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A Review on Smart Grid in India

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Abstract: India's generating capacity is to grow from 232 GW in 2014 to 800 GW in 2030.Indian power system is becoming smarter by integration of information technology and communication system in conventional grid. 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. This provides reliable, stable, economic and quality power to end users by better utilization of currently available assets of power grid. In this paper efforts have been taken to explain Smart grid and its component, 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; two way communication; self-healing; R-APDRP; self-outage recovery

I. INTRODUCTION

Power sector of India is trying to overcome the issues like, increase in energy demand, power quality, and transmission and distribution losses. There is need to make use of technology which will provide uninterrupted, reliable, qualitypower supply efficiently. This technology is known as Smart Grid Technology.The efforts are being done to convert the conventional grid to the smart grid.The Indian government has taken initiatives towards a smart grid.Government of India formed India Smart Grid Task Force and Indian Smart Grid forum in 2010.Smart grid is a type of modern power grid that supports all parts of national grid. [1] Smart Grid is the next generation of power grid. [2, 3].Generation, transmission, distribution and utilization of electrical power are the components of the power system. The distribution and utilization need to embrace active network management technologies with an interface to the transmission system. There is need to meet increasing electricity demand, integrate more distributed sustainable resources including renewable energy sources and advanced storage devices (batteries, compressed air system, fuel cell etc.).The role of the electric grids is becoming very important to balance the energy demand variations with the fluctuating power generation from the irregular sun and wind [4].A smart grid embrace new technologies i.e. telecommunication, control, self -healing, efficiency, reliability and security of power systems [5]. A smart grid is a new type of power grid under development, which allows an unconventional power flow and two way information flows to create an advanced automatic and distributed energy delivery network [6].

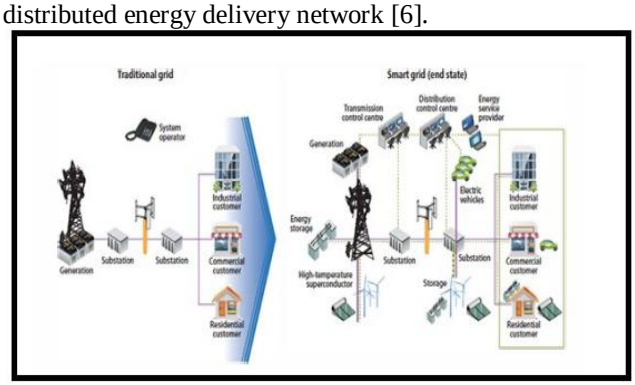

Fig. 1 Representation of Smart Grid and Traditional Grid [8]

TABLE I: Comparison between conventional grid and smart grid [7]

Sr. No	Conventional Grid	Smart Grid
1	Electromechanical	Digital
2	One way communication	Two way communication
3	Centralized Generation	Distributed Generation
4	Few Sensors	Sensors throughout
5	Overall efficiency low	Overall efficiency is high
6	Healing after fault is manual	Self-Healing
7	Grid Topology is Redial	Grid Topology is network
8	Outage recovery is manual	Outage recovery is self
9	Consumer participation is less	Consumer participation is more
10	Limited control	Pervasive Control
11	20th century grid	21st century Grid

III.BENEFITS OF SMART GRID

- Reduction in carbon emission by increasing system load and delivery efficiencies.
- Improved power quality and reliability.
- Improved utilities operational performance asset management and overall productivity.
- Promoting energy independence.
- Integration of renewable energy.
- Improved energy efficiency and more options for energy storage.
- Enabling participation of consumers by empowering them to manage their energy usage.
- Monitoring can be done remotely.
- It reduces peak demand.
- Accurate measurement with digital technology.
- They are stable as they constantly monitor and manage networks to prevent blackouts and maximise availability of power.
- They are financially secure as they enable energy markets by providing tools and processes, to coordinate and manage, transactions and operations.
- Accommodates a wide variety of distributed generation and storage options

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- Minimizes operations and maintenance expenses
- Create controllability of assets, enhance

power system performance and security

IV COMPONENTS OF SMART GRID

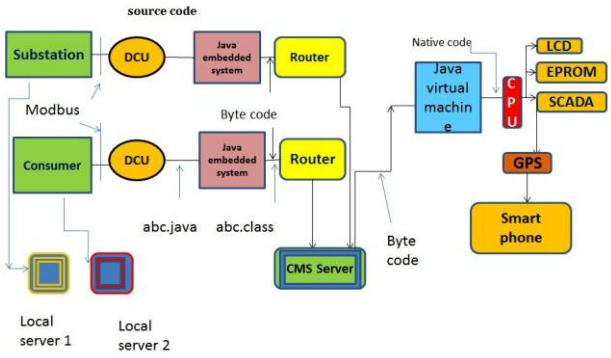

Fig.2 Block diagram showing working of Smart Grid

1.Modbus [12]: TheMODBUS protocol follows a master/slave architecture where a master will request data from the slave. The master can also ask the slave to perform some action. The master initiates a process bysending a function code that represents the type of transaction to perform. The transaction performed by the MODBUS protocol defines the process a controller uses to request access to anotherdevice, how it will respond to requests from other devices, and how errors will be detected and reported.During communications on a MODBUS network, the protocol determines how each controller will know its device address, recognize a message addressed to it, determine the kind of action to be taken, and extract any data or other information contained in the message. Controllers communicate using a master/slave technique where only one device, the master, can initiate transactions or queries. The other devices, slaves, respond by supplying the requested data to the master or by taking the action requested in the query. Typicalmaster devices include host processors and programming panels. Typical slaves include programmable controllers.

