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Planning& Development of SCADA Based Power Distribution System

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Abstract

Smart Grid is sophisticated, digitally enhanced power systems where the use of modern communications and control technologies allows much greater robustness, efficiency and flexibility than today's power systems. A smart grid impacts all the components of a power system especially the distribution level. One subset of smart grids is smart metering / advanced metering infrastructure (AMI) etc. In a smart grid, all the various nodes need to interconnect to share data as and where needed. Smart Grid envisages providing choices to each and every customer for deciding the timing and amount of power consumption based upon the price of the power at a particular moment of time, apart from providing choices to the consumer and motivating them to participate in the operations of the grid, causing energy efficiency and accommodating all generation and storage options, Smart Grid also envisages various properties for the Grid like self-healing and adaptive The suite of Smart Grid products and technologies help maximizing system uptime, while also helping the utility more quickly to restore power to homes and businesses in the event of an outage. Government of India has recently formed "Smart Grid Forum" and "Smart Grid Task Force" for enablement of smart grid technology into Indian Power Distribution Utilities as a part of their Smart Grid initiative to meet their growing energy demand in similar with the developed country like USA, Europe etc.

Keywords: *AMI (Advanced Metering Infrastructure), Distribution Automation, AT&C (Aggregated Technical and Commercial) Loss, Asset Management.*

I. INTRODUCTION

Indian economy is forecasted to grow at 8 to 9% in 2010-2011 fiscal year, which in the coming years is set to reach double digit growth (10%+). But India suffers from grave power shortage which is likely to worsen over the next few decades. On one hand, there are problems with the lack of adequate generation capacity with power cuts ranging to several hours still prevalent in many cities. On the other hand, there are problems with the lack of transmission infrastructure with several thousand villages still not connected to the national grid. 15-20% power transmitted is lost in the transmission and distribution network while 10 to 20 % is lost to theft across the utilities in India. While these losses have been coming down slowly over the recent years, there is still a long way to go for the utilities to achieve the desired state of operations. India has also been missing its generation infrastructure expansion plans for the last several decades.

Recently the Government of India announced the National Mission on Enhanced Energy Efficiency which aims at improving energy efficiency in industrial as well as commercial and residential sectors. While for the industrial sector a scheme similar to the carbon trading, called the energy efficiency certificate scheme is in works, the case with the commercial and residential sector is slightly complicated. The industries can take care of themselves once the binding efficiency targets have been stipulated to them but the government needs to put in more effort for improving efficiency in the commercial/residential sector. Therefore, such a situation calls for the implementation of the smart grid.

A smart grid would help the utilities get information about the electricity use by the consumers and can potentially adapt it distribution process with respect to the time and quantum of power demand. The smart grid which uses smart meters could potentially be used for detecting power theft. In addition, the info that the consumers

would have access through the smart meters would possibly help them manage their energy use in a better and more efficient way.

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In addition, the info that the consumers would have access through the smart meters would possibly help them manage their energy use in a better and more efficient way. Such hyper growth will need unprecedented amount of energy that can only be met through efficient energy utilization through smart metering and smart grid technology. The substations, transformers, and energy meters, which are important part of the energy infrastructure are sort of standalone silos in India, and have no real-time monitoring.

II. MOTIVATIONS BEHIND DEVELOPMENT OF SMART DISTRIBUTION IN INDIA

Energy shortage, climate change and environmental pollution become global issues and affect people's lives and world economic sustainability. We have to change the current energy development and utilization patterns and find a green development path. Coping with the imminent challenges, many countries have expedited the development and application of clean energy and smart grid.

Strategic new industries like electric vehicles expanded rapidly. Smart application is the newest trend and feature of modern society. Great importance has been attached to the level of electricity automation in enhancing electricity supply reliability and improving overall efficiency. On the other side, it has been emphasized that being strong is one of the basic connotations for smart.

