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SMART GRID TECHNOLOGY: A STUDY REVIEW

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ABSTRACT

A smart grid is an evolved grid system that manages electricity demand in a sustainable, reliable and economic way, built on advanced infrastructure and tuned to facilitate the integration of all involved. In the world of smart grid, utility companies and consumer alike have tools to manage, monitor and respond to energy issues. It will provide more electricity to meet rising demand, increase reliability and quality of power supplies increase energy efficiency is able to integrate carbon free energy sources into power networks. Smart meters and home energy management system allow customers to program how and when their home uses energy. Throughout the day the demand for energy changes. Power plants have to work harder to meet the needs of electric consumers when demand is highest. With a mobile device you will be able to see when prices are highest and be altered when prices go up, so you can remotely turn off unnecessary appliances until demand lowers and prices go back down. So because of these benefits smart grid is future for electrical systems.

KEYWORDS : Smart grid, Smart meter.

I. INTRODUCTION

The utility electricity sector in India has one National grid an installed capacity of 350.162 GW as on 28 February 2019. Renewable power plants constituted 33.60% of total installed capacity. During the fiscal year 2017-18, the gross electricity generated by utilities in India was 1,303.49 TWh and total electricity generation in the country was 1,486.5TWh. India is 3rd largest producer and 3rd largest consumer of electricity. In contrast to fossil fuels, renewable energy (RE) offers alternative sources of energy which are in general pollution free, technologically effective and environmentally sustainable.

Smart grid is the combination of centralized bulky power plants and distributed power generators that allows multi-directional power flow and information exchange. Its two-way power communication systems create an automated and energy-efficient advanced energy delivery network. On the other hand, in traditional power systems, power flows only in one direction, i.e., from generating station to customers via transmission and distribution networks.

Smart grid technologies are still new and many are in the development stage. However, it is

anticipated that smart grid technology will play a self-regulatory role in power system networks.

II. COMPARISON OF EXISTING GRID AND SMART GRID

Existing Grid	Smart Grid
Electromechanical	Digital
One-way communication	Two-way communication
Centralized generation	Distributed generation
Few sensors	Sensors throughout
Manual monitoring	Self-monitoring
Manual restoration	Self-healing
Failures and blackouts	Adaptive and islanding
Limited control	Pervasive control
Few customer choices	Many customer choices

The features of the smart grid are as follows:

A. Intelligent and Efficient

Smart grid is capable of sensing system overloads and rerouting power to prevent or minimize a potential outage. It is efficient and potentially able to meet increasing consumer demand without adding any infrastructure.

B. Accommodation

Due to its robustness, smart grid can accommodate energy from fuel sources as well as RE sources and adopt any new technologies for a climate-friendly society.

- C. *Reduce Global Warming*
Possible to integrate large-scale RE into the grid that reduces global warming as well as green house gas emission.
- D. *Repairing and Maintenance*
Automatic maintenance and operation increases the efficiency of the power network. Moreover, predictive maintenance and self-healing reduces system disturbances.
- E. *Reliability*
Improves power quality and reliability as well as enhances capacity of existing network.
- F. *Distributed Generation*
Accommodates distributed power sources efficiently which reduces energy costs, GHG emissions and energy crisis issues world-wide.
- G. *Consumer Focus*
Consumers can customize their energy uses based on individual needs, electricity prices and environmental concerns.
- H. *Security*
With the adoption of security features in smart grid, the network is safer from cyber-attack and any unwanted tampering and natural disaster.
- I. *Quality-Focused*
Ensures power quality of the network by reducing voltage fluctuation (sag, swell and spikes) and harmonic effects in the network.
- J. *Technology*
New concepts and technologies will be developed that enhance power system infrastructure and accommodate new opportunities in innovation.

III. SMART GRID

Technology has transformed our way of life, but our electric grid — which we trust to keep power flowing to our homes, schools, workplaces, and hospitals — hasn't been modernized to match. Now it can be, with a new investment in our nation's energy infrastructure called smart grid. It combines **information technology with power transmission** to benefit your home, your community, and your nation.

What is Smart Grid?

A smart grid is an electricity network based on digital technology that is used to supply electricity to consumers via **two-way digital communication**. This system allows for monitoring, analysis, control and communication within the supply chain to help improve efficiency, reduce the energy consumption and cost, and maximize the transparency and reliability of the energy supply chain.



