

The Smart Grid

The Next Generation Electrical Power System

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Abstract: Grid is the collection of devices that makes any system to generate, transmit and distribute the electricity, Smart grid are syncopation of new technology to stipulate with pressing current and future necessity in the electricity sector and to make omnipotent the effective borrowing of low carbon energy. Smart grid technology could facilitate the integration of electricity network over large graphical area creating the “Super grid”.

Keywords: Artificial intelligence, Carbon dioxide emission, Renewable energy, Smart Grid.

I. INTRODUCTION

The future energy presents the exciting advances in energy production the different methodology has been adopted in power system for the transmission distribution of electricity. Smart grid application at the generation and transmission level has been applied for a number of years and is frequently different from distribution level smart grid. Today’s energy grid has been developed with extensive interconnections; the main purpose of interconnection is to improve the power quality reliability.

A smart grid is an electricity network that incorporates a suit of information, communication to monitor and manage the transport of energy from all generation sources to meet the varying electricity demand of end users. The smart grid means to smartening the electrify grid which has already begun in many regions, For making the energy system more efficient, secure and more sustainable can be achieved by optimizing the utilization and operating efficiency of generating transmission and distribution assets for providing resiliency to unplanned supply and outages. Smart grid technologies could also facilitate the integrity of electricity network over large geographic area. The quality of supply is the major concerns in the power system without any interruption distortion.

The smart grid is a greener grid which enabled distribution would reduce the carbon dioxide emission by the use of wind energy. For improving the economy and reliability, electric utilities are interconnected in many regions by interconnection of the different region to access the power from different sources. In addition to this the neighboring utilities may help to maintain the overall system frequency, The supply of power quality is the main aspect of a power system there are changes in the methodologies of power generation, transmission, and distribution which has

changed the term deregulation indirectly in refer that the complete power system has been redefined in term of business. Due to complete interconnection of power system. It is obvious that the disturbances also result in the form of fault and other power quality problems. By the use of smart grid the failure occurrence due to interconnection can be avoided with the increase proportion of renewable energy generation.

Renewable energy can make a sustainable contribution in the power system with the increase in demand of electricity and the renewable energy is categorized as number fifth in the world. In spite of all the energy sources the hydro power plant, wind, solar and other biomass waste energy offers in an ideal environment. The pace at which every nation is moving toward market is very high every user wants the continuity of supply without any interruption. The purpose of today market is to reduce the price of electricity by competition. This market environment typically consists of pool and private negotiated contracts. Due to complete interconnection of power system and the disturbance which originate from one side can flow to other side and pollute the overall interconnected power system.

A. India Smart grid Forum

India is a developing country and adopting the different technologies to make country smarter, from the literature survey the list of fully crafted smarter cities are;

- 1) Andaman and Nicobar islands (1- port Blair).
- 2) Andhra Pradesh (3- Vishakhapatnam, Tirupati, Ka-kinada).
- 3) Arunachal Pradesh (1- pasighat).
- 4) Assam (1- Guwahati).
- 5) Bihar (3- Muzzaffarpur, Bhagalpur, Bihharsharif).
- 6) Chandigarh.
- 7) Chhattisgarh (2- Raipur, Bilaspur).
- 8) Dadra & Nagar Haveli (1- Silvassa).
- 9) Daman & Diu (1- Diu).
- 10) Delhi (1- NDMC).
- 11) Goa (1- Panaji).
- 12) Gujrat (6- Gandhinagar, Ahmedabad, Surat, Vadodara, Rajkot, Dahod).
- 13) Haryana (2- Karnal, Faridabad).
- 14) Himachal Pradesh (1- Dharamshala).
- 15) Jharkhand (1- Ranchi).
- 16) Karnataka (6- Mangalore, Belagai, shivamagga, Hub-balli-Dharwad, Tumakuru, Devanegore).

- 17) Kerala (1-kochi).
- 18) Lakshadweep (1- kavarrati).
- 19) Maharashtra (10-Navi Mumbai, Nashik, Thane, Greater Mumbai, Amravati, Solapur, Nagpur, Kalyan-Dombivali, Aurangabad, Pune).
- 20) Meghalaya (1- Shilong).
- 21) Mizoram (1-Aizwal).
- 22) Nagaland (1- Kohima).
- 23) Odisha (2- Bhubaneshwar, Raurkela).
- 24) Puducherry (1-oulgaret).
- 25) Punjab (3-Ludiyana, Jalandhar, Amritsar).
- 26) Rajasthan (4- Jaipur, Udaipur, Kota, Ajmer).
- 27) Sikkim (1- Namche).
- 28) Tamilnadu (12- Tiruchirappalli, Chennai, Tiruppu, Coimbatore, , Vellore, Salem, erode, Thanjavur, Tirunelveli, Din Digul, Madurai, Thootukndi).
- 29) Telangana (2- Greater Hyderabad, Greater Warangal).
- 30) Tripura (1- Agartala).
- 31) Uttar Pradesh (13- Moradabad, Aligarh, Saharanpur, Bareilly, Jhansi, Kanpur, Allahabad, Lucknow, Varanasi, Ghaziabad, Agra, Rampur).
- 32) Uttrakhand (1- Dehradun).
- 33) West Bengal (4-New Town Kolkata, Bidannagar, Durgapur, Haldia).
- 34) Energy Management system
- 35) Distribution Management system..