1. Climatic change brought new challenge to the power industry.
2. The growing demand of India’s rapid socio-economic development
3. The need to optimize resources allocation in large area

4. The need to large-scale clean energy development.
5. The grid security is facing challenges.

III. OBJECTIVE OF POWER DISTRIBUTION WITH SMART GRID

Key objective of Smart Grid

• ***Self-healing:*** The grid rapidly detects, analyses, responds, and restores

• ***Empowers and incorporates the consumer:*** Ability to incorporate consumer equipment and behaviour in grid design and operation

• ***Tolerant of attack:*** The grid mitigates and is resilient to physical/cyber-attacks

• ***Provides power quality needed by 21st-century users:*** The grid provides quality power consistent with consumer and industry needs.

• ***Accommodates a wide variety of supply and demand:*** The grid accommodates a variety of resources, including demand response, combined heat and power, wind, photovoltaic, and end-use efficiency

• Fully enables and is supported by competitive electricity markets.

IV. SMART GRID INITIATIVES IN INDIA

India has formed smart grid forum & task force to study and finalize the smart grid road map, keeping in view of the following points:

1. Smart Grid for India

The focus of Smart Grid to provide choices to each and every customer for deciding the timing and amount of power consumption based upon the price of the power at a particular moment of time. India has recently experienced an impressive rate of growth as its government implements reforms to encourage foreign investment and improve conditions for its 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.

2. Need for Smart Grid Distribution in India

With such enormous deficiencies in basic infrastructure, why would India want to consider investing in smart grid

technologies? 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.

3. Recent developments in Indian Grid

The Indian National Government, in cooperation with the State Energy Board, put forward a road to improvement when it announced the new Electricity Act of 2003, aimed at reforming electricity laws and bringing back foreign investment. The act had several important measures:

- Unbundling the State Electricity Board's assets into separate entities for generation, transmission, and distribution, with the intention of eventual privatization

- Implementation of RAPDRP (Restructured Accelerated Power Development & Reform Program) program for power distribution utilities across the country for preparation of baseline data for each project covering Consumer Indexing, GIS Mapping, Metering of all DT (Distribution Transformer) and substation Feeders, and also automated data logging for all DTs, Feeders and SCADA(Supervisory Control and data Acquisition) /DMS (Distribution Management System) for energy auditing /accounting and IT based consumer service centre.

- Adding capacity in support of a projected energy use growth rate of 12%, coinciding with a GDP growth rate of roughly 9%

- Improving metering efficiency

- Auditing to create transparency and accountability at the state level

- Improved billing and collection

- Mandating minimum amounts of electricity from renewable
- Requiring preferential tariff rates for renewable

- End use efficiency to reduce the cost of electricity there has been a recent push in India to begin labelling appliances with energy use to help consumers determine operating costs. There has also been significant effort to improve energy efficiency, for example to increase the average energy efficiency of power plants up from 30% to 40%, and pushing major industries to reduce energy consumption after execution of Energy Conservation Act'2001.

4. Need for Design of India Grid in line with US.

As is the case in most of the world, the Indian national grid was not designed for high-capacity, long-distance power transfer. As is the case in the United States, India needs to interconnect regional grids. Although coal and hydro-electric potential has peaked in many parts of India, there are still several regions with excess capacity. Large wind potential and increasing wind capacity in the south and west also create a need for transmission infrastructure. Unfortunately, like the United States, regions are generally sectionalized, with some asynchronous or HVDC links allowing for minimal power transfer. The biggest difference is that India's transmission grid only reaches 80% of its population, while the transmission grid in the United States reaches over 99% of its population.

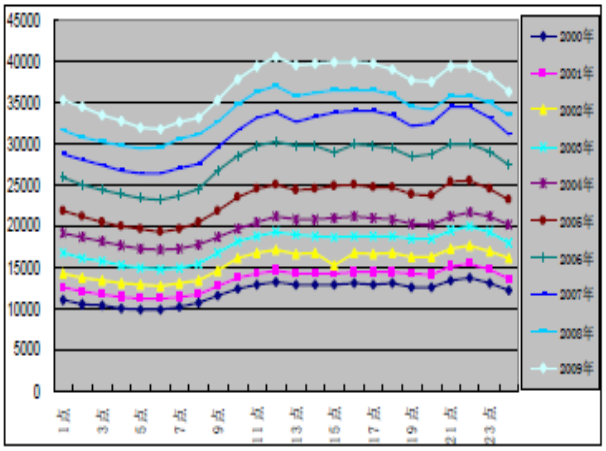

Fig.1 Daily load curve for summer and winter (2000-09)

