

AN IDEA OF SMART GRID TECHNOLOGY IN INDIA

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Abstract--Generally smart grid is a modern technology of power system which can convert the whole power system in to digital format. In brief, a smart grid is the use of sensors, communications, computational ability and control in some form to enhance the overall functionality of the electric power delivery system. A system becomes smart by sensing, communicating, applying intelligence, exercising control and through feedback. For an ideal power system, this permits several functions which can optimize in the combination of the use of bulk generation and storage, transmission, distribution, and consumers. It can fulfill the goal which can ensure reliability and optimization of the use of Energy. It will also keep the environment free from pollution, save the assets, minimize the cost, easy operation against all hazards, maximum possibility to keep out from danger, provides power quality for 21st century needs. The focus of this paper is to familiarize with smart grid perspective to India. The conception of digital grid is almost new in India. The whole power system network in India is very elaborate and complex but primitive. To reduce this complexity and improve the performance of the system, digital grid can be a better solution. Load-shedding is a common phenomenon in India. It can be solved by smart grid technology. As it can automatically detect, calculate and distribute electricity as per load requirements, it reduces the system loss and at the same time a certain amount of electricity from the grid would always be available at each consumer side even at the time of load shedding. India can be greatly benefited by using this technology. The main objective of this paper is to discuss the necessity of smart grid for the perspective of India which may be an effective solution to overcome the recent power crisis.

Index Terms--Communication, Distribution Loss, Energy storage, Load Shedding, Power system, Smart grid, Sensor, Smart Meter, Security System, Transmission Loss.

I. INTRODUCTION

The term "Smart Grid" was first introduced by an article "Toward a Smart Grid" [1]. The actual definition of smart grid has still not been yet established. According to the United State (U.S.) Department of Energy (DOE)'s Modern Grid

A smart grid integrates advanced sensing technologies, control methods and integrated communications into current electricity grid - both at transmission and distribution levels. The objectives of the smart grid, as identified by the U.S. DOE, are:

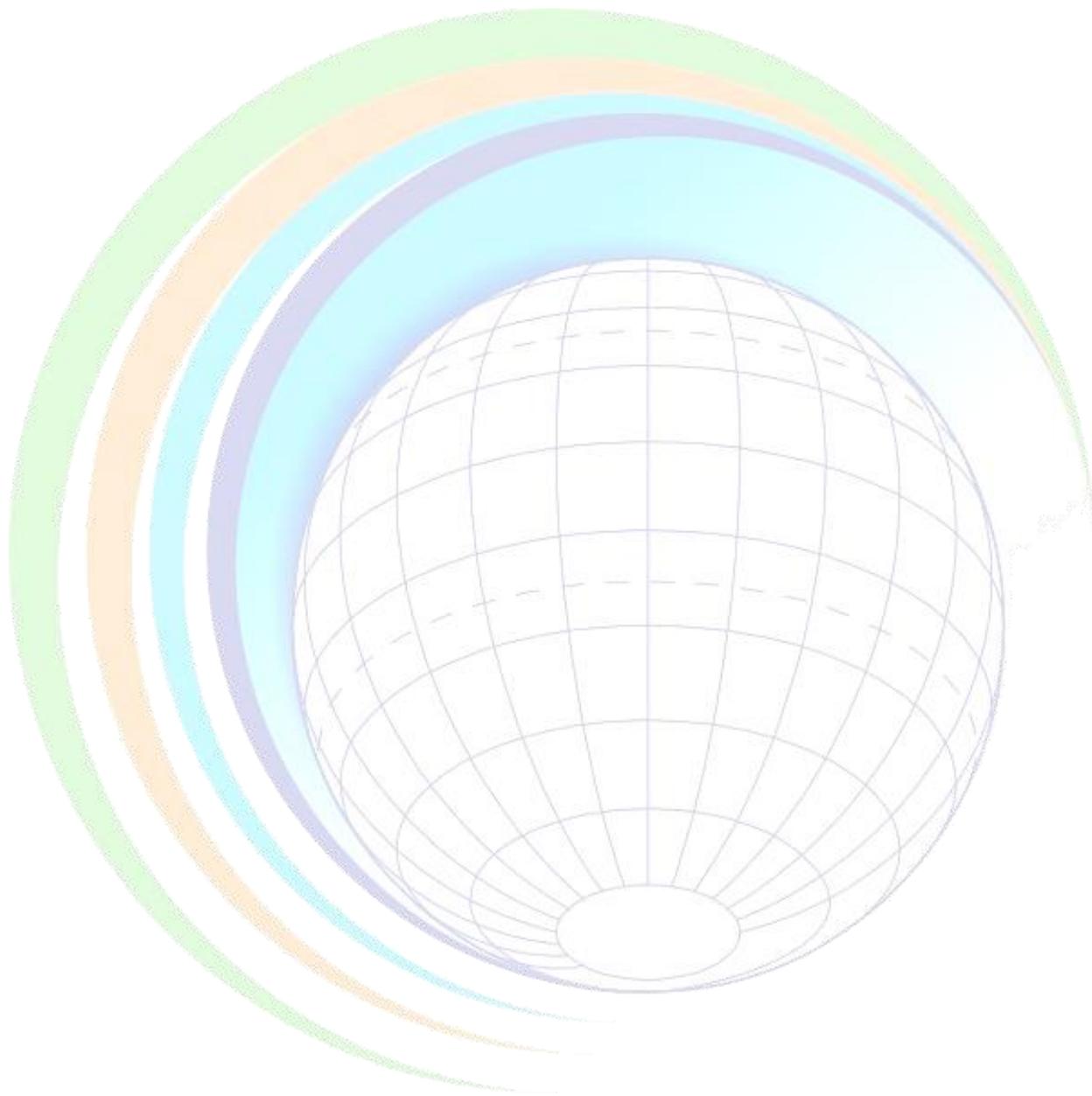
1. Enabling informed participation by customers.
2. Accommodating all generation and storage options.
3. Enabling new products, services, and markets.
4. Provide sang the power quality for the range of needs in the 21st century economy.
5. Optimizing asset utilization and operating efficiently.
6. Addressing disturbances through automated prevention, containment, and restoration.
7. Operating resiliently against all hazards.

