

Review of Smart Grids : - The Necessicity of Future in India

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ABSTRACT : The conventional distribution and transmission networks installed by utilities in developing countries are age old .Due to lack of use of technology in this area the power distribution industry is suffering many problem like poor energy management during peak load hours, the poor fault location and identification methods, load shading problem, effective energy metering etc. especially in developing countries. There is a large potential for installing smart grids to overcome some of the issues addressed above effectively.

More emphasis is given in many developing and developed countries to change the conventional grids to Smart Grids. The smart grids are interactive grids where the IT enabled technology helps to monitor the system conditions and helps for effective monitoring and controlling and maintenance of the network.

This review paper is aimed at understanding the present situation of Smart Grids in various developed and developing countries like India, Brazil, USA, UAE ,China, Japan and present status of Smart grid technology in India.

The aim of proposed research work is to identify the scope of application of smart grid concepts for distribution networks to identify the fault type and location of the fault .The standard IEEE 13-bus distribution system will be considered for implementation using MATLAB

KEYWORDS: Smart Grids, Distribution Networks, IEEE 13 Bus system, Wavelets, Artificial Neural Networks, GSM

I. INTRODUCTION

The use of information Technology in all walks of life have changed the working of all the section may it be the field of banking, tickets booking of railways, airways, e-shopping , electricity billing etc.

The extensive use of I.T. enabled services has made human life more comfortable & trouble free. No wonder the power distribution sector will remain away from this. Efforts are being taken in this direction to construct the interactive grids called smart grids to replace the conventional non interactive grids. The smart grids are also called as the next generation grids to effectively manage the problems related to power distribution. As rightly said the smart grids is transfer of kilobytes of data for transferring megawatts of power.

The research on smart grids started in year 2001 & has grown up gradually over the years, The research is being carried out in various countries to make the grids interactive. The over view of development in the field of smart grids in various countries is taken in this paper including India.

As already mentioned in the introduction the smart grids are emerging as the next generation grids to effectively manage the problems related to power distribution. The research is going in various countries to develop algorithms to effectively address the various issues in the grid management like power flow data management, identification of fault locations on transmission and distribution networks, smart billing, energy management and optimum use of the available infrastructure.[1]

II. RELATED WORK

Here the review is given about smart grids in various developed and developing countries about scenario in these countries.

(1) SMART GRID SCENARIO IN CHINA :-

China is considered as one of the technologically fastest growing country of the world . According to International Monitoring Fund (IMF) it is the second largest economy of the world. With huge progress in research & development, high quality infrastructure & sustained records to excel in the area, china has emerged as leader in smart grid area.

China is the world's largest consumer of electricity, and its demand is expected to double by next decade, and triple by 2035. In 2010, 70 percent of China's electricity generation came from coal-fired power plants, but now the Chinese government is investing heavily in renewable energy technologies and implementation of smart grids. As of 2013, 21 percent of China's electricity generation comes from renewable sources. [1]

This represents only 9 percent of China's overall primary energy use coming from renewable resources. To implement China's new clean energy capacity into the national power grid, and to improve the reliability of the country's existing infrastructure, requires significant upgrades and ultimately, a Smart Grid.

A smart grid differs from a conventional power grid in that it includes a system of information and communication technologies to bidirectional transmit and distribute electricity more efficiently and reliably. Additionally, this technology allows consumers to manage their power usage and make choices for economically efficient products and services. China's national utility, the State Grid Corporation of China (SGCC), is responsible for the oversight of these upgrades.[2]

(2) SMART GRID SCENARIO IN INDIA :-

The development of S.G.in India is not similar to that in China. There are many reasons for necessity of smart grid in India in addition to the one mentioned in case of china. The fore most important is power theft due to little protection of grid. The second reason is highest growth for electricity demand & third one is hash transmission & distribution losses. It is estimated that power losses in India are as high as 26% which is considered to be highest in the world & lastly the poor maintenance of the existing grids which makes the break downs locations difficult to be located.

