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RECENT TRENDS IN SMART GRID TECHNOLOGY

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ABSTRACT

The development and implementation of a smart grid for power supply is one of the pressing issues in modern energy economy, given high national priority and massive investments, although the entire subject is still in its infancy stage. The smart grid delivers electricity from producers to consumers using two-way digital technology, and allows control of appliances in the consumers' houses and of machines in factories to save energy, while reducing costs and increasing reliability and transparency. Such a modern electricity network is promoted by many governments as a way of handling energy independence, global warming and security of supply. Smart meters are part of the smart grid, but do not themselves constitute a smart grid. A smart grid includes an intelligent monitoring system that keeps track of all the electricity that flows in the system. It could incorporate the use of super-conducting transmission lines to reduce losses, as well as the ability to integrate electricity from alternative sources such as solar and wind. When electricity cost is low, the smart grid can offer the customer to run intensive consumption household appliances, such as washing machines, or processes in plants that operate at flexible hours. On the other hand, smart grid at peak hours can, in coordination with the client, turn off selected appliances and machines to reduce demand.

Keywords: Electronic support, Electronic Attack, Signals Intelligence, lectronic harassment, Stealth technology, anechoic chamber, frequency modulated noise, broadband transmitter, jamming- to-signal ratio, lock – on, Electro-optics sensor, seeker detector

I. INTRODUCTION

Almost as soon as there were electrical distribution grids, there was a demand for devices to measure the consumption and to help the suppliers distribute, price, and monitor their service. The path from the first tentative devices used to measure consumption, to today's smart grid technology which uses two-way metering technology which can turn appliances on and off according to demand and off-peak electricity prices, has been a long one. Many obstacles needed to be overcome in order to obtain accurate information about the way the grid behaved, and some of the obstacles to the earliest attempts to devise technologies for monitoring electrical distribution one hundred or more years ago are strikingly similar to obstacles facing smart grid technologies today.

The development and implementation of a smart grid for power supply is one of the pressing issues in modern energy economy, given high national priority and massive investments, although the entire subject is still in its infancy stage. The smart grid delivers electricity from producers to consumers using two-way digital technology, and allows control of appliances in the consumers' houses and of machines in factories to save energy, while reducing costs and increasing reliability and transparency. Such a modern electricity network is promoted by many governments as a way of handling energy independence, global warming and security of supply. Smart meters are part of the smart grid, but do not themselves constitute a smart grid. A smart grid includes an intelligent monitoring system that keeps track of all the electricity that flows in the system. It could incorporate the use of super-conducting transmission lines to reduce losses, as well as the ability to integrate electricity from alternative sources such as solar and wind. When electricity cost is low, the smart grid can offer the customer to run intensive consumption household appliances, such as washing machines, or processes in plants that operate at flexible hours. On the other hand, smart grid at peak hours can, in coordination with the client, turn off selected appliances and machines to reduce demand. In principle, the smart grid is an upgrade of

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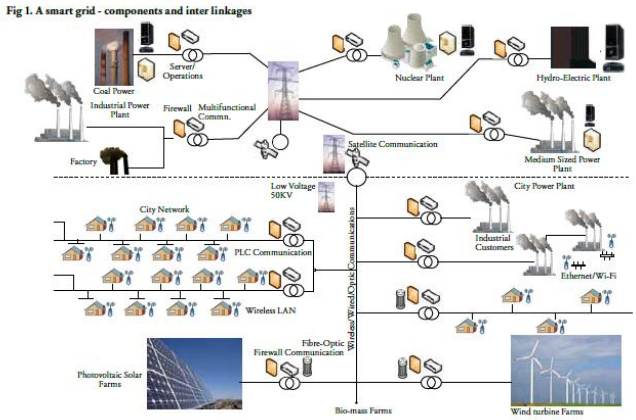
the common electricity grids that operate mostly to provide one-way power from several major power plants to a large number of consumers. This upgrade is expressed in the ability to operate in conditions of uncertainty in order to route the power supply in an optimal way that responds to a wide variety of situations, to encourage users in off-peak hours and charge premium rates from consumers who use energy during peak hours. The key to this capability is fast, accurate and two-way transmission of information between all parts of the grid. Situations that require fast response can occur at all parts of the grid – at the chain of production, transmission and 2consumption. The source of the event could be in the environment (sudden cloudiness that decreases solar power, or a very hot day that increases the demand for air conditioning), inparts of the grid itself (sudden failures, the need for proactive maintenance) or in the demand (work hours compared to hours of rest).