All the above cities implemented and following the challenges that motivates developing smart grid and its elements. In addition to the economic and policy motivation, the smart grid implementation respond to rate of advancement in the emerging technologies such as energy storage, carbon dioxide emission, renewable energy, communication system, artificial intelligence.

II. CARBON DIOXIDE EMISSION

Applying smart grid electric technologies can potentially reduce carbon dioxide emission; current power generation causes 29.5% of global carbon emission. Smart grid is having some key factors to reduce carbon emission by introducing the renewable energy capacities elements to with-stand the consumption, which inevitably reduces carbon dioxide emission by replacing inefficient grid with smart grid which can also reduce the energy losses. The different energy sources which require high carbon dioxide polluting fossil fuels to meet the demand at peak loads, with the use of smart grid energy usage can be relayed back to the utility. In the survey list of countries contributing for high carbon dioxide emission, India stands at number second. The major carbon dioxide offenders are China, India, United States and European Union. There are huge impacts of carbon dioxide emission which results in earth sea level rising, droughts, floods, forest fires etc. may results warming and will push the planet past critical threshold. The best evidence mankind probably needs to reduce carbon dioxide. Electricity sector is the major source of total global warming of approximately 40% worldwide followed by transportation, industry, and others sectors. The smart

grid can be regarded as a concept to step-up the generation of electrical power system. The smartness of the smart grid lies in the decision layers; the automation system electronic design to which all the relays run by computer programming. Generally smart grid refers to the use of digital information to improve the security and overall efficiency of smart grid. The different technologies are used to reduce the carbon dioxide emission in the atmosphere. The concept of smart grid is revealed in the environment by adding intelligence components in the power system from generation transmission and distribution. The use of renewable sources instead of thermal power plants will lead to fossil fuel conservation and reducing environment issues, greenhouse effect and thermal emission.

III. COMPONENTS OF SMART GRID

- Nerves-** AMI (Meter & Network) Advanced Grid Sensing & Visualization Technology.
- Brain-** Demand response Building the Energy Management System, Meter Data Management system, End user Energy efficiency.
- Muscle-** Distribution generation from Renewable & other Sources, Energy storage technologies.
- Bones-** New Transmission lines (HVDC, Superconductor) New Transformer & substation equipment.

IV. INDIA'S WIND POWER POTENTIAL

The total wind potential in India ranges from 748 GW to 976 GW at 80 m hub height. India has an estimated renewable energy potential of about 900 GW from commercially exploitable sources wind- 100GW small hydro -20 GW; Bioenergy- 25GW; and 750GW solar energy. India has developed extensive data bases for renewable resources in country. The National institute of wind Energy formally known as Centre for wind Energy Technology has developed the wind Atlas of India.

Renewable energy has been witnessing over 20% growth in last five years; from the total renewable power installed capacity of 14,400MW at the beginning of 2009 it has reached a capacity of 33,791 MW by the end of Dec 2014. Wind energy continues to dominate India's renewable energy industry. India occupies the fifth position in the world with a wind power installed capacity of 22.5GW.

V. SMART GRID CHALLENGES FOR INDIA

By 2032 the estimated demand will be 900GW for which India is pursuing one of the world's largest grid connected programme. Integration of such network will require smarter system for which India launched the National Electric mobility mission with the target 6 million electric vehicles by 2020. Successful rollout of Electric vehicle will requires smarter system. The overall responsibilities for successful implementation will be focusing at reduction of transmission

losses, strengthen of Extra High Voltage/Distribution system & improvement in power quality Renewable integration of 30 GW.