India is a very large country with complex issues and many infrastructure challenges around a growing population that is expected to become the world's largest by 2030, exceeding 1.5 billion people.

The ISGF, a public-private partnership formed to assist the government and utilities on smart grid policy and activities, worked with Ministry of Power and other stakeholders to finalize the Smart Grid Roadmap that was issued by Ministry of Power in August 2013 with activities and targets towards achieving a nationwide rollout of smart grids by 2027.

India initiated smart grid pilots in 2012, however, these hadn't turned out as expected comments, attributing this to a lack of knowledge on smart grid technologies at the time and underestimation of the costs involved in such projects. Of the 14 projects initiated, only seven are in various stages of execution and three have been cancelled, while there are four in tendering stage.

Now, with the hundreds of smart grid projects successfully executed around the world, India can draw from these experiences. [3]

(3) SMART GRIDS SCENARIO IN USA:-

In December 2007, US Congress passed, and the President approved, Title XIII of the Energy Independence and Security Act of 2007 (EISA). EISA provided the legislative support for DOE's smart grid activities and reinforced its role in leading and coordinating national grid modernization efforts. Key provisions of Title XIII include:

- Section 1303 establishes at DOE the Smart Grid Advisory Committee and Federal Smart Grid Task Force.
- Section 1304 authorizes DOE to develop a "Smart Grid Regional Demonstration Initiative."
- Section 1305 directs the National Institute of Standards and Technology (NIST), with DOE and others, to develop a Smart Grid Interoperability Framework.

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- Section 1306 authorizes DOE to develop a "Federal Matching Fund for Smart Grid Investment Costs"[4]
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(4) SMART GRIDS SCENARIO IN UAE:-

Initiatives have been taken by governments in the Middle East to move into sustainable modes of energy by transitioning from the power grid to the smart grid, making them fast High-level event supported by Ministry of Energy, U.A.E. in Abu Dhabi was Gulf's 4th Annual Smart Grids and Smart Meters summit, an annualized event dedicated to power developers and distributors in the Middle East, aims to nurture and build strong and effective foundations that ensures efficiency in operations in a demand burdened energy market. To be held on at the Park Rotana, Abu Dhabi, the summit received official support by the Ministry Of Energy, U.A.E. who are driving the vision of energy conservation and long lasting sustainability and emerging in these verticals. [5]

(5) SMART GRIDS SCENARIO IN BRAZIL:-

The deployment of smart grids in Brazil has followed trends in countries where the smart grid concept was initially conceived, such as the United States, Canada and some European countries. In these countries smart grid projects are developed from the outset based on smart metering projects that cater in the same deployment phase for commercial and industrial (C&I) as well as residential consumers.

Distribution Automation (DA) projects are often implemented at the same time as smart metering projects and use the telecommunications infrastructure that was put in place to meet the requirements of smart metering. However, the regulatory, technological and socioeconomic contexts in which these models have been developed are very different from those in emerging and developing countries such as Brazil.

In view of the obstacles and uncertainties in the Brazilian electricity sector, CPFL Energia adopted an alternative approach that seeks to reduce the risks involved and the investment required to build a smart grid infrastructure. The main challenges faced by Brazilian distribution companies in deploying their smart grid projects are regulatory aspects and technological challenges like, Automatic Meter Reading (AMR) mechanisms, Advanced Distribution Automation (ADA), telecommunications and information technology (IT) [6]

(6) SMART GRIDS SCENARIO IN JAPAN:-

The government of Japan assumes that a large portion of renewable energy in the near future will be provided by photovoltaic generation systems installed at end consumers. Thus, smart grids in Japan will be established mainly at the distribution and the end-consumer level of power systems. Considering this situation, the Smart Grid Working Group, created inside the Cooperative Study Group on Applications of Power Electronic Simulations of IEEJ (Institute of Electrical Engineers of Japan), is currently discussing and developing standard simulation models for components of the distribution and the end-consumer-level power systems. These components include distribution substations, distribution lines, voltage regulation equipment, pole-mounted transformers, photovoltaic panels, power conditioning systems, Li-ion batteries, and small and micro wind power generation systems. The purpose of developing the standard models is to use in transient simulations related to smart grids.[7]

