Research Paper Engineering

Role of Smart Grid in India

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ABSTRACT

In this paper introduction of smart grid is given. Intelligent components make it possible to work traditional grid smart way by using features like two way communication, self-healing, self-outage recovery, use of smart sensors etc. In this paper efforts have been taken to explain Smart grid and its Elements, benefits of smart grid and how the smart grid is different from traditional grid. Also pilot projects Under R-APDRP scheme in India are discussed for various states. And various companies taking interest for development of smart grid are listed with its contribution of development.

KEYWORDS

Smart grid; smart grid in India self-healing; projects in India

Introduction

The general understanding is that the Smart Grid is the concept of modernizing the electric grid. The Smart Grid comprises everything related to the electric system in between any point of generation and any point of consumption. Through the addition of Smart Grid technologies the grid becomes more flexible, interactive and is able to provide real time feedback.

It is an electricity network that can intelligently integrate the actions of all users connected to it – generators, consumers and those that do both – in order to efficiently deliver sustainable, economic and secure electricity supplies.A Smart Grid employs innovative products and services together with intelligent monitoring, control, communication, and self-healing technologies to:

- facilitate the connection and operation of generators of all sizes and technologies;
- allow consumers to play a part in optimizing the operation of the system;
- provide consumers with greater information and choice of supply;
- significantly reduce the environmental impact of the whole electricity supply system;
- deliver enhanced levels of reliability and security of supply

Smart Grid drivers

- Aginginfrastructures: Large parts of the existing infrastructure dates back to the 1960s or even earlier and is reaching the end of its useful life. Equipment is under extreme stress during peak demand.
- Integrating intermittent energy sources: Intermittent energy sources such as wind and solar will put additional strains on existing grids. Their intermittence must be counter-balanced with more intelligence in the Grid, base load power generation (hydro, nuclear) and storage.
- Lower energy prices: Regulators are pushing for more competition to lower energy prices. Utilities need to add information and communication techniques to maintain profitability and retain the ability to invest in infrastructure.
- Security of supply and increase in energy needs: Efficient and reliable transmission and distribution of electricity is fundamental to maintain functioning economies and societies. Electricity demand is steadily increasing.
- Sustainability: Efficient and reliable transmission and distribution of electricity is fundamental to maintain functioning economies and societies. Electricity demand is steadily increasing.

- Utilities need to address the following challenges

High power system loading
Increasing distance between generation and consumption
Fluctuating energy availability of renewables
Additional and new consumption models (electric car, smart buildings)
Central power generation in parallel to large numbers of small, decentralized (distributed) generation
Increasing cost and regulatory pressures
Utility unbundling
Increased energy trading
Transparent consumption & pricing for the consumer
The priority of local drivers and challenges might differ from place to place.

Elements of the Smart Grid

- Asset Management Systems and Condition Monitoring Devices: Condition-based maintenance, for example, allows the reduction of maintenance costs without sacrificing reliability.
- Building Automation and Control System (BACS): Include the instrumentation, control and management technology for all building structures, plant, outdoor facilities and other equipment capable of automation.
- Decision Support Systems and System Integrity Protection: Protect the primary equipment (e.g. transformers) from fatal fault currents, and power systems from instabilities and black-outs. System Integrity Protection Schemes will enhance the target of protection devices, and guard primary equipment (e.g. transformers) from fatal fault currents. It helps to avoid uncontrollable chain reactions that are initiated by protective actions and avoids limited load shedding actions
- Distribution Automation and Protection: Advanced distribution automation concepts promote automatic self-configuration features, reducing outage times to a minimum ("self-healing grids"). Distributed energy resources are able to create self-contained cells ("MicroGrids"), which in turn can help to assure energy supply in distribution grids even when the transmission grid has a blackout.
- Distribution Management System (DMS): Is the counterpart to the EMS and is therefore the control centre for the distribution grid. In countries where outages are a frequent problem, the Outage Management System (OMS) is an important component of the DMS.
- Energy Management System (EMS): Is the control centre for the Transmission Grid. Today customers require an open architecture to enable an easy IT integration and a better support to avoid blackouts (e.g. phasor measurements, visualization of the grid status, dynamic network stability analysis).
- Information and Communication Technology: Throughout the Smart Grid the increased use of IT technologies allows to improve the interaction and integration of former-

ly separated systems. Buildings respond to occupants not vice-versa. Utilities increase their ability to detect and correct problems in their system. All of this leads to cost and energy savings.

- Local Production: Is currently not a large component, however it is proposed as a future driver of Smart Grid requirements.
- Power Electronics: Is an important part of the control mechanisms of the power grid. Systems like HVDC and FACTS enable actual control of the power flow and can help increase transport capacity without increasing short circuit power.
- Power Quality and Power Monitoring Systems: Act in a very similar way to Quality Management Systems in companies. They are independent from Operation, Control and Management Systems and supervise all activities and assets/electrical equipment in a corresponding grid. Therefore such systems can be used as "early warning systems" and are a must to analyse faults and to find out the corresponding reasons.
- Security: Security of a critical infrastructure has always been an issue. However Smart Grid solutions will see an enormous increase in the exchange of data both to improve control and observation. The security of this data exchange and the physical components behind it will have be increasingly important.
- Smart Consumption: Will enable demand response and lies at the interface between distribution management and building automation.
- Smart Generation: Uses power electronics to control harmonics, fault ride-through and fluctuating generation from renewables. It helps increase the flexibility of conventional fossil fuel power plants enabling their use to counter-balance intermittent power generation.
- Smart Homes: Are houses which are equipped with a home automation system that interconnects a variety of controls including lighting, security, appliances and other devices in a common network infrastructure that also allows it to become more energy efficient.
- Smart Meter: Is a generic term for electronic meters with a communication link. "Advanced Metering Infrastructure" (AMI) allows remote meter configuration, dynamic tariffs, power quality monitoring and load control. Advanced systems integrate the metering infrastructure with distribution automation.
- Substation Automation and Protection: Is the backbone for a secure transmission grid operation. During recent years serial bus communication has been introduced (IEC 61850). Security is based on protection schemes.

