A Power Sector of India by Electric Grid

Prof.R.S.Somalwar
Electrical Engg. Dept
Datta Meghe Institute of Engineering
Technology & Research
Wardha(India)
rahulsomalwar@gmail.com

Mr.S.M.Apte
Electrical Engg. Dept
Datta Meghe Institute of Engineering
Technology & Research
ardha(India)
sandipapte2490@gmail.com

Mr.Y.R.Ikhe
Electrical Engg. Dept
Datta Meghe Institute of Engineering
Technology & Research
Wardha(India)
yogesh08mar@gmail.com

Abstract **:** The electric grid of tomorrow is being built now and it will be quite different from the one that powers houses, factories and business today. The transformation is the most ambitious reconstitution of the grid since its inception more than a century ago and the change will pose serious challenges affecting all of society. The future grid will be more distributed than centralized as it will involve millions of new participants affecting power supply and demand. It will convey more and more electricity from solar and wind energy sources, which are inherently intermittent and difficult to predict. In this paper discussed the need of smart grid for Indian power sector and methodology of Maintaining grid stability by using the various reliable energy supplies by considering the existing technique

In this paper discussed the role of smart grids in addressing the problems associated with the efficient and reliable delivery and use of electricity and with the integration of renewable sources. Solar and wind power plants exhibit changing dynamics, nonlinearities, and uncertainties—challenges that require advanced control strategies to solve effectively. The use of more efficient control strategies would not only increase the performance of these systems, but would increase the number of operational hours of solar and wind plants and thus reduce the cost per kilowatt-hour (KWh) produced.

Key words: *Smart grid, Solar energ.*

*****

INTRODUCTION

In 2009, India had the third largest energy demand in the world after China and the United States and just ahead of Russia. As World Energy Outlook (WEO) 2011 shows, India's energy demand more than doubled from 319 million tones of oil equivalent (Mtoe) in 1990 to 669 Mtoe in 2009. Notably, India's per-capita energy consumption is still at a much lower level than that of developed countries and even of some developing countries. Its per-capita energy consumption is 0.58 (toe/capita), compared to the world average of 1.8, OECD of 4.28, China of 1.7 and Africa of 0.67 in 2009 (IEA, 2011b). The low per-capita energy consumption level indicates that India's energy demand still has a long way to reach saturation. With a growing economy and a 1.30 billion population aspiring for a better quality of life, India's energy demand growth is inevitable. [1]The question is at what scale and speed India's energy demand will expand and which fuels and technologies it will use. This is the key for understanding

energy is very small as compare to coal and Hydro power generation the future landscape of India's and eventually the world energy market .The fig1 shows the present status of installed capacity of India were the share of Renewable energy is very small as compare to coal and Hydro power generation

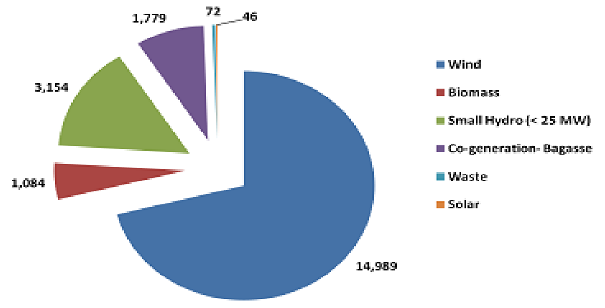


Fig. 1. Installed capacity of Renewably Energy (MW) as on Aug 31, 2011

METHODS OF POWER ENGINEERING

Power systems are fundamentally reliant on control, communications, and computation for ensuring stable, reliable, efficient operations.

The transient stability, small-signal stability, and voltage stability analysis had been sufficient for system planning. Today, more sophisticated stochastic metrics and modeling techniques are needed to understand the volatility and related dynamic changes in a power system.

