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Development Of Smart Grid For Integrated Power System

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Abstract_

The paper presents the current scenario in India the role of integration of power grid using smart grid. In India most of the power generation is carried out conventional energy sources, coal and mineral oil-based power plants which contribute heavily to greenhouse gases emission. Smart grid refers to electric power system that enhances grid reliability and efficiency by automatically responding to system disturbances. The new communication infrastructure and scheme designed to integrate data, protection control using smart grid with the help of renewable sources and non-renewable sources is discussed in this paper.

INTRODUCTION

Energy is key point to drive and improve life cycle. Power system consists of generation, transmission, distribution and utilization of electrical power. The Indian power systems have been developing over the years in the form of integrated independent regional grids based on regional self-sufficiency. A smart grid embrace new technologies i.e. telecommunication, control, self -healing, efficiency, reliability, security of power systems and its must also provide the electric energy to all consumers with a highly reliable, cost effective power supply, fully utilizing the large centralized generators and smaller distributed power sources. The smart grid is a network of computers and power infrastructures that observe power system parameters and control energy usage. Smart power grids supports decision makers using sensor networks and adaptive and intelligent algorithms of post failure restoration ensure quick and precise localization of faults and selection of the best restoration strategy.To switch from modern grid to smart grid all the relevants must be involved: government, regulators, consumers, generators, traders, power exchangers, transmission companies, distribution companies and power equipment manufacturers.

SMART GRID

A **smart grid** is a digitally enabled electrical grid that gathers, distributes, and acts on information about the behavior of all participants (suppliers and consumers) in order to improve the efficiency, importance, reliability, economics, and sustainability of electricity services. An electrical grid is not a single entity but an aggregate of multiple networks and multiple power generation companies with multiple operators employing varying levels of communication and coordination, most of which is manually controlled. Smart grids increase the connectivity, automation and coordination between these suppliers, consumers and networks that perform long distance transmission or local distribution tasks. The smart grid implies a fundamental re-engineering of the electricity services industry, but focuses on the technical infrastructure. The smart grid is a network of computers and power infrastructures that observe power system parameters and control energy usage. The smart grid can be used in two way i.e from renewable sources and non-renewable source of energy. Intelligent creation of autonomous electric power systems enable to carry out island operation which will increase the power supply safety at the time of blackouts and improved communication infrastructure cannibalize existing monitoring networks (data acquisition and simulation of possible incidents). Smart grids are the answer to ensuring a safe, reliable and economical supply of electrical power in the future.

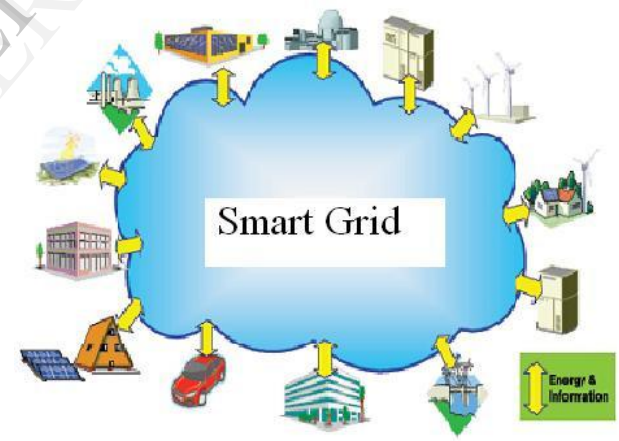
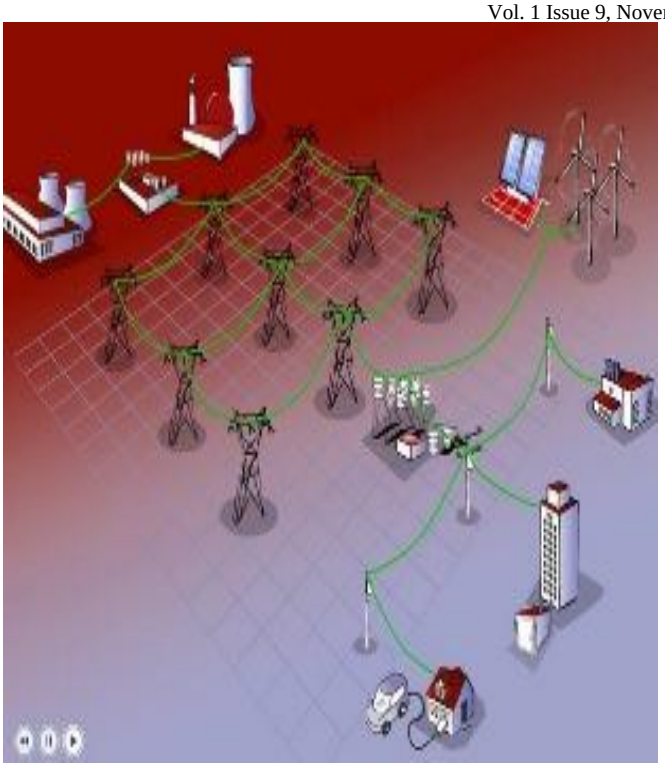