Electric vehicle charging station in urban, implementation of dynamic tariff, strengthen of optical fiber communication system for transmission line and substation need to be facilitated. Also infrastructure like development of micro grids, storage options, virtual power plants (VPP), vehicle to grid (V2G), solar to grid (PV2G), and building to grid (B2G) technologies to arranged in order to manage peak demand, optimally usage of installed capacity and elimination of load shedding and black-outs. The transmission system has become vulnerable to blackouts because of a century-long effort to reduce power losses. As power moves through a wire, part of it gets wasted in the form of heat. The loss is proportional to the amount of current being carried, so utilities keeping the current low and compensate by raising the voltage. They have also built progressively longer, higher-voltage lines to be more efficient for delivering the power from generation plants to customers located far away. These high-voltage lines also allow neighboring utilities to link their grids. Due to which no single operator or utility can stabilize or isolate a transmission failure. Managing a modern grid in real time requires much more automatic monitoring and far greater interaction among human operators, computer systems, communications networks and data-gathering sensors that need to be deployed everywhere in power plants and substations. Reliable operation also requires multiple, high-data-rate, two-way communications links among all these nodes, powerful computing facilities at the control center which do not exist in today's scenario. Intelligent processors with ability to automatically reconfigure power flows when precursors to blackouts to be sensed must be distributed across the network.

A self-healing smart grid can best if its architects try to fulfill three primary objectives

The most fundamental is real-time monitoring and reaction. An array of sensors would monitor electrical parameters such as voltage and current, as well as the condition of critical components. These measurements would enable the system to constantly tune itself to an optimal state. The Self-Healing technique, as the name suggests, is a unique feature which incorporates grid communication thus help in rectifying any fault in electric grids.

The second goal is anticipation. The system must constantly look for potential problems that could trigger larger disturbances, such as a transformer that is overheating. Computers would assess trouble signs and possible consequences. They would then identify corrective actions, simulate the effectiveness of each action, and present the most useful responses to human operators, who could then quickly implement corrective action by dispatching the grid's many automated control features.

The third objective is isolation. If failures were to occur, the whole network would break into isolated "islands," each of which must fend for itself. Each island would reorganize

its power plants and transmission flows as best it could. Although this might cause voltage fluctuations or even small outages, but it would prevent the cascades that cause major blackouts.

Power Quality concerns affects all connected electrical and electronic equipment, and is a measure of deviations in voltage, current, frequency, temperature, force, and torque of particular supply systems and their components. In recent years there has been considerable increase in nonlinear loads, in particular distributed loads such as computers, TV monitors and lighting. These draw harmonic currents which have detrimental effects including communication interference, loss of reliability, increased operating costs, equipment overheating, machine, transformer and capacitor failures, and inaccurate power metering. Electric utility managers and designers must build and operate systems that take into account the interaction between customer facilities and power system.

There are four major reasons for the increased concern:

1. More sensitive load Equipment.
2. Increasing emphasis on overall power system efficiency.
3. Increased awareness of power quality issues.
4. Interconnection therefore, failure of any component has much important consequence.

The main causes behind growing concern are:

- Global competitive market.
- Increased productivity Requirements.
- More productive and efficient machinery.
- The equipment is sometimes the sources of additional power quality problem profitability based on productivity.
- Utilities also to work efficiently.

A. METHODOLOGIES CAN BE USED

For making our system smart we need to mitigate the fault, for this Artificial neural network can give us better results. As we know Neural networks is its self-learning capability, an Artificial Neural Network (ANN) can be described as a set of elementary neurons that are usually connected in biologically inspired architectures and organized in several layers.

The first single layer perceptron can be used for finding the better results for measuring the accurate efficiency for which the classifier Algorithm can be used. A single layer perceptron (SLP) is a feed-forward network based on a threshold transfer function. SLP is the simplest type of artificial neural networks and can only classify linearly separable cases with a binary target (1, 0).

The single layer perceptron does not have a priori knowledge, so the initial weights are assigned randomly. SLP sums all the weighted inputs and if the sum is above the threshold (some predetermined value), SLP is said to be activated (output=1).

$W_1 X_1 + W_2 X_2 + \dots + W_n X_n > Q_1$ then output =1 if

$W_1 X_1 + W_2 X_2 + \dots + W_n X_n < Q_1$ then output =0

The input values are presented to the perceptron, and if the predicted output is the same as the desired output, then the

performance is considered satisfactory. First, the network is presented with a set of correct input and output Values. Then it adjusts the connection strength among the internal network nodes until proper transformation is learned. Second the network is presented with only the Input data, and then it produces a set of output values.

VI. CONCLUSION

A twenty-first-century economy requires a modern electric power grid that can effectively utilize renewable energy sources. With the growing technologies for enhancement, the demand of power in intelligent way and for making much efficient grid with 24hrs power supply; the concept of smart grid would go long way. This interconnected network needs to improve the quality of supply. Through the use of smart grid technologies energy can be used in the most optimized way with no wastage. Modernized version of energy would make everything smarter. By addition of new technologies to strengthen the existing one with the desired specifications can change whole pattern of the world.

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