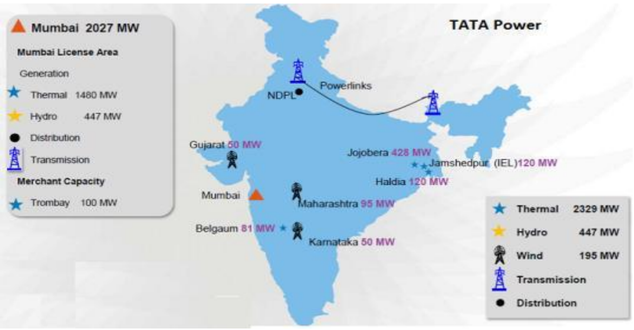
Integration of widespread distributed energy resources requires reconsideration of investment and cost allocation decisions. This includes the engineering- economics of an electric distribution system. The expected increase in two-

 ISSN: 2321-8169
774 – 777

way power flows over distribution circuits will require both physical
infrastructure upgrades and new intelligent distributed
control systems.
One might wonder what Smart Grids can do for power sector in India , where the per capita consumption is very low per annum. Although Indian Smart Grid may look quite different from an American or European Smart Grid, but its value and impact are no less. Reese Rogers writes report that driven by increasing shares of renewable energy in the electricity generation mix and by the need to update aging grid infrastructure, global investment in "smart grid" technologies rose 7 percent in 2012, totaling $13.9 billion worldwide, according to new research conducted by the World watch Institute for its Vital Signs Online service.[1]Despite a slight decline in investments, the United Sates maintained its position as a leader in smart grids, followed closely by China.

PRESENT SCENARIO OF ENERGY SECTOR

Smart Grids are an important option for sustainable development, but we must also recognize that it is not a miracle cure for the challenges that Indian Power Sector is facing today. If we compare with China, China's rising investment in smart grid technologies stems from its plans to update its poorly designed and inefficient transmission system, and China is poised to surpass the United States in smart grid investment in 2013.



Other countries in Asia are also investing in smart grid technologies and deployments. South Korea, February 2012, had deployed smart meters to fewer than a million households, or roughly 4 percent. And Japan is already home to one of the most efficient electricity grids in the world, with distribution losses averaging 4.9 percent over the period 2000 to 2010. procure power by involving the end consumers in the supply-demandcycle. By making the consumers responsive, utilities can reduce procurements during the peak price periods. The reduced consumption by the end consumers is compensated appropriately by the utilities in the form of financial incentives to reduce their actual electricity bill.[3]
An innovative and interactive power system will result inthe moderation of peak load, hence the reduction of required power generation capacity, and better integration of renewable-based electricity to the grid smart grid required. A smart grid is defined as ― electricity network that uses digital information and communications technologies to improve the efficiency and reliability of electricity transport.‖ [1]-[3]The increasing use of highly variable energy resources requires sophisticated control systems to facilitate
Fig 2 Inter-regional transfer capacity of India where as in India the transmission grid will be synchronous, and the backbone will be ultra-high-voltage – tests are already underway for 1200 kV AC lines. Fig 2 gives the idea of Inter-regional transfer capacity will grow enormously which is important since supply sources (both coal and renewable) are region-specific. New technologies such as Flexible AC Transmission Systems (FACTS) are expected to mature, and we have already started the learning process for (Synchro) Phasor Measurement Units (PMUs) to enable a Wide Area Measurement System, or WAMS, which can help improve the transmission system stability as well as its transfer capacity.[2] Of course, increasing supply and strengthening the grid is only a small part of the future. Before discussing the Smart Grid we must understand the basics points on which smart grid technology to be implemented

a. Technical Losses
b. Commercial losses i.e. Bills raised & realized by State electricity Board.
c. Theft of electricity by meter tampering
d. Theft of electricity by hooking
e. Distribution Transformer having uncontrolled losses

SMART GRID

Smart grids are not an overnight process, the details are impossible to predict, but the trends are easier to identify. Macro-economic pressure means there will be a need for much more capacity growth, and policy choices will push a more sustainable grid. The unified grid will remain the 3rd largest in the world, but it need not look like today's. [3]
Smart grid enables the energy utilities to effectively
Grid-scale energy storage technologies are another important aspect of evolving grid networks, providing an alternate or complementary solution for the integration of variable renewable energy into the grid.