V. METHODOLOGY FOR SMART GRID PROJECT IMPLEMENTATION IN INDIA

The Smart Grid project mainly comprises three technological areas as follows:

1. Metering & Meter Data Management:

- AMI/AMR (smart meters/modules, AMR application and relevant server
- Meter data transport infrastructure and communication network
- Meter Data Management (MDM) application &relevant Server

2. Distribution Automation (DMS/SCADA):

- DMS/SCADA application, Server, RTU and
- Communication network.
- Distribution peak demand reduction application
- Conservation of voltage regulation system

3. Demand Response:

Industry and Home automation along with dynamic tariff plan. The relatively straightforward part of Smart Grid programs is putting meters and network components in the field and building the Home area network (HAN). As the vision for Smart Grid technology moves from concept to reality, utilities worldwide are struggling. System-wide integration is being acknowledged, but operational integration is missing from many program plans.

A move from "business as usual" is required; the move to a fully integrated smart grid, operationally and organizationally, is possible with proper planning and execution through effective project management.

One of the most important aspects of a Smart Grid project implementation is a standard project methodology supervised by a centralized project management team. Implementation methodology is based on Project Management best practices, which includes five steps in project management labelled process groups: project initiation, planning, executing, monitoring and controlling, and closing.

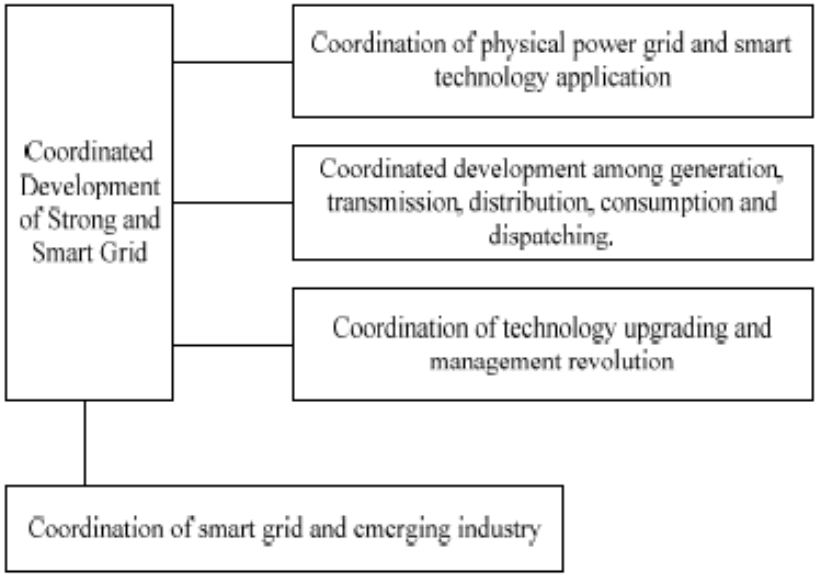

Fig.2 Main points of coordinated development of Smart grid distribution

The activities defined within each process group can be iterative. Not all activities have to be used during a project life cycle to be successful Project size and complexity will correlate to the detail and repetition of activities used within process groups.

VI. CHALLENGES IN IMPLEMENTATION OF SMART DISTRIBUTION IN INDIA

The challenges for implementing the Smart Grid project in India are much the same as the challenges faced during reformation due to market liberalization was first announced nearly 20 years ago. The problems that afflict India's power sector are many and serious, and are very well known to all stake holders. The loss of 30% of total electricity generated, the sector's legendary voltage fluctuations, chronic blackouts in rural areas, the lack of electricity connections for almost half the population, and so-called "free" power to the 25-30% of farmers with irrigation pumps are not simply unfortunate happenstance.

All these outcomes persist despite the Government of India's huge annual subsidy to the sector and what must now be the equivalent of many billions of dollars in time, effort and capital that have been invested in power sector reforms since the early 1990s. There are causes for these

effects and, if left unaddressed, they could dampen the impact of any smart grid scheme as they did in the past for other initiatives.