**ABOUT SMART GRIDS:
COMPONENTS**

1.Transmission Automation 2.Distribution Automation 3.Renewable Integration 4.Demand Participation 5.Small appliances / PVEV/ Storage 6.Distributed Generation & Storage 7.Energy Efficiency 8.System operation

LATEST TECHNOLOGY TO BE USED FOR SMART TECHNOLOGY

- 1) System performance monitoring, simulation, and prediction Phasor measurement analysis Weather prediction and integration Ultra-fast load flow analysis fast load flow analysis Market system simulation High-speed computing speed computing
- 2) Different communication choices Ex. Broadband over power New Technology Development.
- 3) Wide-area monitoring system (WAMS) area monitoring system (WAMS)
- 4) Dynamic line rating technology
- 5) Conductor/ compression connector sensor
- 6) Insulation contamination leakage current sensor

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- 7) Electronic instrument transformer
- 8) Fault-testing and automatic reclosure.

VARIOUS DOMAINS OF SMART GRID :-

• Bulk generation • Transmission • Distribution • Markets • Operations • Service provider • Customer

SALIENT FEATURES OF SMART GRID

1. Self healing: The grid has the ability to rapidly detect, analyze, respond and restore from disturbances;
2. Tolerant to attack: The grid should be resilient to physical and cyber security attacks;
3. Provide quality power required by users;
4. Accommodate various generation options, including green power;
5. Allow competitive electricity markets;
6. Use IT for monitoring and minimize O & M costs;
7. Empower the consumer and incorporate consumer equipment and behavior in operation and design of the grid.

FOLLOWING ARE THE SUGGESTIVE MEASURES TO BE TAKEN FOR INDIA:

1. Enlighten all stake holders about global developments.
2. Insist and mandate to procure equipment based on open standards.
3. Work with National & International bodies complying Smart Grid concepts.
4. Standardize software / Hardware devices based on International standards (Meter to Control Room) –
5. Implement the best security standards.
6. Software standardization in distribution sector based on IEC 61968 / 61970 (EMS). Measures to be taken for few pilot projects.
7. Action to be taken for replacement of equipments not suitable for integration purposes. [7]

FOLLOWING PILOT PROJECTS ARE BEING CARRIED OUT IN INDIA

- 1) WHBNN, Haryana at Paniput city covering 30,544 consumers & Distribution system of 531 DTs with 131-8mu energy HP
- 2) CESC, Mysore, at additional city area division, Mysore with 21,824 consumers (mixed)types, 14feeders, 473 distribution transformers, 151.89 mu input
- 3) TSECL, Tripura at Asurtula Town with 46,071 consumer,
- 4) KSEB, Kerala at selected distribution section offices of kerla states
- 5) Govt of Puduchery at Division No. 1 covering 87031 consumers
- 6) UGVCL, Gujrat at Naroda of Sabarmati & Deesa of palanpur circle with 39,422 consumers
- 7) AP CPDCL at Jeeditmetla Industrial area with 11,904 consumers Das, ST & SCADA will be used.
- 8) APDCL, Assam at Guhahati with 15,000 consumers, IT implementation R-APDRP, SCADA/DMS
- 9) MSEDCL, Maharashtra of Baramati covering 25,629 consumers, 261.6 MU
- 10) CSPDCL, Chhattisgarh at Siltara-Urla area of Raipur District with 508 HT <, consumers 83 DTs, 86mu HP energy
- 11) PSPCL, Punjab at industrial division of Amritsar with 85746 consumers, RAPDRP scheme for SCADA & GI mapping
- 12) WBSEDCL, west Bengal at Siligudi Town with 4 nos 11kv feeders 4404 consumers 42mu unit
- 13) JVVNL, Rajasthan at VKIA Jaipur with 2646 consumers 374.68mu. RAPDPP scheme
- 14) HPSEB, HP at Industrial town Kalaamb with 650 consumers, 533 Mu energy.