2. **Java Embedded System**: Itenables efficient operation, communication, monitoring and control. [13]

3. **Data concentrator Unit (DCU)**:DCU, Multi Utility Controller (MUC) and gateway are devices acting as an interface betweenthe utility-controlled smart grid and the home area network. Theymanage the data exchange between smart meters; utility providersand energy-consuming in-house objects.While a data concentrator manages the information for severalhomes, a multi utility controller, also known as an energy gateway,manages the data exchange for a single home [16].

4.**Route**r: A Router is a device that forwards data packets between computer networks [14]

5.**IP- based protocols**: IEC has defined the IP based protocols IEC 61850 that achieve intelligent control,monitoring, and protection applications in distribution substations and that adopted Transmission Control Protocol TCP/IP as a part of its protocol stacks. The IEC 61850 standard is related to Ethernet Local Area Network (LAN) to integrate substation automation devices supplied by different manufacturers and it is implemented in smart grid framework worldwide for common information exchange among intelligent electronic devices within power substation [15].

V.SMART PROJECTS IN INDIA

R-APDRP,(Restructured-Accelerated Power Development and Reform Program [10]

Following are the latest updates from pilot projects:

1) Andhra Pradesh Central Power Distribution Company Limited, Andhra Pradesh

Update: CPRI has been selected as the consultant. Draft Request for Proposal (RfP) was received from CPRI and was put up for internal approval on 10 April, 2014. Target date for issue of RfP: 15th May, 2014.

2) Assam Power Distribution Company Limited, Assam

Update: Medhaj Techno Concept has been selected as the consultant. RfP for appointment of Smart Grid Implementing Agency was released on 4thMarch, 2014. Pre -bid meeting was held on 9th April, 2014. The last date of bid submission is15th May, 2014.Target date for award is by the end of July, 2014

3) Chamundeshwari Electricity Supply Corporation Limited, Mysore, Karnataka

Update: On 4 thMarch, 2014, CESC, Mysore, awarded the smart grid pilot project allocated by Ministry of Power, Government of India, to a consortium of companies led by Enzen Global Solutions Pvt. Ltd.

4) Chhattisgarh State Power Distribution Company Limited, Chhattisgarh

Update: PGCIL has been appointed as consultant. DPR was revised to change project area to Raipur. RfP is expected to be released by May, 2014.

Electricity Department of Government of Puducherry

Update: PGCIL is the consultant. Though the RfP is ready, and under approval PED. The State Government is now testing out a grid.

5) Himachal Pradesh State Electricity Board Ltd, Himachal Pradesh

Update: PGCIL has been selected as the consultant. A detailed project report and draft RfP has been prepared. The tender is expected to be floated by end of May 2014.

6) Jaipur VidhyutVitaran Nigam Ltd, Rajasthan

Update: PGCIL has been selected as the consultant. RfP has been finalized and will be floated by May 2014

7) Kerala State Electricity Board, Kerala

Update: A tender was issued for selection of Smart Grid Implementation Agency. Bids were opened on 7th March, 2014. Two companies, L&T and EDMI submitted their bids and bid evaluation is going on. The project would be awarded by end of Jun2014.

8) Maharashtra State Electricity Distribution Company Limited, Maharashtra

Update: Received four bids which were opened on18thMarch, 2014. Technical evaluation is in progress and the project would be awarded by June, 2014

9) Punjab State Power Corporation Limited, Punjab

Update: The RfP has been finalized and will be floated by end of May, 2014

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10) Tripura State Electricity Corporation Limited, Tripura

Update: PGCIL has been selected as the consultant. The tender is expected to be floated in May 2014.

VI. CONTRIBUTION OF VARIOUS COMPANIES IN SMART GRID [11]

TABLE II.Various companies

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 transmission efficiency
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

11) Uttar Gujarat Vij Company Limited, Gujarat

Update: Bids were opened on 2nd January, 2014 and the utility has received 6 bids.

The technical evaluation was completed and 5consortiums have been shortlisted for Proof of Concept for demonstrating their AMI connectivity solutions with 300 meters each. This isto be completed by June 2014.

12) Uttar Haryana BijliVitran Nigam Limited, Haryana

Update: This project at Panipat has been proposed for implementation under a grant from NEDO, Japan. Pre-feasibility Study will be completed by June 2014.

13) West Bengal State Electricity Distribution Company Limited, West Bengal

Update: PGCIL has been selected as the consultant. The DPR was finalized in March, 2014and the RfP is expected to be issued in May,2014

VII. VARIOUS SMART GRID TECHNOLOGIES ALREADY BEEN USED BY INDIAN POWER SECTOR

- Intelligent Digital meters
- AMR
- Multiple Payment options
- SCADA System
- Call centers
- Protection system
- Use of IT
- Load Forecasting
- Web Based Information
- GIS mapping of assets
- On line monitoring of supply quality
- On line monitoring of system health
- Document imaging and record keeping

VIII. CONCLUSION

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. Flexibility of grid can be enhanced.Also efficiency,reliability and safety of existing power grid can be improved by adding Java Embedded System, Java Vertual Machine,GPS,and Smart Phone(mobile computing) into it.Smart grid benefits not only end user but utility as well.After implementation of smart grid pilot projects underR-APDRP scheme Indian power system's future is definitely bright.

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