CHALLENGES IN SMART GRID TECHNOLOGY

The major challenge with renewable, their intermittency and unpredictability, is ripe for a nimble and responsive system, i.e., a smart system, where we not only have storage as an option, but consumer participation to match demand with supply.

1).Extreme reliability: The power grid is extremely reliable and consumers expect it to stay that way. When a customer turns on a switch the customer expects high-quality power to flow
2) Volatility of some renewable generation and customer

ISSN: 2321-8169
774 – 777

demand: How the variability of power from a photovoltaic (PV) solar or large wind farm and customer load/supply on the grid will affect the large-scale integrated electrical system is not well understood.

3) Time scales of economic and grid control actions: The grid is extremely reliable because it is controlled adaptively at time scales of seconds. By contrast, contracts between load-serving entities and power generation companies last for many decades. In the coming decade millions of independent agents, individuals and devices, will make economic and control decisions at vastly different time

1.Advanced metering infrastructure (AMI) is a vision for two-way meter/utility communication. Two fundamental elements of AMI have been implemented. First, automatic meter reading (AMR) systems provide an initial step toward lowering the costs of data gathering through use of real-time metering information. Second, meter data management (MDM) provides a single point of integration for the full range of meter data. It enables leveraging of that data to automate business processes in real time and sharing of the data with key business and operational applications to improve efficiency and support decision making across the enterprise

4) Rapid changes in technology: The cost effectiveness of solar power has improved significantly in a few years and may well continue to improve rapidly. The technology of energy storage systems is, likewise, improving. Bulk energy contracts are made for multiple decades and during that time advances in Incentives for reducing dependence on fossil fuels: Some governments and agencies like

Municipal carporation provide substantial incentives for renewable energy generation and for improving energy efficiencies of homes, offices and factories. The influence of current incentives and expectations of future incentives makes long-term analyses of markets challenging.

Electrical transmission and distribution system design and operation will need to evolve significantly over the next twenty years to accommodate the expected variability and diversity of supply and participation. The current electrical grid is an immensely complex and vast machine, not just of wire and steel but of political jurisdictions, human values and societal needs. It is arguably the most complex machine ever invented. The scale and scope of the change needed is unprecedented for both transmission and distribution infrastructure. [4]

Much of the grid is at approaching the end of its expected life. The Brattle Group estimated transmission and distribution infrastructure investment Distributed energy resource adoption at the levels in the analyses above will affect grid reliability in numerous ways, not all of which can be anticipated yet. What is known today is that solar PV energy production is dependent on weather conditions which are inherently changeable. This variability can create extreme changes in power output over short time periods as to create grid instability as illustrated in Figure 2. Likewise, the second-to-second changes in power output from solar PV due to clouds and humidity can introduce transients in the distribution system that can also negatively affect power quality and in some cases reliability

However, this limited dampening doesn't help with variations beyond instantaneous changes. Monitoring can also help provide better short-term wind flow predictions during a day and within an hour which also help operators manage system stability. Unfortunately, neither of these two techniques can address the fundamental variability of output and general misalignment of wind production with typical energy consumption patterns.

Smart grid concepts encompass a wide range of technologies and applications. We describe from [5] a few below that are currently in practice with the caveat that, at this early stage in the development of smart grids, the role of control, especially advanced control, is limited:

2)Distribution management system (DMS) software mathematically models the electric distribution network and predicts the impact of outages, transmission, generation, voltage/frequency variation, and more. It helps reduce capital investment by showing how to better utilize existing assets, by enabling peak shaving via demand response (DR), and by improving network reliability.

