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Some studies on Smart Grid in reference to India

KEYWORDS: Smart grid, power grid, existing grid

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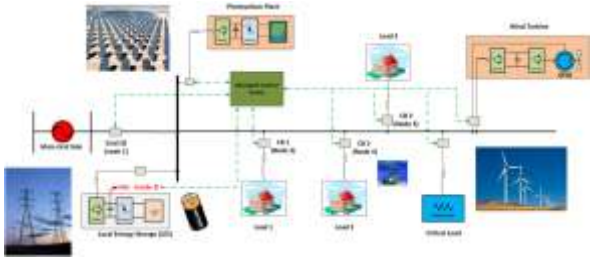
ABSTRACT *The electric power system is undergoing a intense change driven by a number of needs, including environmental compliance and energy conservation. Grid reliability, operational efficiencies and customer service become important with aging electric utilities to infrastructure. This paper includes a plan for make their distribution grid a modern one, a smart one, an agile one. Smart Grid solutions, including Distribution Automation, Asset Management, Demand Side Management, Demand Response, and Distributed Energy allow Management and Advanced Metering Infrastructure, utilities to identify and correct a number of specific system issues through a single integrated, robust and scalable Smart Grid platform. The paper provides an overview of technologies being deployed and key Smart Grid applications being implemented.*

I. SMART GRID

- The Smart Grid, regarded as the next generation power grid, uses two-way flows of electricity and information to create a widely distributed automated energy delivery network
- A smart grid is an umbrella term that covers modernization of both the transmission and distribution grids. The concept of a smart grid is that of a "digital upgrade" of distribution and long distance transmission grids to both optimize current operations by reducing the losses, as well as open up new markets for alternative energy production. Components of smart grid is shown in figure 1
- Smart grid concept relates to essentially combining information and communication technology with power to really optimize performance, improve productivity, efficiency, reduce overall costs and get a better handle on energy resources.



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

III. COMPONENTS OF SMART GRID

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

IV. LATEST TECHNOLOGY TO BE USED FOR SMART GRID

1) Use of Superconductors for transmission lines, Transformers, Generators, HT Cables Nano materials going to play a major role.
2) The sophisticated revenue models they will employ to shape customers' behavior.
3) Easy-to to-low install, low-cost sensors to measure energy use with high resolution
4) Networked power electronics for everything from solid state, New Technology development opportunities, lighting to solar micro-inverters
5) Grid-scale electricity storage to buffer transients in supply and demand
6) Electrified-vehicle infrastructure including batteries and charging stations (Few MW)
7) Universal Remote Control to a Set Set-top Box which includes Home Control
8) Fuel Cell

V. LATEST TECHNOLOGY TO BE USED FOR SMART TECHNOLOGY

1) ANALYTICAL TOOLS

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

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Fault Fault-testing recloser

VI. VARIOUS DOMAINS OF SMART GRID

1) Bulk generation
2) Transmission
3) Distribution
4) Markets
5) Operations
6) Service provider
7) Customer

VII. CHALLENGES TO BE TACKLED WHILE DESIGNING SMART GRID

1) Financial Resources
2) Government Support
3) Development of compatible Equipment
4) Speed of Technology Development
5) Policy and Regulation to be framed
6) Cooperation between different entities

VIII. BENEFITS AND REQUIREMENT OF SMART GRID

1) Improving power reliability and quality;
2) Optimizing facility utilization and averting construction of back-up (peak load) power plants;
3) Enhancing capacity and efficiency of existing electric power networks;
4) Improving resilience to disruption;
5) Enabling predictive maintenance and self-healing responses to system disturbances;
6) Facilitating expanded deployment of renewable energy sources;
7) Accommodating distributed power sources;
8) Automating maintenance and operation;
9) Reducing greenhouse gas emissions by enabling electric vehicles and new power sources;
10) Reducing oil consumption by reducing the need for inefficient generation during peak usage periods;
11) Presenting opportunities to improve grid security;
12) Enabling transition to plug-in electric vehicles and new energy storage options;
13) Increasing consumer choice;
14) Enabling new products, services, and markets.

IX. 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 the equipment and behavior in operation and design of grid.

X. THE BASIC REQUIREMENTS OF SMRT GRID

1) Dynamic, fast response to varying supply demand situations;
2) Preparation of old grids to the era of alternate energy and energy efficiency;
3) Constant monitoring and communication all around the electric grid;
4) Establishment of dynamic energy markets and optimal revenue patterns to generators and utilities;
5) Improving the overall efficiency of the network through better management of resources, thus reducing the effect on the environment;
6) Improving the operational efficiency of utilities. This aspect is not to be under estimated, just changing the way utilities measure power and do billing can yield tremendous benefits;
7) And last but not least, probably the foremost is to improve the stability of the electrical system under any adverse conditions.

XI. OVERVIEW OF SMART GRID TECHNOLOGY

1) Detect and address emerging problems before they impact service;
2) Respond to local and system wide inputs and know much more without broader system problems;
3) Incorporate extensive measurements, rapid communications and feedback controls that quickly return the system to a stable state after interruptions or disturbances;
4) Automatically adapt protective systems to accommodate changing system conditions;
5) Reroute power flows, change load patterns, improve voltage profiles and take other corrective steps within seconds of detecting a problem;
6) Enable loads and distributed resources to participate in operations;
7) Be a grid that is self- healing and adaptive, interactive with consumers and markets, more secure from attacks, accommodate all generation and storage options, accommodate bidirectional energy flow for net metering and predictive rather than just reacting to emergencies.