II. NEED FOR SMART GRIDS IN INDIA

According to the Ministry of Power, India's transmission and distribution losses are amongst the highest in the world, averaging 26 per cent of total electricity production, and as high as 62 per cent in some states. These losses do not include non-technical losses like theft etc.; if such losses are included, the average losses are as high as 50 per cent. India losses money for every unit of electricity sold, since India has one of the weakest electric grids in the world. Some of the technical flaws in the Indian power grid are - it is a poorly planned distribution network, there is overloading of the system components, there is lack of reactive power support and regulation services, there is low metering efficiency and bill collection, etc. India is venturing very fast into renewable energy (RE) resources like wind and solar. Solar has great potential in India with its average of 300 solar days per year. The government is also giving incentives for solar power generation in the form of subsidies for various solar applications; and has set a goal that solar should contribute 7 per cent of India's total power production by 2022. With such high targets, solar is going to play a key role in shaping the future of India's power sector. A lacuna of renewable resources is that their supply can be intermittent i.e. the supply can only be harnessed during a particular part of the day, like day time for solar energy and windy conditions for harnessing wind energy, also these conditions cannot be controlled. With such unpredictable energy sources feeding the grid, it is necessary to have a grid that is highly adaptive (in terms of supply and demand). Hence, the opportunities for building smart grids in India are immense, as a good electric supply is one of the key infrastructure requirements to support overall development.



Smart grid technologies

Smart metering/demand side management:
Smart meters are microprocessor based devices that provide a two way communication capability. They help *homeowners* and the suppliers to manage the respective electricity usage and supply in a more efficient and cost effective manner. With the help of the information provided by such smart meters the power companies will have the capability to set up real time pricing systems for electricity.

Virtual power plants:
The goal of virtual power plants (VPPs) (Fig 2) is to allow discrete energy resources (DERs)to access the energy market i.e. to feed the electricity grid constantly and reliably.
Micro grids:

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A micro grid (Fig 3) is a cluster of local DERs and loads in such a way that an operation is possible within the grid or in independent mode. Usually it is connected at the low voltage level but sometimes also at the medium voltage level. All these technologies can be used in India in different forms depending on the applications. Different algorithms can be used for the control of smart grids, VPPs etc.

Implementing organisation	Details
Bangalore Electricity Supply Company Limited (BESCOM), Bangalore, Karnataka	USD 100 million smart grid pilot project.
North Delhi Power Limited (NDPL), New Delhi	Collaboration with GE for smart grid.
Indian Institute of Technology Kharagpur (IITK) and Indian Institute of Technology Madras (IITM)	Collaboration with IBM for smart grid research.
Management Development Institute (MDI), Gurgaon, Haryana	Smart grid educational programme at the School of Energy Management

III. CHALLENGES AND SOLUTIONS POLICY AND REGULATION

No defined standards and guidelines exist for the regulation of smart grid initiatives in India. The current policy and regulatory frameworks were typically designed to deal with the existing networks and utilities. With the move towards smart grids, the prevailing policy and regulatory frameworks must evolve in order to encourage incentives for investment. The new framework will need to match the interests of the consumers with the interests of the utilities and suppliers to ensure that the societal goals are achieved at the lowest cost to the consumers.