3) Geographic information system (GIS) technology is specifically designed for the utility industry to model, design, and manage their critical infrastructure. By integrating utility data and geographical maps, GIS provides a graphical view of the infrastructure that supports cost reduction through simplified planning and analysis and reduced operational response times. Many more like Outage management systems (OMSs) speed outage resolution so power is restored more rapidly and outage costs are contained. Intelligent electronics devices (IEDs) are advanced, application-enabled devices installed in the field that process, compute, and transmit pertinent information to a higher level. Wide-area measurement systems (WAMS) provide accurate, synchronized measurements from across large-scale power grids. WAMS consist of phas or measurement units (PMUs) that provide precise, time-stamped data, together with phasor data concentrators that aggregate the data and perform event recording. WAMS data plays a vital role in post-disturbance analysis, validation of system dynamic models, FACTS control verification, and wide-area protection schemes. Future implementation of wide-area control schemes are expected to build on WAMS. Energy management systems (EMSs) at customer premises can control consumption, onsite generation and storage, and potentially electric vehicle charging. EMSs are in use today in large industrial and commercial facilities and will likely be broadly adopted with the rollout of smart grids. Facility energy management can be seen as a large-scale optimization problem: Given current and (possibly) uncertain) future information on pricing, consumption preferences, distributed generation prospects, and other factors, how should devices and systems be used optimally?

Benefits Envisaged

ISSN: 2321-8169
774 – 777

- Reduction in AT&C losses
- Reduction in requirement of field staff through proper management of unforeseen outages
- Improvement in reliability parameters like SAIFI, SAIDI, CAIDI etc.
- Reduction in Meter Reading cost, bringing efficiency in meter reading.

CONCLUSION

Grid operations in the coming decade will undergo a significant transformation due to increased variability in electric generation production from wind and solar PV resources as well as customer load becoming less predictable given onsite generation and responsive loads. These two fundamental changes to traditional supply and demand management are creating a new operating paradigm in which decision time cycles are decreasing beyond human capability to be central to the process as is the case today. Also, the need for coordination of transmission operations across operating regions is increasing and traditional jurisdictional boundaries between transmission and distribution are blurring. These factors combined with the massive capital investment to replace aging infrastructure replacement point to the need to reconsider fundamental design and operational reliability principles. The anticipated high degree of variability and uncertainty should be addressed through the use of models and methods designed for such stochastic applications The India Smart Grid Forum was launched by the minister of power in 2010 and subsequently aTask Force was set up to create a roadmap for development of smart grids in India. India looks at smart grids with a view to the benefits for the distribution level, as one of the components of smart grids is smart metering/advance metering infrastructure. (PIB, 2010b) Smart grids could help contain the huge commercial losses from which Indian state power distribution companies suffer. But India's goal goes beyond the distribution level and it will be achieved if follow the steps given below The renewable sector features strong private investments, which are essential to materialize the potential of renewable for supplying a clean and modern energy, particularly in rural areas.

To complete the transformation of India's energy sector into an open and functioning energy market, the country needs a courage to convey clear policy messages.

REFRENCES

[1] R. Brown, "Impact of smart grid on distribution system design," in Proc. 2008 IEEE Power and Energy Society General Meeting, pp. 1-4

[2] P. Parikh, M. Kanabar, and T. Sidhu, "Opportunities and challenges of wireless communication technologies for smart grid

[3] Mathur, Neerja (2011) "Indian Power Sector – An Overview" presentation at Joint IEA-India Workshop on High Efficiency, Low Emission Coal Technology, New Delhi, 29 November 2011.

[4] Gomez-Exposito, A. Abur, A. de la Villa Jaen, and C. Gomez-Quiles, "A multilevel state estimation paradigm for smart grids," Proceeding of the IEEE,vol. 99, no. 6, pp. 952–976, June 2011

[5] Joseph, Kelli (2010), "The politics of power: electricity reform in India", Energy Policy 38 (2010), pp.503-511

[6] Mathew, Jose (2003), "Development Policies of India with Special Reference to New Economic Policy", Mahatma GandhiUniversity,Keral.