Developed countries from North America, Europe and

China are adopting advanced and effective techniques in Power systems day by day. Some countries have already made cities with smart grid. The earliest, and still largest, example of a smart grid project was 'Telegestore'. The project was installed by Enel S.P.A. of Italy. The

'Telegestore' project was highly unusual in the utility world because the company designed and manufactured their own meters, acted as their own system integrator, and developed their own system software. The Telegestore project is widely regarded as the first commercial scale use of smart grid technology to the home, and delivers an annual savings of 500 million euro at a project cost of 2.1 billion euro [3]. In USA the city of Austin, Texas has been working on building smart grid since 2003, when 1/3 of its utility was first replaced by smart meters other than its manual meters, which can communicate via a wireless mesh network. At the time of its commissioning, it was capable of managing 200,000 devices in real-time (smart meters, smart thermostats, and sensors across its service area), which had been increased to 500,000 since 2009, is currently serving one million domestic and 43,000

commercial consumers [4].



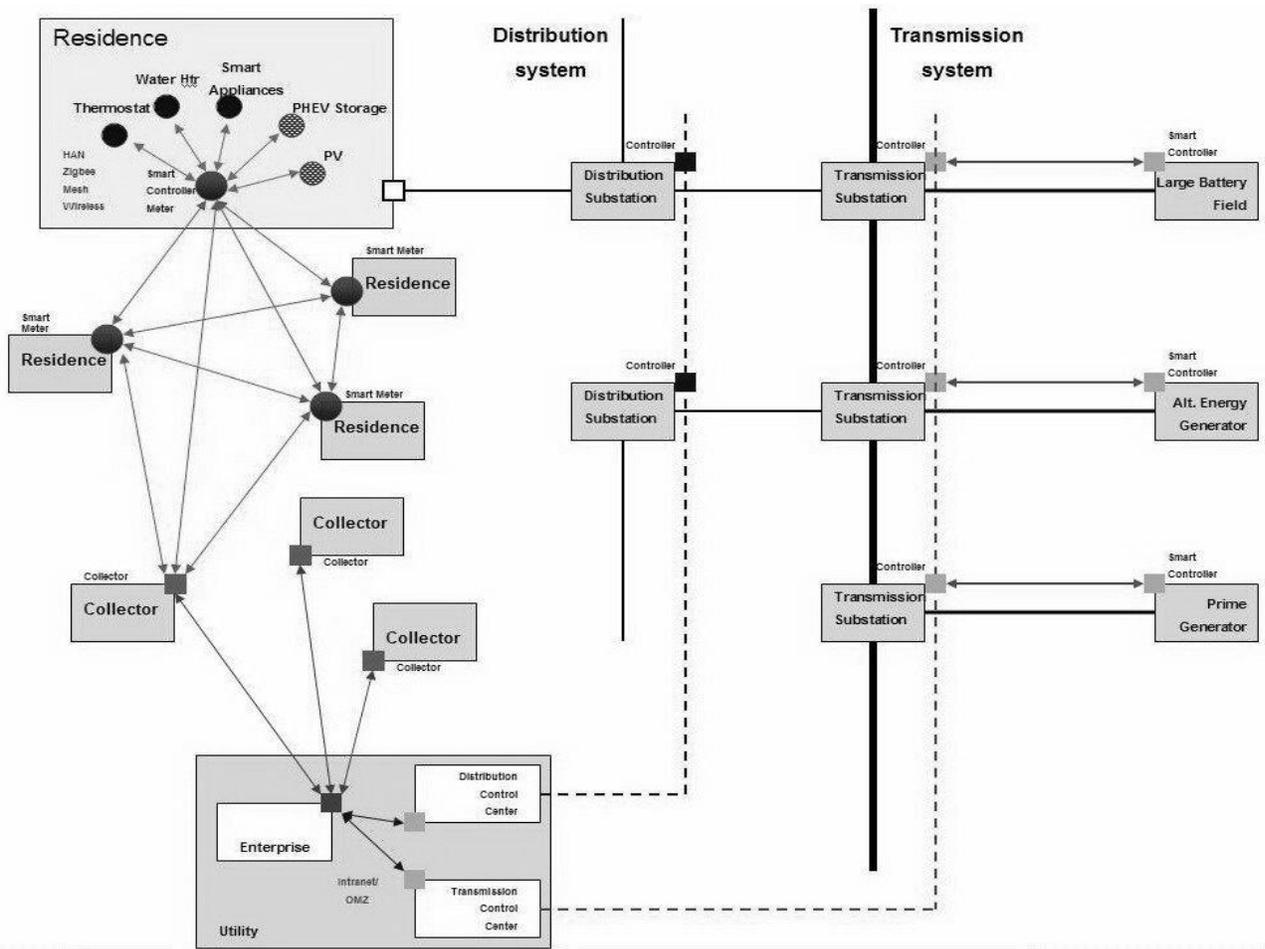


Fig. 1. Typical block diagram of typical smart grid components and connections.

In Boulder, Colorado the first phase of its smart grid project was completed in August 2008. Both systems use the smart meter as a gateway to the home automation network (HAN) that controls smart sockets and devices [5]. Hydro one, in Ontario, Canada is in the midst of a large-scale Smart Grid initiative, deploying a standard compliant communications infrastructure from Trillionth. By the end of 2016, the system will serve 1.3 million customers in the province of Ontario. The initiative won the "Best AMR Initiative in North America" award from the Utility Planning Network [6]. The City of Mannheim in Germany is using real-time Broadband Power line (BPL) communications in its Model City Mannheim named as "MoMa" project .So by using smart grid technology developed countries have already started solving the major environmental problem like carbon and massive green house gas emissions. They have introduced bi-directional power, (Plug in) Hybrid vehicles, home automation, home monitoring and green power. On the other hand a developing country like India is far behind from smart grid technology.