Cost:

If smart grids had made easy business sense, they would have been the norm everywhere. Cost is clearly one of the biggest hurdles in implementing smart grids. Some older equipment that cannot be retrofitted to be compatible with smart grid technologies will have to be replaced. This may present a problem for utilities and regulators since keeping equipment beyond its depreciated life minimizes the capital cost to consumers. The early retirement of equipment may be an issue. Cost of implementing smart grids runs in crores of rupees. The benefits from smart grids are not just meter readings but include reduction in equipment failure, better quality of supply and greater use of green energy. It takes careful societal cost-benefit analysis, beyond return of investment calculations, to justify the use of a smart grid.

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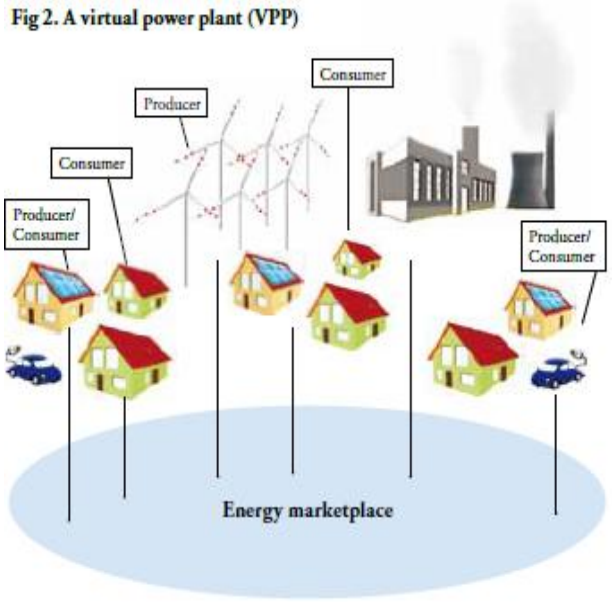
Fig 2. A virtual power plant (VPP)



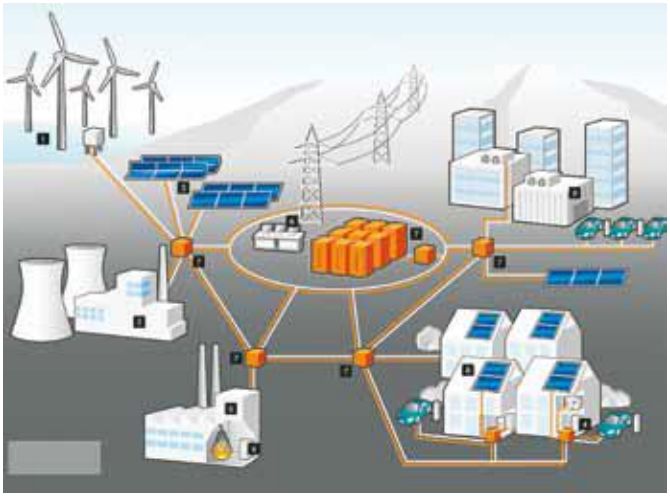


Fig 3. A micro grid

By the end of 2017, Gurgaon will become the first city in India to get a full-scale smart grid. The Millennium City, which has been struggling with prolonged power cuts, frequent tripping of feeders and voltage fluctuations, finally sees some progress in the Smart Grid project that was approved in October 2015. If all goes well, the city will soon see an end to diesel generators and chronic power woes.

According to reports, the Centre has committed Rs 273 crore for the first phase of the project. While the state government will contribute same amount, the remaining fund will come from Power System Development Fund. The total cost of the project has been estimated at Rs 7,000 crore with the first phase likely to cost Rs 1,382 crore. The Centre's decision to extend financial support to Haryana is seen as a way of rewarding one of the better performing states under Ujwal Discoms Assurance Yojana, a revival plan for state-owned power distribution companies. According to the Union Power Minister Piyush Goyal, the project will prove beneficial for conservation of environment and put an end to the role of builders for power supply.

