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Smart Grid the Future of Electric Transmission System

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ABSTRACT: This paper represents the discussion of future of smart grid technology as it is one of the most emerging technology across the globe, from generation to transmission and from the substation to the distribution of electricity to consumers, embedded with feedbacks controls for making automatic computational intelligent decisions. This has been recognized by the public sector utility and private sector utility this technology is becoming necessary due to increasing population, business, infrastructure and myriad of consumer products which in turn effects the load demands and shortages of electricity particularly in remote areas but smart grid has emerged as a solution for all such problems. Moreover it provides bidirectional flow of energy and information from the source to the consumer rather than the conventional grid flow of energy which is unidirectional in nature. The smart grid technology is a step towards using sustainable energy, reducing the greenhouse effects in environment to some extent. This technology enables us to meet the power requirement of our 21st century also called the “digital age”, making a paradigm shift in the technology. This paper deals with the future visions of smart grid, facing technical issues, deploying necessary implementation as well as power thefting.

KEYWORDS: overview of smart grid, communications features of smart grid ,renewable integration, power thefting

I. INTRODUCTION

Electricity plays a more crucial role in today's time, than it has ever played in the past. We rely on it for our basic needs and mundane jobs. Thus, it has become essential that we must know how to control this energy, in order to derive maximum efficiency from the power generated. Electrical networks are very dynamic in nature and thus the equipments are replaced with the ones that are cleaner and that support renewable sources of energy. Like the solar and wind power generation would reduce the considerable amount of carbon dioxide emissions in atmosphere also people are engaging in renewable energy sources and smart home appliances but they are indeed becoming dependent on more energy demands like for example if there are more electrical vehicles they need to charge the vehicles for transportation and in turn the huge demand of charging will effect the grid during peak hours and can lead to load shedding .so the there is challenge arising everywhere when developing a new technology but the challenge indeed needs to be solved by finding a smarter solution .Smart Grid also represents the idea of a network that constitutes of technologies like sensors, advanced meters, energy storage, that will support us to make use of these renewable resources as a part of the electrical network. Smart Grid will further ensure the evolution of new rules and standards, management practices, increase in system stability and effort to make this distribution system frugal, especially for individual users to be part of this grid. Smart grid also enable the temporal faults in the system and can give the real time data on meter display by uploading through the internet this increases the stability and possible errors due to humans

II. OVERVIEW OF SMART GRID

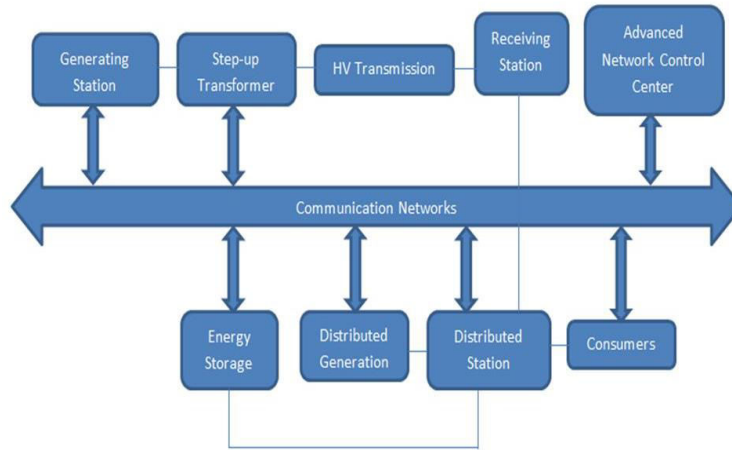


Figure : 1 block diagram for the smart grid

The electrical distributed network using the digital way of communication shown in above figure (2) to determine local changes in the grid and react automatically to occurring faults without any human intervention is called a smart grid the above block diagram just represents the above statement it shows the bidirectional communication in the network that the power generation, transmission, distribution, storage is delivered to consumers the entire communications networks acts as the master control where every detail aspect can be monitored by the utility companies. and the consumers can monitor the power usage based on real time data displayed by the smart energy meters. These meters obtain the information from the end users “load” to the utility companies by measuring the power consumption of the consumers this provides an efficient way for the utility for recording and billing of the consumers . this smart meters have the ability to connect – disconnect certain types of loads of consumer appliances to manage demand and loads . this encourages the consumers also and they can estimate there bills the smart meter also enables the utilities to collect the data and prioritize the billing for consumers Moreover the Indian smart grid market is expected to grow at a Compound **annual growth rate** (CAGR) of 3% over the period of 2020-2025 huge investment and deployment of smart meters, EV chargers and smart grid related equipment can seem to boom in the upcoming years. India is increasingly viewing smart grid technology as a strategic infrastructural investment that will sustain their long term economic prosperity and help them to achieve their carbon emission reduction targets. This in turn is expected to provide a ample amount of opportunity to the companies involved in smart grid network market in the future the Indian government has planned as investment of usd 44.9 billion in smart grids during the forecast period for which several projects have been sanctioned to meet the constant energy demand further driving the smart grid network market in the country