XII. DRIVERS FOR SMART GRID

1) The global movement towards smart grid is driven by improving operational efficiency, enhanced customer satisfaction, improvement in energy efficiency and environmental impact. These are elaborated below:
2) Operational efficiency: Increase operational productivity, reduce capital and operating costs, improvement physical/cyber security.
3) Efficient energy use: Optimize usage, meet growing demand, and enhance utilization of existing assets.
4) Customer satisfaction: Improve reliability matrix, empower consumer to control energy usage, stronger communications.
5) Environmental aspects: Reduce GHG emissions with utility, give more environmental options to consumer, and adhere to regulatory mandates.

XIII. FIXED DEVICES REQUIRED FOR IMPLEMENTATION OF SMART GRID TECHNOLOGY

1) The smart grid has a lot to do with decentralization i.e distributed generation and storage, distribution system automation and optimization, customer involvement and interaction, plug in hybrid electric vehicles (PHEV) and even micro grids. That means that it will be necessary to have more intelligence and control beyond generation and transmission throughout the distribution grid and all the way to the retail consumer's side of the meter. This will involve few fixed devices like :
2) Supervisory and data acquisition (SCADA) devices and distribution control automation (DA) devices;
3) Automatic meter reading (AMR) devices and smart meters;
4) Retail premises monitoring and control systems and energy management systems (EMS) and
5) Emerging technologies for monitoring and control, both for electric utilities and for consumers.

XIV. ALTERNATIVE ENERGY SOURCES

1) Solar Power
2) Fuel Cells
3) Photo Voltaic (PV) Cells
4) Wind Turbines
5) Biodiesel Generator
6) Micro Turbine

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XV. SUGGESTIVE MEASURES TO BE TAKEN FOR INDIA

1) Enlighten all stake holder about global developments.
2) Insist and mandate to procure equipment based on open standards
3) Work with National & International bodies compiling Smart Grid concepts.
4) Standardize software / Hardware devices based on International standards (Meter to Control Room) -
5) No proprietary.
6) Implement the best security standards.
7) Software standardization in distribution sector based on IEC 61968 / 61970 (EMS).
8) Measures to be taken for few pilot projects covering large area as in other countries.
9) Action to be taken for replacement of equipment not suitable for integration purposes.

XVI. CONCLUSIONS

With smart communication between end user and the service/power provider, power consumption can be optimized. 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.

Intelligent or Smart grids, the vision unfolded, would soon become a reality in a couple of years. 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 industry will need very sophisticated analytical tools to ensure that coming generations of grid design are safe. Micro grid also can be a well-established approach to provide electricity to remote areas of our country.

REFERENCE

[1] "Smart Grid – The New and Improved Power Grid: A Survey"Xi Fang, Student Member, IEEE, Satyajayant Misra, Member, IEEE, Guoliang Xue, Fellow, IEEE, and Dejun Yang, Student Member, IEEE | [2] "Smartgrid technology with reference to indian power system", Dr. S. Roy Barman; WBSETCL | [3] C. Alvial- Palavicino,N. Garrido-Echeverria, G. Jimenez-Estevz, L. Reyes, and R. Palma –Behnke, " A Methodology for community engagement in the introduction of renewable based smart microgrid,"Energy for sustainable development vol.15,pp .314-323,2011 | [4] S. Massoud Amin and Bruce F. Wollenberg,"Toward a Smart Grid" IEEE Power & energy magazine, pp 34-79, September/October, 2005. | [5] Thomas F.Garrity, "Getting Smart" IEEE Power & Energy Magazine, pp 38-45, March/April, 2008. | [6] Technology Roadmap, Smart grid ,2011, www.iea.org | [7] "Smart Grid Vision For India "By The United States Agency for International Development, March , 2010. | [8] Smartgrid-for-India.blogspot.com/ | [9] www.ni.com/modbus | [10] White Paper on, ,"Making the Smart Grid Smarter with Embedded Java"March 2011 | [11] en.wikipedia.org | [12] Maria Carmen Falvo,Luigi Martirano,Enrico Bocci,Technologies for Smart Grids: a brief review, 2013 IEEE | [13] www.st.com/DCU | [14] J.Z. Hui Hou,Yongchuan Zhang, Xiongkai Hen, " A Brief Analysis on Differences of Risk Assesment between Smart Grid and Traditional Power Grid," Fourth International Symposium on knowlwdge Acquisition and Modelling(KAM) | [15] Indiasmartgrid.org | [16] H.Farhangi The path Of Smart Grid IEEE Power and Energy Magazine, 8(1);18-28,2010 | [17] Jixuan Zheng, "Smart Meters in Smart Grid: An overview" IEEE Green Technologies Conference ,2013 | [18] L.Peng and G.S.Yan," Clean Energy Grid Connected Technology Based on Smart Grid," Energy Procedia, vol.12, pp. 213-218,