The grid system of India needs major improvement because it is facing some major problems like-

1. *Overloading of system components.*
2. *Poor planning of distribution network.*
3. *Lack of reactive power support and regulating services.*
4. *Power theft.*
5. *Metering and monitoring efficiency are low.*
6. *Corruption in power sector.*
7. *Delaying policy making and implementation*
8. *Lack of sufficient fund and budget.*

These problems can be solved through smart grid. The present population of India is 125cr. Among this large population, only 78% have the access to electricity. Even this 78% of population are not getting sufficient and secure power supply as per demand. This has happened mainly due to lack of generation capability. But another major problem behind this is transmission and distribution loss. At present in India transmission loss is 3.38% and distribution loss is 14.6% .This loss can be easily minimized by using smart grid technology. Load Shedding, currently, is considered as the most significant problem in India. This can be solved by smart peak management. Currently the average efficiency of world's conventional electricity grid is around 33% but the new generation grid and smart grid are 60% efficient .So it is high time India Power Development Board should look forward to adopt the smart grid technology for improving and upgrading the existing power network.

II. BENEFITS OF SMART GRIDS

It is proven that smart grid technology is much more beneficial and effective in modern power system rather than traditional grid system of India. Smart grid technology is beneficial from all respect of technical and economical point of view for India. So this technology can create a field of opportunities for India engineers, teachers, researchers and young professionals.

A. Technical Benefits:

The traditional technical situation compared to smart grid can be shown as follows:

TABLE I

Technical Situation in India	Benefit of Smart Grid If Implemented in India
The power generation in India is Centralized.	Power generation will be centralized and distributed
If there is a fault in Transmission and distribution system the fault can be identified automatically but it can't recover automatically.	Smart grid technology can recover the fault automatically. It can reduce additional transmission lines.
Distribution system is not atomized.	Atomized and it process real-time information from sensors and meters for fault location, automatic reconfiguration of feeders, voltage and reactive power Optimization.
No modern technology to reduce transmission loss	Smart grid can reduce the reactive power flow and maximize the amount of real power to minimize transmission losses.
One of the main reasons of load shedding is due sufficiency of circuit breakers in distribution network and these breakers not automatic radio controlled.	Smart grid required digital radios to wirelessly control the distribution network. Under this system the area will be divided in two very small regions and if fault occurs then whole area will be not victimized.
Most of the meter is electromechanical and security system of these meters is very inefficient and poor.	Most of the meter is digital .It can detect non working meters and bypassed meters
Only distributed sources can integrate.	It can integrate renewable energy and distributed sources.
Billing problem is a major concern. Meter readers are not concerned about bill collection but very much concerned about harassment and corruption with consumers.	It can eliminate billing error, detect nonpayment of bills, remotely disconnect for non paying consumer and reconnect after payment
Every year a lot of transformer lost due to theft and authorities failed to find those transformers due to technology.	Theft detection of transformer level is possible.
Communication is not present or if present it is one way but not real time.	Two way and real time.
Control of power flow is limited and one	Power flow is automated,

way.

comprehensive and multiple
power
flow pathways.

greenhouse gas emission 20% by 2050. India can be beneficial of this.

B. Economic benefit:

The system loss of India is still high. At present the system loss in India is 33.3%. The demand for power is increasing by huge MW annually and an investment of about

Tk. 110 billion is needed for that [12]. This huge amount of investment is a burden for a country like India with such an economic condition. By using smart grid technology both economic loss and investment can be reduced.

It is clear that every year power sector is giving huge amount of loss instead of income. Each and every operating expense can be minimized significantly by using smart grid technology because the energy efficiency of smart grid technology is much improved compare to traditional system. So if the technology is adopted and implemented there will be a significant reduction in operating expenses which will result an overall profit for the power sector..

Smart grid technology is almost new in India. Fresh graduate engineers can create own employment by designing the smart grid and they can sale their own design in different national power companies and service providers. Young engineers can establish a smart grid consultant firm and create lot of employment for future engineers.

Smart grid technology is consumer friendly as consumers can create their own HAN (Home Area Network). There are many useful applications under this system. Under this system, security of home and office is a major concern. If there is a problem safety alert will inform persons who are not home at that time. Consumers can save a good amount of cost by peak load reduction in smart buildings. Based on the nationwide pilot data consumers can reduce their electricity consumption up to 25% during peak hours [14]. Smart buildings, homes and offices can encourage consumers for energy savings. India government can implement smart buildings with smart grid technology to get rid of extra economic and financial loss.