Fig. 2: Smart Grid

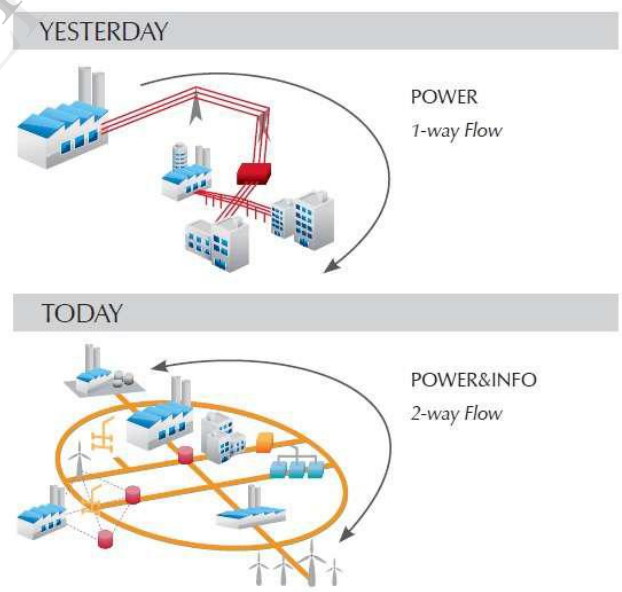
A national Smart Grid would evolve the existing system into one that would be better suited for the information flow which is required for energy conservation, higher reliability and the introduction of variable generation power from renewable sources. Smart Grid is the convergence of Information Technology (IT), communication technology and electrical infrastructure. Smart Grid technology is for the last stretch of reliability - meaning going from 99% to 99.9% reliability. The Indian power grid has about 75 to 85 % reliability. For example India has recently experienced an impressive rate of growth as its government implements reforms to encourage foreign investment and improve conditions for its 1.1B citizens. However, with its electrical grid, India loses money for every unit of electricity sold.

Because India is home to one of the weakest electric grids in the world, the opportunities for building the Smart Grid are great. Ultimately for India to continue along its path of aggressive economic growth, it needs to build a modern, intelligent grid. It is only with a reliable, financially secure Smart Grid that India can provide a stable environment for investments in electric infrastructure, a prerequisite to fixing the fundamental problems with the grid. Without this, India will not be able to keep pace with the growing electricity needs of its cornerstone industries, and will fail to create an environment for growth of its high tech and telecommunications sectors. A smart grid includes an intelligent monitoring system that keeps track of all electricity flowing in the system. It also incorporates the use of superconductive transmission lines for less power loss, as well as the capability of integrating alternative sources of electricity such as solar and wind. Smart grid provides attractive incentives for customers to install green power generation technology. Smart energy demand describes the energy user component of the smart grid. A smart grid puts information and communication technology into electricity generation, delivery, and consumption, making systems cleaner, safer, and more reliable and efficient. Smart Grid is a recently widely discussed topic although so far there is no universal standard definition of it. The common understanding of Smart Grid is that besides the conventional grid, a "SMART" two-way electricity and information flow. "A smart grid is the electricity delivery system (from point of generation to point of consumption) integrated with communications and information technology". Smart Grid market has three primary components: Smart Metering (intelligent billing), Grid Intelligence (the grid infrastructure and its controls) and Utility IT (intelligent data management). The smart grid is a network of computers and power infrastructures that observe power system parameters and control energy usage. The intelligent electronic devices communicate energy usage to the utility using a modern communication technology. The
intelligent electronic device at each consumer premises is called a smart meter.