Benefits of smart grid for Gurgaon residents

Smart grids increase quality of power supplies and increase energy efficiency. They have demand response capacity to strike a balance between power consumption and supply. Smart grids can integrate new energy sources like solar and wind with traditional sources. Once smart grids get installed in Gurgaon, its residents with solar or wind systems can

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start feeding unused power into the grid. This unused power gets adjusted against total consumption from the mains. Consumers have to pay for the balance. They can also get paid for excess supply.

Consumers will become suppliers by day as they will feed surplus power from rooftop solar panels into the mains. A smart grid can also offer time-of-day metering, which means consumers can choose off-peak hours to run heavy appliances because power tariffs will be low during those hours. For a consumer, all these lead to uninterrupted supply of power and, that too, at a reduced cost.

Main features of the Smart Grid project

Under the Smart Grid initiative, Gurgaon is likely to see an increase in load carrying capacity from the present 11 KV system to 33 KV. The city will see a transition from overhead HT and LT system to underground cabling. The cables will be laid through trenchless boring. In places, where laying underground cables will not be possible, an overhead system on mono-poles will be installed.

Supervisory Control and Data Acquisition (SCADA) system will be implemented to ensure remote identification, isolation and back feeding of a faulty portion

Advanced Metering Infrastructure (AMI) will be implemented to help in peak load management, outage management and elimination of manual process of collection of readings leading to loss of manpower and billing errors.

Remote Terminal Units (RTUs) and Ring Main Units (RMUs) will be installed on different sections for prompt supply restoration. Software applications such as Outage management system, Peak Load Management System and Demand Side Management will be integrated with SCADA and AMI.

Progress of Smart Grid project so far

The project, which will be jointly piloted by the State and Union governments, didn't see much development on the ground so far. The Power Grid Corporation of India Limited has reportedly floated the tender. "Our tender will open on July 22 (for bidding) and close in two months. Groundwork will begin immediately afterwards," said S K Chabra, superintending engineer of smart grid team. The project is expected to be completed in 18 months from date of the contract is awarded. According to the plan, the power distribution network will be expanded and upgraded to meet rising demand and integrate various power sources. Moreover, cabling will be moved underground.

Extent of the project

The Haryana power department has proposed to break the Smart Grid project into three phases with the first phase covering the city's most high-consumption stretch, Sector 1-57. It will cover DLF, Sohna Road, South City, Maruti, IDC, Qadipur and New Colony. Sector 58-115, where small constructions are coming up, will be covered under the second phase. In the third phase, the Industrial Model Township Manesar area will be covered.

Pollution tethered to power crisis

Currently, Gurgaon needs around 135 lakh units (13.5 MW) of power per day. Haryana only manages to provide 102.74 lakh units (10.27 MW) by sourcing it from Hisar, Khedar, Panipat and Yamuna Nagar, power plants. This is because Gurgaon doesn't have any power plant of its own. So, how is the deficit met? People resort to diesel generators. Regular power cuts for hours had prompted widespread use of polluting diesel generators. The people might be meeting the power deficit through these generators but at the cost of environment. Moreover, they have to shell out hefty amount for the service. The city consumes around 350,000 litres of diesel every hour when there's a power cut, according to a report published in India's Real Estate Forum.

IV. FUTURE SCOPE

With the growing world population and thus increasing demand and the need for resource-depleting intelligent and efficient in our energy. The current mode of transmission and distribution of electricity has proven to be unreliable and inefficient. This is because the grid technology currently in use has changed very little since it was developed. Researchers are now experimenting with smart grid technologies to overcome the shortcomings of the traditional grid. A smart grid can help reduce greenhouse gas emissions by up to 211 million metric tons and is much more reliable than a traditional grid. This is what is driving investors to put their money in this new technology. By 2020, the industry is expected to have a valuation of over $400 billion

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