Fig.1. One way communication



Fig.2. Two way communication

IV. SMART GRID COMPONENTS

The smart grid system involves some of the following components

- A. **Smart meter**
Smart meters are advanced meters that identify energy consumption in more detail than a conventional meter. They look much like the electric meters that are in your home now, but their technology is far more advanced. They have the ability to communicate information via a secured network back and forth between your home and utility.



Fig.3. Smart meter

Smart meters are foundation for updating existing electrical system into smart grid because they have two way communications between utility and user that is it receives information from utility and also transmits energy usage information to utility.

Smart meters are safe and secure:

Smart meters have been thoroughly tested for safety and reliability. They have undergone extensive tests by utilities in USA. Smart meters operate at a level that is much lower (1.4%) than the maximum permissible exposure limits for radio frequency.

B. Phasor Measurement Units

A **Phasor measurement unit (PMU)** or **synchrophasor** is a device which measures the electrical waves on an electricity grid, using a common time source for synchronization. Time synchronization allows synchronized real-time measurements of multiple remote measurement points on the grid. High speed sensors called PMUs distributed throughout a transmission network can be used to monitor the state of the electric system. Phasor are representations of the magnitude and phase of alternating voltage at a point in the network. Using a PMU, it is simple to detect abnormal waveform shapes.

Benefits of PMU:

1. Using a PMU, it is simple to detect abnormal waveform shapes.
2. Time synchronized sub-second data
3. Dynamic behavior observing
4. High data rates and low latency due to computation

V. SMART GRID IN GENERATION, TRANSMISSION & DISTRIBUTION

A. Smart grid in generation

Integrates all sources of energy and advanced plant controls
 Hydro power plants,

Wind farms,
 Solar farms,
 Thermal power plants etc.

B. Smart grid in transmission

It uses Smart power electronics having following features:

- Unmanned station with comprehensive diagnostic facilities using real time telecommunication,
- High reliability-99% efficiency of power transmission,
- Shunt and series line compensation,
- Improved AC power quality,
- Digital substation (AIS & GIS)-Compact optical sensor intelligence,
- PMUs,
- Integrated signal processing for advanced equipment diagnostic and monitoring,
- Improved substation safety and reliability,
- Transmission control room-Energy management system,

- Advanced generation scheduling,
- Wide area automation,

C. Smart grid in distribution

- Integrated distribution management system
- Real time monitoring using smart meters,
- Real time management of distributed renewable, storage and electric vehicles,
- Real time management of demand response.

VI. CURRENT IMPLEMENTATIONS

- A. NEW DELHI:** Tata power Delhi has become the first Indian power utility to launch the Automated Demand Response (ADR) Project with smart meters in the capital. Under the project, Tata Power Delhi Distribution's select Industrial and Commercial Consumers having load greater than 100 KW. The project covers an area of more than 100 sq. km in the industrial, commercial and institutional belts of Tata Power Delhi Distribution like Lawrence Road, Narela, Delhi University, Civil Lines, Naraina, Wazirpur, Pitampura etc. covering industry sectors like Flour Mills, Food Processing Industry & Cold Storages, Commercial establishments, Plastic & Footwear Industry etc. A Total of around 250 consumers are participating in this project and will contribute towards a collective shed potential of 20 MW. This project involves around hundred 11 KV feeders, fed from 40 grid stations spread across the Tata Power Delhi Distribution's distribution area.

- B. Smart Grid in Pondicherry - A Reality**
Power Grid Corporation of India jointly with **Electricity Department, Govt. of Pondicherry**, is developing smart grid pilot project at Pondicherry through open collaboration.

VII. CONCLUSION

It's smarter for you- The more you know about your electricity consumption, the more control you have over your usage and your bills .When it comes to manage electricity, knowledge really is a

power. **It's smarter for planet-** The technology will provide daily estimation of greenhouse gases associated with electrical usage. At the same time the technology will improve and provide how renewable energy sources are integrated with electrical grid. **It's smarter for us all-** Smart meters and smart grid can make your electricity supply more reliable, with fewer and shorter outages. We need to start planning for the future today, by building smarter grid and giving people smarter ways to control their energy consumption.

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