Real-time information and power exchange between elements of the Smart Grid requires high-speed, fully integrated, two-way communication—down to the every customer level. The smart grid will improve environmental quality by allowing customers to purchase cleaner, lower-carbon-emitting generation, promote a more even deployment of renewable energy sources, and allow access to more environmentally-friendly distributed generation. The smart grid will allow for more efficient consumer response to prices, which will reduce the need for additional fossil fuel generation capacity.



(Smart grid diagram with two flow)



(The figure shows the various element of utility)

Smart grid is a vision for electricity networks to the rising challenges and opportunities, which bring benefits to all consumers. Much in the way that a "smart" phone these days means a phone with a computer in it, smart grid means "computerizing" the electric utility grid. It includes adding two-way digital communication technology to devices associated with the grid. Each device on the network can be given sensors to gather data (power meters, voltage sensors,

fault detectors, etc.), plus two-way digital communication between the device in the field and the utility's network operations center. A key feature of the smart grid is automation technology that lets the utility adjust and control each individual device or millions of devices from a central location. Smart Grid refers to an improved electricity supply chain that runs from a major power plant all the way inside your home.

BENEFITS OF SMART GRID TO CONSUMERS

The objectives are to provide grid observability, controllability of assets, enhance power system performance and security, reduction in operating cost, maintenance and system planning and "Smart grid" is a term that refers to the modernization of the electric system through the integration of new information-age technologies, new strategic public policies, and allows for new uses of the electric grid, both in operations and through new customer side applications, that extract the benefits of more efficient operation, more efficient use of grid assets, and more cost-effective expansion of the electric grid.

1. **Residential and Small Commercial Customers**: Improved system reliability will create benefits for consumers. However, perhaps the most significant benefits arise from more empowerment and individual control over energy use and monthly bills. Smart grid can provide a new set of tools for consumers to manage their usage and total energy bills.
2. **Low Income Customers, Customers on Fixed Incomes, and the Elderly**: Elderly people are most at risk to extreme heat and cold when power is lost. A more reliable grid will limit the risk of outages. In addition, by helping to reduce the need for costly new generation, transmission, and distribution facilities a smart grid can help relieve upward pressure on prices to the benefit of families on low or fixed incomes.
3. **Large Customers**: Large commercial and industrial customers require access to information, including price signals, to make efficient energy decisions. A smart grid will provide additional benefits from more detailed information and better reliability. A smart grid will allow large customers to integrate their production, storage and efficiency investments easily into wholesale market operations.
4. **Local Governments**: Local governments can benefit from higher reliability and lower duration of outages that will reduce the burden on local fire, police and other city resources that must help with such events. Greater information and control over the distribution system will also allow grid operators to assist with emergency situations, such as fires and storms, by turning off power selectively or by restoring power faster and more efficiently. Local governments are also consumers of electricity and can take advantage of the consumer-related benefits of smart grids.
5. **State and Local Economies**: Benefits can arise from increasing the reliability of the power system, creating a modern infrastructure for 21st century commerce and attracting or retaining new and innovative businesses providing new jobs and income. Most importantly, a modern electricity infrastructure can protect the economic and environmental viability of communities that are essential to creating a truly sustainable economy.

OBJECTIVES AND COMMUNICATIONS OF SMART GRID.