The power sector's chronic problems must be acknowledged, but not accepted. Despite the troubled state of the industry, there have been some notable successes, including the Delhi public-private partnership, under which DISCOMS operated by Tata Power's NDPL and two Reliance-owned DISCOMS are revitalizing one of the most intractable electricity distribution systems in the country, and the franchise concept that offers intriguing potential38 as does an early trial of an agricultural demand-side management (DSM)project currently.

The major hurdles for smart grid project implementation are:

- No proven commercial viability for large-scale smart grid roll outs.
- Poor financial health of most state-owned T&D companies.
- Low awareness of technological developments in the utility sector.
- No coordinated national road map for smart grid deployment. Each power distribution utility, setting a comprehensive smart grid strategy involves a complex mix of internal and external challenges as follows:
- The technical challenges of new systems, new devices, new communications technologies, and a deluge of new data can be overwhelming.
- The impact on existing business processes needs to be identified, with new business processes defined. The organization has to make it-self ready for the significant and perhaps radical changes that will take place.
- Customers, regulators and investors need to understand the change and be convinced that it is beneficial. A successful migration to a smart grid environment will require that all of them embrace the vision, not merely accept it.

CONCLUSION

This paper discusses about the smart grid initiatives in India, implementation methodology, challenges and benefits. The paper discusses the need for smart grid technology to minimize the AT & C losses which is a burning issue across all power

distribution utilities in India. The authors have highlighted some aspects of various key areas related as to smart grid initiative for Indian Power distribution utility like AMI, GIS, CRM, EAM, DMS etc.

Also elaborates the methodology to implement the smart grid project in Indian power scenario. This paper highlights the various challenges to implement smart grid in India. Finally elaborate the benefits, will achieve through successful implementation of smart grid for the utilities as well for the consumers, and obviously benefit to the Indian economy.

REFERENCES

Periodicals:

1. "The Green Grid: Energy Savings and Carbon Emissions Reductions Enabled by a Smart Grid," EPRI Palo Alto, CA: 2008
2. Frederic Butler, "A Call to order – A regulatory perspective on the smart grid," IEEE Power & Energy Magazine, April 2009
3. ZHANG W.L., LIU Z.Z., WANG M. J., and YANG X.S., Research status and development trend of smart grid. Power System Technology, vol. 33, no. 13, pp. 09
4. CARRASCO J.M., BIALASIEVICZ J.T., GUISADO R.C.P., and et al. Power electronics systems for the grid integration of renewable energy sources: a survey. IEEE Trans Industrial Electronics, 2006, 53(8): 1009- 1012.

Books:

1. Sohal, G.S., "Glimpses of Power Sector", Ist Edition, Confluence International, New Delhi, 2004
2. Shahi, R V, "Indian Power Sector: Challenge & Response", Excel, New Delhi, 2006
3. "Overview of Power Sector in India 2005 (revised edition)", India Core Publishing, New Delhi, 2005
4. 'The Indian Electricity Market: Country Study and Investment Context" P.M. Lamb. , July.2006

Technical Reports:

1. "Electricity Act' 2003", Govt. of India, New Delhi, 2003
2. "The Energy Conservation Act 2001", Government of India
3. "The Electricity Policy", Ministry of Power, Government of India, February2005

4. 'The Smart Grid: An Introduction, 2009," US Department of Energy.
5. "Power Politics: Process of Power Sector Reform in India", Navroz K. Dubash&SudhirChellaRajan, September, 2001]
6. "An Energy Overview of India (2003),' U.S. Department of Energy
7. "Plight of the Power Sector in India: SEBs and Their Saga of Inefficiency," KP Kannan. N. VijayamohananPillai
8. "Impact of Power Sector Reforms on Technology, Efficiency and Emissions: Case Study of Andhra Pradesh, India, PES", P.R. Shukla, DebashishBiswas, Tirthankar Nag, AmeeYajnik, Thomas Heller and David G. Victor, 2004
9. "Overview of the Smart Grid – Policies, Initiatives, and Needs," ISO New England, Inc., February, 2009
10. "The Smart grid Vision for India's Power Sector", PA Government Services, Inc., March, 2010
11. "Innovative development of smart power grid and interactive smart grid in China", Power System and Clean Energy, 2009.
12. "Integration of Distributed Generation in the Power System- A Power Quality Approach", Wollongong, Australia, 28 September - 1October 2008.