart grid protection in Generation, transmission, distribution is Important. The overview of smart grid and key attributes of smart grid in India is discussed in section 2, In section 3 smart grid standard are discussed, In section 4 we discuss about the Smart Metering Technology finally in section 5 we makes the conclusion.

II. SMART GRID OVERVIEW

A “smart” grid is an electric grid system where all participants in the grid system (from electricity generators, to transmission and distribution operators, to electricity consumers) communicate and work with each other to increase the efficiency and reliability of the grid. A key feature of a smart grid system is the use of advanced technologies (such as smart meters) that provide participants with relevant, real-time

information. These technologies allow generators, system managers, and customers to receive instantaneous information on electricity needs and prices, and to work together to meet electricity needs in the most efficient way possible [1]

Smart grid is defined as an intelligent grid which provides bi-directional flow of electricity and information, with improving the power grid reliability, security, and efficiency of electric system from generation to transmission and distribution. It is driven by the need to provide a more robust, flexible and efficient electric system to overcome the increasing demand of electricity, uprising treat from green house gases emission, depletion of energy resources and other rising issues in traditional grid [2, 3].

Figure1: Smart grid and its function

With comparing to a traditional power grid [2, 4], smart grid enables the (i) integration of renewable energy resources at distribution network, (ii) supervisory control and real-time status monitoring on the power network, (iii) self-monitoring and (iv) self-healing feature, adaptive response to fault and etc.

Key features of Smart Grid are:

Self-Healing

To ensure grid stability and improve the supply quality, avoid or mitigate power outages, power quality problem, and service disruption using real-time information from embedded sensor and automated control to anticipate, detect and respond to system problem, is conferred to be a self-healing power network. Such systems are independent of user interaction, where decisions making are based on the knowledge from the pre-estimated and pre-monitored results. In general, the self-healing is distinguished in two levels: self-healing in the physical (monitored hardware) layer and the logical (monitored application/system) layer, according to situation of concerns [5].

Wide Area Monitoring and Control (WAMC)

Wide Area Monitoring and Control (WAMC) and Wide-area monitoring, protection, and control (WAMPAC) encompasses the use of system-wide information and the communication of specific local information to a remote location to counteract the propagation of large disturbances in a system. With the invasion of adaptive system of smart power grid; a dynamic, stochastic, computational and scalable (DSCS) with innovative control technologies can be a promising trait for a reliable, secure and efficient functioning of WAMPAC. Synchrophasor Measurement Technology (SMT) is an important element to WAMPAC which includes both short-term objectives such as enhanced visualization of the power system, post

disturbance analysis, and model validations, and long-term objectives such as the development of a WAMPAC system.[6]

Power System Islanding

When interconnected power system out-of-step occurs, it is authoritative to sense it rapidly, and islanding should be taken to prevent widespread blackout of the system. Due to system transient instability, which causes large separation of generator rotor angles, large swings of power flows, large fluctuations of voltages and currents, and eventually lead to a loss of synchronism between groups of generators or between neighboring utility systems, for certain severe disturbances, shall be intentionally spilt into two or more 'islands' to preserve as much of the generation and load as possible. [7]

Key Drivers of Smart Grid in India are:

Supply shortfalls

Demand, especially peak demand, continues to outpace India's power supply. The increasing affordability of household appliances is adding to the burden on the grid.

Peak load management

India's supply shortfalls are expected to persist for many years. A smart grid would allow more "intelligent" load control, either through direct control or economic pricing incentives that are communicated to consumers in a dynamic manner. Such measures would help mitigate the supply- demand gap.

Loss Reduction

India's aggregate technical and commercial (ATC) losses are thought to be about 25%, but could be higher given the substantial fraction of the population that is not metered. Smart grid can make a substantial reduction in AT

Managing the "human element" in system operations

Labor saving is not a prime driver for the smart grid in India, as contracts for outsourcing are inexpensive. However, automated meter reading would lower recording and other errors.

Technological leapfrogging

Perhaps most intriguing driver for India is the potential to "leapfrog" in to anew future for electricity, as it did with communications. Also the "smart" in a smart grid is ICT that means an area of unique capability in India.

III. SMART GRID STANDARDS

According to the Energy Independence and Security Act of 2007 (EISA) and Cabinet-level National Science and Technology Council (NSTC) report [12], the standards for Smart Grid help to ensure that the investments in the Smart Grid remain valuable in the future which include to catalyze its innovations, to support consumer choice, to create economies of scale to reduce costs, to highlight best practices and to open worldwide markets for Smart Grid devices and Smart Grid systems. Smart Grid standards are developed by groups of experts, namely as standards-setting organizations (SSOs) or standards development organizations (SDOs). These groups of experts from each industry come together from different nation to discuss, to develop new standards and to update the current standards. At the present, there are hundreds of standards in both technical and non-technical aspects, over 25 SSOs and SDOs are involved. These SSOs and SDOs include institutions such as The Institute of Electrical and Electronic Engineers (IEEE), International Electro

