SMART GRID

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ABSTRACT

In today's world, non renewable resources are limited, but demands are increasing day by day. So, we need to look forward towards renewable sources to fulfill our demands. In this context, electricity is foremost need. In this paper, we are focusing on micro/mini smart grid for rural areas of India. Smart grid is a "vision' of future technology for the electrification of rural areas. This paper concludes with the suggestion and proposals for the regional approach to mini/micro grid development that explains the demand for smart grid capability for rural areas in India.

Keywords: Mini/Micro Smart Grid, IED, AMI, Solar Energy.

I INTRODUCTION

Every night, more than a billion people live in the dark when the sun goes down. They experience a different world than that of people in developed countries. Their only source of light, where available, comes from kerosene – a fuel that is expensive, dirty and potentially dangerous. Consequently, their immediate environment is often filled with smoke and fire, thereby making it difficult to even see properly. India has a large portion of its population living in rural areas where access to energy is still a challenge. 1.21 billion people (2011 census) lives in India, rural population nearly –70 %(83.3 crore 2011census) depends on solid fuel for their cooking needs [1]. This number alone is an indicator of systemic challenges faced by rural India. In case of electricity although 55% rural households have a grid connection but the mere extension of grid does not guarantee access to reliable electricity [2]. In India, the rural-urban gap in energy access levels has been significant. This indicates the need and importance of fast tracking access and smart micro/mini grid systems to energy especially in the rural India.

The World Resources Institute estimates that in India, the off-grid energy access market includes 114 million households who are earning less than US$2/day. Specifically, decentralized renewable energy enterprises (DRE) offer in India a market opportunity of US$2.04 billion per year while the solar home lighting (SHS) market is estimated to be US$27.4 million a year. The IEA estimates that the 400 million people without access to electricity in the country spend over US$60 billion annually on energy (primarily inefficient and antiquated sources such as kerosene). Indian government has also facilitated the emergence of this rural clean energy sector by supporting distributed generation in the form of community-based, self-sufficient biomass and solar power [3]. Government of India is all set to scale up the targets set up for Jawahar Lal Nehru National Solar Mission from 20000 MW to 100

GW by 2022.National Solar Mission also has an ambitious goal of providing 20 million solar lighting systems in place of kerosene lamps to rural communities [4,5].

II TECHNOLOGY FOR RURAL ELECTRIFICATION-A SMART GRID

The present traditional grid is used for a power system that may support to the four operations: power generation, power transmission, power distribution, and power control [6]. A power grid is a grouped name for all the electrical wire, transformers and infrastructure that transport electricity from power plants to consumers. The present day grid is unidirectional (From centralized supply sources (power plants) to demand) and unsecured, does not support to efficient power supply. The operation of grid is based only one-way communication from the utilities to the users.

The invention of the Smart Grid facilitate two way communication for information flow and power flow on the basis of power engineering, communication engineering, digital and information technologies as shown in Fig. 1.

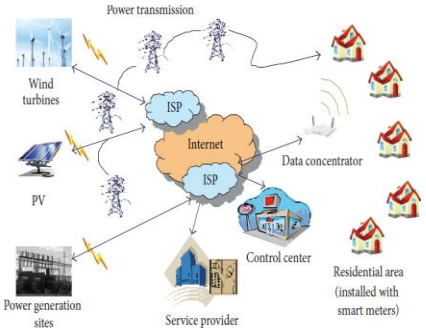

Fig 1 Architecture of Smart Grid

What Makes a Grid "Smart?" smart grid or intelligent energy system?

The digital technology that allows for two-way communication between the utility and its customers, and the sensing along the transmission lines is what makes the grid smart. Like the Internet, the Smart Grid will consist of controls, computers, automation, and new technologies and equipment working together, but in this case, these technologies will work with the electrical grid to respond digitally to our quickly changing electric demand.

The Major Benefits of Smart Grid Technology:

The benefits of the smart grid, as summarized by the US DOE, include [7].

(1) Improved reliability;

(2) Increased physical, operational. and cyber security and resilience against attack or natural disasters.