III. RENEWABLE ENERGY INTEGRATION WITH SMART GRID

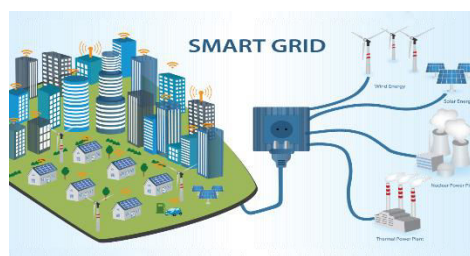


Figure :2 integration of renewable sources to smart grid

In India renewable energy power plants constitutes only 28% of total installed capacity and remaining 72% of non renewable energy power plant . Indian power plant uses fossil fuel ,coal and oil for power generation .and this fuels



causes tremendous hazard to environment by emission of carbon dioxide in the environment resulting greenhouse effect . india is one of the biggest country in coal burning for power generation. Approximately in India 120,000 people kill in every year because of the coal electricity generation. The hazardous air pollutants from coal power plants spread wide range of health problems. India is one of the fastest developing country and nowadays india is moving towards industrialization In the power sector generation and consumption India is on third rank after the United States and China, but however india electricity infrastructure faces blackouts in electrical networks inadequate planning of power system design infact india has faced severe blackout in history like On 30 and 31 July 2012 two severe power blackouts had given warning bells to India for a complete cosmetic changeover with advanced smart grid technology. Today's centralized grid is not as efficient for occurring, power shortages, frequency regulation, voltage deviation and severe time when loads exceed the power generation and this where smartgrid enters where the renewable energy can be used as islanded distributed generation when there is peak demand in load .operating intellectually and in a tangible manner .consider a small residence where the entire power is being supplied through solar energy, wind and biomass .enabling to provide and efficient way of power delivering to the residence . Here power conversion from AC to DC and again into AC for wind, But for solar it's DC-AC for grid connection. Power electronic converters are used to interface between renewable energy resources and the power grid. Reactive power output is controlled by power electronic converters; all these depend upon the feedback being provided by the controllers .this type of grid can also be used as backup power or to boost the main power grid . this type of grid enables the consumer to generate their own power inturn completing the need of energy for the booming population .there must be some advanced technologies for optimizing the energy at consumer ends and this can be done by smart home technology Smart home technology emerging from smart grid sector contributes effective energy management by using concept of home area network (HAN). Smart Home will be a future home which is designed for proper energy demand management by using smart meters & smart appliances.

IV. COMMUNICATIONS IN SMART GRID

The automated and distributed energy system delivered by smart grid depends upon two way flow of electricity and two way flow of information. Instantaneous balance of supply and demand at the device level in smart grid is possible due to the incorporation of distributed computing and communication which enables exchange of information in real time communication between the systems is important for maximizing the available electric power in a reliable and cost effective way. The smart grid communication being vast may use various communications and networking technologies like copper cable, fibre optic cable, power line carrier and wireless communications like WifMAX, cellular, microwave short range communication like WiFi, Zigbee can be used for some smart grid applications such as in home area networks. One of the applications area in smart grid communication is the so called advanced metering infrastructure AMI unlike traditional way in which technicians are being sent to the consumer site for billing record the smart meters in AMI provide real time monitoring of electric loads remotely where the real time data is being sent to the central location the data is efficient and price accurate this allows utility providers for energy consumption, billing and power outages by two way communications further AMI provides historical data and precise pricing and as well as suggestion to reduce peak loads this encourages the customer also and can be displayed on some in home display IHD AMI would have four layers: (1) the backbone that is the utility data center (2) backhaul the aggregation point of neighborhood data (3) the access point that is the smart meters (4) home area network HAN the HAN is envisioned to connect smart meters, EV , smart appliances to incorporate data communication for IHDs and load control for automated energy management during peak hours.