The two primary objectives of smart grid are economic development and customer satisfication . Economic development is the overarching goal. Smart grid investments will help drive the formation and growth of "green" supplier companies and enhance the competitiveness of key cities. Improved reliability will help retain important companies and American jobs in the state. In the short term, smart grid economic development will be accelerated through Federal Stimulus grants and Governor Paterson's Jobs Plan.

1. **New jobs**:
The manufacture, installation, operation and maintenance of the smart grid and its components will create new jobs within the state.
2. **Innovation**:
Research has been a hallmark and economic engine of any country. Smart grid innovation will enable the growth of business while customers will value the new product.
3. **Lower Costs**:
Costs rise over time and energy is no exception. But the smart grid should provide energy at a lower future cost than otherwise would be possible. As such, it will save customers money that can be invested or consumed as they choose.
4. **Improved Reliability:**
The Advanced Transmission Operations (ATO) and Advanced Distribution Operations (ADO) inherent in the smart grid will reduce and shorten outages and improve the quality of power.
5. **Increased Efficiency:**
The integrated advanced components of the smart grid will improve efficiency and lower costs for customers.
6. **Customer Energy/Cost Savings:**
As pricing becomes more transparent and is aligned with the underlying economics of generation and distribution, customers' decisions to save money will benefit society as well.
7. **Highest Security:**
Security will be incorporated into the design of the smart grid and will require the implementation of practices and procedures by individual stakeholders. In this way, the physical and cyber security risks can be managed to the highest standards possible.

8.**Timely renewables**: Smart grid is the enabler of more renewable energy. Its development will allow for the timely incorporation of these sustainable sources of power in a user-friendly, cost-effective manner.

9. **Green:**

Slowing the advance of global climate change and offering a genuine path toward significant environmental improvement.

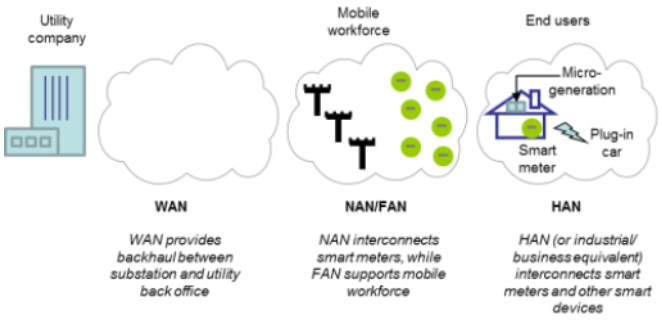
COMMUNICATION

A communications backbone is the key to achieving that interoperability. If the backbone isn't developed early, projects may have to be retrofitted later to accommodate the eventual communications standards, adding greatly to time and expense. Moreover, each individual project will be burdened with communications planning and costs, and the business cases for each will become much harder. Smart Grid will integrate all the components of power system to enhance the performance of the grid. Much of the integration of components relates to communication systems, IT systems, and business processes. Efficient communication is needed for proper co-ordination of protective devices to adopt the new operating conditions.

Electric utilities use a wide variety of telecommunications including:

- Wired and wireless telephone
- Voice and data dispatch radio
- Fiber optics
- Power line carrier
- Satellite
- The internet Fiber ,Hybrid fiber cable (HFC) , Digital subscriber line (DSL),Broad band over power lines (BPL),Wire less (wi-fi and wi-max), and satellite.

Smart grid requires fast communication with utility. Delay in communication may be higher through WAN. The current transmission media can not meet all the high capacity and quality of service requirement.



CONCLUSIONS:

In near future, electricity demand is expected to continue to grow further, to provide the power quality and to meet the ever rising demand economically, more power generation is needed at centralized level or at distribution level. It is the policy of the country to support the modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth. In today's world, we need to utilize all available technologies in planning a system that is as energy and operationally efficient as possible. This will require a change in attitude in the way we approach distribution system planning . Modern communication technology has ability to introduce a new era in electricity generation, distribution, and consumption.

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