(3) Self-Healing or ease of repair, particularly remote repair;

(4) Increased information available to consumers regarding their energy use.

(5) Increased energy efficiency along with the environmental benefits gained by such efficiency;

(6) The integration of a greater percentage of renewable energy sources, which can be inherently unpredictable in nature;

(7) The integration of plug-in electric vehicles; and,

(8) A reduction in peak demand.

Basic components of Smart Grid:

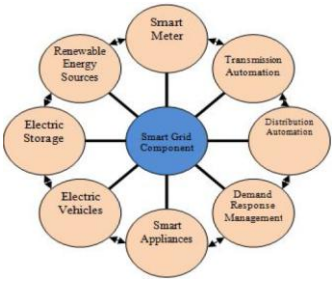

Fig 2. Smart Grid Components

Smart grid concepts encompass a wide range of technologies and applications. We describe a few advance components (Fig. 2) that are currently in practice with efficient smart grids.

1. **Advanced metering infrastructure (AMI)** is a vision for two-way meter/utility communication. Two fundamental elements of AMI have been implemented. First, automatic meter reading (AMR) systems provide an initial step toward lowering the costs of data gathering through use of real-time metering information. Second, meter data management (MDM) provides a single point of integration for the full range of meter data. It enables leveraging of that data to automate business processes in real time and sharing of the data with key business and operational applications to improve efficiency and support decision making across the enterprise

2. **Distribution management system (DMS)** software mathematically models the electric distribution network and predicts the impact of outages, transmission, generation, voltage/frequency variation, and more. It helps reduce capital investment by showing how to better utilize existing assets, by enabling peak shaving via demand response (DR), and by improving network reliability.

3. **Geographic information system (GIS)** technology is specifically designed for the utility industry to model, design, and manage their critical infrastructure. By integrating utility data and geographical maps, GIS provides a graphical view of the infrastructure that supports cost reduction through simplified planning.

Smart Grid project model initiatives by power companies in India [8]:

1. NDPL Smart Grid.
2. BESCOM Smart Grid Project.
3.West Bengal State Electricity Distribution Company Ltd (WBSEDCL) Smart Grid Project.
4. Smart Grid Customer Demo Center (CDC) by Mahindra Satyam in Partnership with Schneider electric.
5. Smart Mini-Grid System at The Energy and resources Institute (TERI).

III CONCLUSIONS

The smart grid has opened up many opportunities, also many security risks. Protecting the energy generators must be given highest priority, in addition to protecting the privacy of the consumers. Power houses can be attractive terrorist targets, as much as defense installations. Therefore, in order to achieve the benefits of a smart grid, it is imperative to develop a network solution that is highly reliable and secure. The major highlights of this paper are elaborated below.

1.Status of electrified villages as are total of 29 states of India, only 9 states have achieved 100 percent village electrification as on the 31st August 2013.A total of 32,227 villages of India are yet to be provided with electricity access out of 593,732 inhabited villages (561505 villages were electrified).

2. For off-grid generation could be dispatched by the central control center and used only during peak times. The smart grid can convert the customers adverse pricing by blending the cost of off-grid generation into average weighted price of off grid electricity tariff, this is an advantage for India, and changes in regulations and feed-in tariffs can manage the societal aspects.

3. Cyber security encompasses privacy. The Government of India has yet not demonstrated superior cyber security enforcement, and its standards for security are limited.

4. Micro grids can increase the reliability of power supply locally through active control of internal loads and generations. It can incorporate renewable energy sources, which helps to reduce environmental pollution. Furthermore, it can limit feeder losses, improve voltage quality, and provide uninterrupted power supply. Micro grid electrification system will be very useful project for remote rural areas like in hilly areas of state of Chhattisgharh, Uttarakhand, J &K, Himanchal etc.

5. The earning of carbon credits by using smart grid electrification will be most attractive economic trend in global level can be achieved by rural India. It can enhance the economy of our villages in national and international market.

6. The smart grid technology also suitable for industrial sector (Glass, Paper, Food processing) like power generation by wastage heat recovery technology as a micro grid system between industry and grid supply.

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