technical Commission (IEC), International Organisation for Standardisation (ISO), National Electrical Manufacturers Association (NEMA), International Telecommunication Union (ITU), and American National Standard for Protocol Specification (ANSI) and etc. IEEE 2030 (approved by the American National Standards Institute (ANSI) in 2011) and its associated standards which addresses Smart Grid interoperability, is the standard that provides a roadmap at establishing the framework on cross-cutting technical disciplines in power applications and information exchange and control through communications. IEEE 2030 provided the guidelines for defining Smart Grid interoperability in the necessity of integrating energy technology, information and communications technology as a whole. IEEE 1547 (approved by ANSI in 2003) and its associated standards address the distributed resources (DR) interconnection standards. It is a DR interconnection standard which provides technical and interconnection test specifications that help to decrease the time and effort associated with DR interconnection developments.

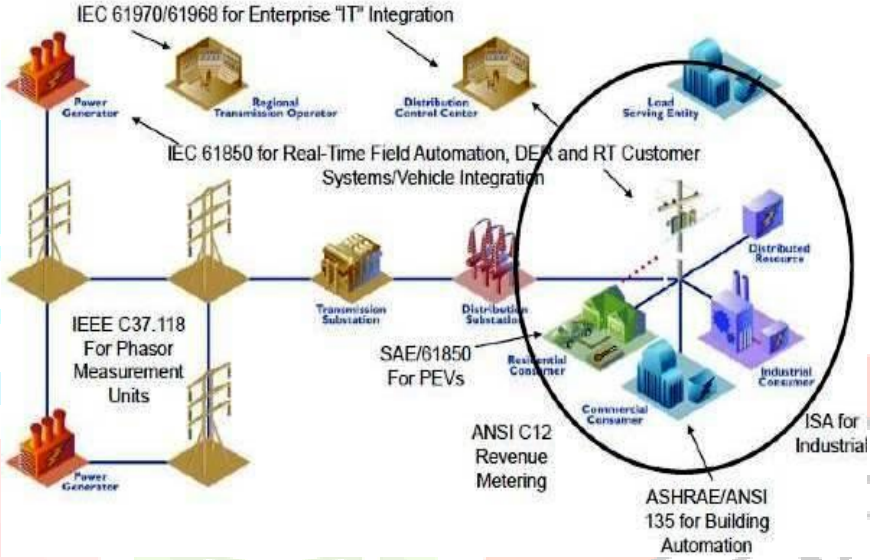

Figure 2: International Standard for smart grid

With IEEE 2030, both standards support the expansion of Smart Grid and realization of the revolutionary benefits in Smart Grid such as greater consumer choice, improved electric-system reliability, and increase reliance on renewable energies [8]. Besides that, some other standard such as IEC 61850 for electrical substation automation and ANSI C12.22 for smart metering are emerging in adoption [4]. IEC 61850 and its associated standards address the interconnecting and interoperability of intelligent electronic devices (IEDs) that support the emerging favorites of data communication technologies such as wide area network (WAN), ethernet based local area network (LAN) and TCP/IP networks. In addition, ANSI C12.22 and its associated standards define the specification for interfacing of smart infrastructure to data communication networks that enable the new generation smart meters to communicate simultaneously with other smart meters and corresponding substation gateways. IEC 61850 has been adopted and in practice [9] in the developing countries such as Malaysia.

IV. SMART METERING TECHNOLOGY

Smart metering system has been considered as an effective method for improving the pattern in power consumption and efficiency of energy consumers thus reducing the financial burden of electricity. It is the

combination of power system, telecommunication and several other technologies. Indisputably, with the development of science and cutting edge technology, more facilities have been added to this area.

Figure 3: Automatic meter and its function

Smart meter is an advance energy meter that measures the energy consumption of a consumer and provides added information to the utility company compared to a regular energy meter. The bidirectional communication of data enables the ability to collect information premeditated with communication infrastructure and control devices. In addition, the meter is used to monitor and control home appliances and devices, collect diagnostics information about the utility grid, support decentralized generation sources, energy storage devices, and consolidate the metering units.

Advanced metering Infrastructure (AMI), an appellation of smart metering technology which consists of set of smart meters, communication modules, LAN, data collectors, WAN, network management system (NMS), Outage Management System (OMS), Meter Data Management Systems (MDMS), and other subsystems [10]. With an advance feature of data collection, the system procures a safe, secure, fast and self-upgradable with developed vision of reliable and flexible access to electricity consumption of the subscribers using power and distribution grid.

V. CONCLUSION

The development of smart grid is still in its nascent stage. The entire power society is busy now in understanding & developing smart power grid system which is no longer a theme of future. Some of the technologies may be improving the system reliability and increasing the life of the equipment/system, however not providing the direct monitory benefit to the utility, do not get much attention as a mindset. Intelligent or Smart grids, the vision unfolded, would soon become a reality in a couple of years. Increasing energy demands, depletion of natural resources, effect of carbon emissions ,need for a sustainable environment together with changing life styles requiring increased automation, make smart grids an inevitable option of the future.

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