Features of Smart Grid-

Sustainability -Smart Grid allows us to rely on conventional as well as non-conventional resources, increasing both reliability as well as flexibility. The current network infrastructure is not programmed to handle many feed-in points, and the current transmission-level infrastructure cannot accommodate it. Such rapid fluctuations in the network infrastructure can put the power engineers under crisis. Hence, here the Smart Grid technology would come into play and help us update our current network infrastructure.

Reliability -Smart Grid allows us to rely on conventional as well as non-conventional resources, increasing both reliability as well as flexibility. The current network infrastructure is not programmed to handle many feed-in points, and the current transmission-level infrastructure cannot accommodate it. Such rapid fluctuations in the network infrastructure can put the power engineers under crisis. Hence, here the Smart Grid technology would come into play and help us update our current network infrastructure.



Flexibility -It will soon be possible to handle bidirectional flow in the transmission and distribution infrastructure, which will allow us to depend on non-conventional sources like charging to or from an electric car battery, wind turbines, pumped hydroelectric power, power generated through solar panels installed on the rooftops. Originally, smart grids were designed only for one-way flow of electricity, however, if the consumption on the receiving side increases then issues like reverse flow, safety and reliability come into play.

Efficiency- Through demand-side management, improvement in the efficiency of power transmission infrastructure can be achieved. For example, turning off electronics like refrigerators or air conditioners during short- term spikes in electricity price, reducing the voltage through lines through VAR. Also, Advance Metering System plays a major role in increasing the efficiency of the Smart Grid.

V. POWER THEFTING

It is one of the major drawbacks of smart grid and solutions are still being found for its annihilation. Modern AMI (Advanced Metering Infrastructure) solutions can help us identify attempted and actual fraud and theft through increased intelligence. However, this increased intelligence offers increased vulnerability to cyber-attack.

Types of energy theft and fraud

- 1) Direct theft : The thief can simply take energy from the DSO (Distribution system operators) without letting the DSO have the opportunity to meter the consumption.
- 2) Meter tampering : The meter is compromised in such a way that it delivers false/tampered readings. With the addition of smarter meters, there is more opportunity for a cyber-attacker to tamper with the meter, or the data it holds, and this can be very difficult to spot.
- 3) Unpaid bills : Customers simply do not pay their bills and hence make it hard for the DSO to cut off power supply.
- 4) The latest AMI bring the following significant improvements
- 5) Meter tampering and alarms – The latest generation of smart meters provide alarms for the preparation for and the actual execution of fraud and theft at the meter. In the most sophisticated smart meters, this can include events which indicate attempts to hack the meter or the communications network.
- 6) Automation of meter-to-cash – The humans can be largely removed from the process. The reduction of theft and fraud is a major business driver for initiating a smart meter project.
- 7) Remote control – smart meters allow the DSO to restrict access to energy and even cut off supply in the event of non-payment of bills. Not only is the remote control convenient and reduces costs – the energy cut off is faster, reducing the revenue leakage, and it avoids the need for physical confrontations with the thief.
- 8) Analysis of consumption in the low-voltage grid – in high quality deployments of smart grid, it is now possible to assess energy flows within the low-voltage grid allowing DSOs to spot the leakage of energy, possibly resulting from theft
- 9) Low-voltage grid topology analysis – a pre-requisite for analysis is to know the topology of the low-voltage grid. This is a challenge for many DSOs as records may be out of date or simply not exist. The latest AMI solutions allow the topology to be inferred from communications statistics
- 10) Usage statistics – some forms of illegal usage of energy, such as growth of drugs, can be detected from a deep analysis of consumption patterns and their correlation with other data, such as the weather.

VI. CONCLUSION

modernizing the old conventional grid to the the smart grids is challenge but the smart grid ensures the two way energy and information system and provides a reliable way for the utilities and consumer to manage the peak loads and integrating renewable energy to smart grid can provide direct and indirect benefits in excess cost and to the environment also through reduction of CO2 emission predictive analysis say 57% of energy can be generated through renewable energy sources by 2050 the smart grid can transform the 20th century power grid in more intelligent ,flexible and reliable manner enabling economic growth. also smart grid creates some new market for smart home automations,green buildings etc. smart grid also includes the newway communication technologies and with development in future may extent where the entire grid can be controlled by an A.I encouraging us towards a step towards future technologies and comfortability of humans



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