Of these 14 projects, 07 projects are in execution stage,03 are cancelled due to infesibility,04 projects are in infant stage. [3]

Thus it is seen from above that evolution of smart grid is still in its nascent stage in India. The entire power society is busy now in understanding & developing smart power grid system which is no longer a theme of future. Some of the utilities are progressive and have come forward to implement new technologies in their network for getting hands on experience and would like to be the first to use latest technology, where as many utilities are still looking forward to share the experiences gained by the others before implementing the new devices/technologies in their

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networks. The companies like **Crompton Greaves, Siemens, ABB** etc are taking efforts to develop suitable technology in the field.

With smart communication between end user and the service/power provider, power consumption can be optimized. The customer is ignorant about the status of grid overloading, cost of the power at any instant of time in order to schedule its consumption to optimal use. At the moment it is difficult to access or predict the contribution of smart grid technology to the Nations' energy efficiency applicable for the present grid.

In the coming years, many distribution systems will not resemble the distribution systems of today. These systems will have advanced metering, robust communications capability, extensive automation and distributed generation. Through the integrated use of these technologies, smart grids will be able to operate, provide high degree of reliability and power quality. There will also be multi-directional directional power flow possible, increased equipment utilization and more importantly, the customers will be offered a variety of services possibly at lower costs.

Increasing energy demands, depletion of natural resources, effect of carbon emissions, need for a sustainable environment together with changing life styles requiring increased automation, make smart grids an inevitable option of the future. The only viable way to realize an extensive smart grid is to develop a vision for the ultimate design of a smart grid and then make short term decisions that incrementally transform existing distribution systems into this future vision.

It is needed now to develop an integrated vision for smart grid, and strong leadership to implement this concept to the people who are ultimately responsible to make it happen. Hence, this market represents many opportunities to penetrate the ecosystem both by exploiting adjacencies as well as exploring new areas.

Fundamental to this revolution is an understanding of how to measure and control voltage, current, power, energy, current, power, energy – whether on the load side, generation side or in distribution. An understanding of alternate energy (especially Solar PV), which is very closely tied to energy efficiency markets is essential.

The industry will need very sophisticated analytical tools to ensure that coming generations of grid design are safe. [6]

III. TEXT INPAINTING

The Proposed research work is inclined to develop the algorithm in MATLAB to identify the type of the fault and the location of the fault (Bus Number) . The abnormal condition will be identified by the Wavelets and the type of the fault will be identified by the Neural Network. The result of the Neural Network will be communicated to the utility operator using GSM module in the form of a SMS . The concept will be implemented on standard IEEE 13 Bus distribution system using MATLAB.

IV. EXPERIMENTAL RESULTS

As this is a review paper for studying the Smart Grid scenario in various developing and developed countries , the concept of implementing the proposed work on IEEE13 bus distribution in MATLAB and the experimental results will be demonstrated in subsequent research paper.

V. CONCLUSION

From this review article it is seen that developed nations are well ahead in research & development in smart grids. After reviewing & analyzing many research articles and government documents, developing nations like India is also taking keen interest in this emerging area. The smart grids can be proposed for various upcoming grids.

There is large scope for research in the area of smart grids. The focus of authors is towards the distribution networks as the distribution networks are most commonly used by consumers and are prone to maximum disturbances due to change in load patterns, faults, optimization of energy utilization etc.

The automatic fault location and fault type alert system to the utility operator is proposed in this research work. The concept of wavelets will be used to identify the disturbances in the distribution system due to variations in voltage occurring due to fault and the artificial neural networks (ANN) will be used to identify the type of the fault in the distribution system .The GSM module will be used to communicate the result to the operator of the utility. The

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simulation will be done in MATLAB and IEEE 13 bus standard distribution system will be considered for the further research work.

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