At present, Delhi, the capital of India is top listed among the polluted cities in the world. Smart grid technology is also environment friendly. It can reduce carbon gas emission because smart grid system gives continuous feedback on electricity use. It can also reduce greenhouse gas emission. For example: electric vehicles. Electric Power Research Institute (EPRI) found that high penetration of PHEV (Plug -in hybrid electric vehicle) will reduce

III. DEVELOPMENT AND CHALLENGES

Development is a continuous progress. This initiative has already been proven in Europe, America, Canada and some developed Asian countries. Because they have already developed smart grid and day by day they are progressing rapidly. From perspective of India, development of smart grid should not be considered as a dream. Rather it should be taken as a scope to improve the power sector of India and certainly the implementation of such a technology would be nothing but a serious challenge for us.

First of all government and high officials should be concerned about smart grid. Most of the India engineers and even government engineers do not know about smart grid technology. They may be trained by professionals or multinational companies who are researching, working and developing smart grid technology. Then the second step for the engineers may be to introduce smart grid technology and convince to the policy makers about the benefits, usefulness and necessity of smart grid.

Second challenge of the smart grid will be financial. Implementation of smart grid will need a large amount of money. For a developing country like India, it is almost impossible to bear the entire project cost. So at first a pilot project of smart grid can be undertaken jointly with India and any other foreign investor. If the project becomes successful then government can go for further expansion of smart grid. If government take smart grid as a national project then third challenge will be to withstand against corruption. To get rid of these problems, policy makers can invite an online based tender notice and set up an evaluation committee, where honest national and international bureaucrats, person appointed from the relevant ministries and at least two or three Member of parliament may be appointed. The committee will be completely out of any kind of influence.

The third challenge of smart grid will be the policies and regulations. Though most of the developed countries had already built smart cities with smart grid but it is also true that most of them do not have definite smart grid policies, regulations, standards and guidelines. In the case of India, Indian Energy Regulatory Commission (IERS) should step forward to amend different sets of rules and policies. They can make new policies and regulations. This is the only major piece of federal legislation that addresses the modernization of the United States electric utility transmission and distribution system by upgrading to the

smart grid.

The fourth challenge of smart grid maybe the implementation of the technology that is, its design, planning operation and maintenance. Only a well structured government organization can perform these tasks effectively. An autonomous government financed organization under the direct supervision of the “Ministry of Power, Energy and Minerals” of India should be formed with well-defined organ gram.

The fifth challenge may be to familiarize and educate the consumers about smart grid. This task can be taken by the government or professional engineers who are working in this field. Electronic print media and newspapers can play a vital role here. Government can take initiative for training programs and workshops where consumers will be taught about the use of smart grid, associated benefits and the potential implementation issues.

In India as well in many other universities do not have any curriculum of smart grid technology. Introducing this technology in the curriculum can be a good way of make the students familiarized with it. In case of technical and engineering universities, they can include this topic in the relevant courses as well as perform some research activities in developing the technology in India.

Security of smart grid should be taken as a major consideration. The whole smart grid technology is controlled by digital communication network where important and private data are stored. So, proper encryption must be provided to ensure the security of the system from any kind of cyber-attack or hacking. The sixth challenge of smart grid would be to ensure the cyber security.

IV. CONCLUSION

Developed countries have started developing and implementing smart grid since when the technology was first introduced. Compare to the developed countries especially in Europe and North America; India is still lagging far behind by every technical and economic aspects. They are giving strong effort in this sector and spending their man, and money to be more developed. They are investing a great deal of amount in this sector. For example, according to the IEA (International Energy Agency) the electricity sector in European Union (EU) has an annual turnover exceeding 112 billion and contributes 1.5% of EU GDP. Investment in this sector is approximately 22 billion Euros per year. So it can be said that investment in smart grid technology is not worthless and this technology can contribute greatly in our GDP. According to the Recent ‘Power System Master Plan’ by IPDB (India Power Development Board) the transmission loss will be

reduced to 3% by 2018 and distribution loss will be reduced to 10% by 2019. But it may be not possible due to some hurdles like- corruption, insufficient technological support and political uncertainty. In that case smart grid technology can be a good choice. Because it is such a technology that once it is implemented, then it will be very easy to maintain and operate the whole system. As a result less amount of resource will be needed for operating the entire power system of the country which will result a great amount of saving of both money and man power. At the same time the utilization of the available resources will be optimized to a great extent.

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