Comparison between conventional grid and smart grid

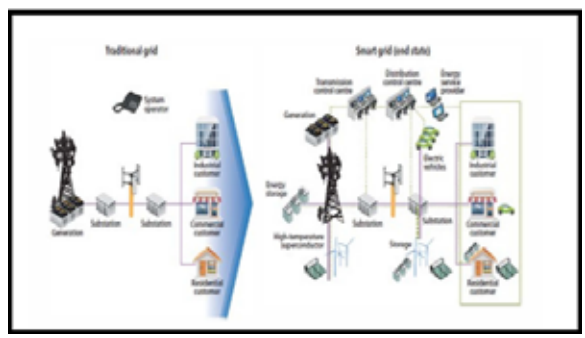

Fig. 1 Representation of Smart Grid and Traditional Grid

Characteristic	Traditional Grid	Smart Grid
Self-heals	Responds to prevent further damage. Focus is on protection of assets following system faults.	Automatically detects and responds to actual and emerging transmission and distribution problems. Focus is on prevention. Minimizes consumer impact.
Motivates & includes the consumer	Consumers are uninformed and non-participative with the power system	Informed, involved and active consumers. Broad penetration of Demand Response.
Resists attack	Vulnerable to malicious acts of terror and natural disasters.	Resilient to attack and natural disasters with rapid restoration capabilities.
Provides power quality for 21st century needs	Focused on outages rather than power quality problems. Slow response in resolving PQ issues.	Quality of power meets industry standards and consumer needs. PQ issues identified and resolved prior to manifestation. Various levels of PQ at various prices.
Accommodates all generation and storage options	Relatively small number of large generating plants. Numerous obstacles exist for interconnecting DER	Very large numbers of diverse distributed generation and storage devices deployed to complement the large generating plants. "Plug-and-play" convenience. Significantly more focus on and access to renewables.
Enables markets	Limited wholesale markets still working to find the best operating models. Not well integrated with each other. Transmission congestion separated buyers and sellers.	Mature wholesale market operations in place; well integrated nationwide and integrated with reliability coordinators. Retail markets flourishing where appropriate. Minimal transmission congestion and constraints.
Optimizes assets and operates efficiently	Minimal integration of limited operational data with Asset Management process and technologies. Siloed business processes. Time based maintenance.	Greatly expanded sensing and measurement of grid conditions. Grid technologies deeply integrated with asset management process to most effectively manage assets and costs. Conditions based maintenance.

SmartProjects inIndia

- Telangana Southern Power Distribution Company Limited, Telangana Jeedimetla Industrial Area
- Assam Power Distribution Company Limited, Assam Guwahati Distribution Region
- Chamundeshwari Electricity Supply Corporation Limited, Mysore, Karnataka Additional City Area Division, Mysore
- Chhattisgarh State Power Distribution Company Limited, Chhattisgarh Siltara – Urla area of Raipur District
- Electricity Department of Government of Puducherry Division 1 of Puducherry
- Himachal Pradesh State Electricity Board Ltd, Himachal Pradesh

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- Jaipur VidhyutVitaran Nigam Ltd, Rajasthan VKIA Jaipur
- Kerala State Electricity Board, Kerala
- Selected Distribution Section offices spread over the geographical area of Kerala
- Maharashtra State Electricity Distribution Company Limited, Maharashtra Baramati Town
- Punjab State Power Corporation Limited, Punjab Industrial Division of City Circle Amritsar
- Tripura State Electricity Corporation Limited, Tripura Electrical Division No.1 of Agartala town
- Uttar Gujarat Vij Company Limited, Gujarat Naroda of Sabarmati circle and Deesa of Palanpur circle
- Uttar Haryana BijliVitran Nigam Limited, Haryana Panipat City Sub-division
- West Bengal State Electricity Distribution Company Limited, West Bengal Siliguri Town in Darjeeling District

ContributionofVariousCompaniesinSmartGrid

Cap Gemini	Smart Energy Services, Smart Metering , Smart Home Solutions
HCL Info Systems Ltd.	Smart Metering And Network Infrastructure Services.
New Delhi Power Ltd. And General Electric(GE)	Efficient distribution of electricity, research towards clean energy , various innovative products for the smart grid and efforts for improving energy and transmissionefficiency
Power Grid	The government has entrusted company with various projects and schemes like Rajiv Gandhi Gram VidhutYojana .The company is major player in Smart Grid
Telvent	It is going to start smart Grid projects in Maharashtra state in collaboration with L & T
ABB	It has strong smart grid focus and has been actively collaborating with utilities from US, UK , Europe , China and India
IBM	It has set up global intelligent utility network coalition organization to collaborate with various utilities of world
Infosys	AMI, and meter data management services.
Accenture	AMI, Intelligent Data Management, Home Area Network,Demad Response, and Plug In Electric Vehicles
Siemens	Smart Distribution, Smart consumption, smart metering , e- mobility segment

Conclusion

We have understood the importanceof Smart grid in our future. Different elements of smart grid are discussed. After implementation of smart grid Indian power system will have smart features like load management, cost of preventive maintenance is lower than cost of repair, participation of consumer, green power,control peak demand by availability based tariffs, automation to reduce manpower costs,monitoring of service request status by consumer,distributed computing,Web Based Information, and GIS mapping of assets.

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