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Micro Smart Grid Technology for Rural Indian model

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Abstract:
Today world is step-in 21st century. But still in major part of India cannot get 24 X 7 eclectic power supply. Electrical power has become a prime necessity for any country for economic development. And power shortage is a dominant problem, being faced by the most of the countries today. On the top of this, the conventional fuel sources for power generation i.e. coal & oil deposits are fast getting depleted. The Obvious way out, is to shift focus to renewable sources of energy and in country like India our village population & remote location load always suffer by power cut or grid failure although they have enough potential to generate own power but due to lake of technology they can't get 24 x 7 power supply to provide some solution of this problem we try to develop smart grid Indian version.

Although more invention has to be carried out still in the use of non-conventional energy sources for power generation to reach to most economic point, but every little effort in this direction may provide a solution to power shortage problems. Hence the same topic was selected as a part of the curriculum. The goal of the paper is to construct a micro smart grid which is capable of producing enough electrical power by using local removable energy electrical power sources like wind, bio-gas, solar, current running hydro plan for the places like remote places like villages

In this paper, we propose a decentralized framework named Micro Smart GRID to tackle grid resource management a simulation study of operation and control of local generation & co-ordination with state grid in case of normal operation or power islands in Micro Smart Grid environment.

Introduction:

The development of smart grid wills the future of grid system. It required advance technology, device& management system to make the grid 'Smart'. The automation of the transmission and distribution system will be critical for full smart grid development. While definitions Micro grid is essentially smaller version of the lager electrical grid and design to serve localized electrical loads. Micro grid are develop around distributed energy resources (DER) which provide power and make the micro grid self sufficient. Microgrid is typically connected to a utility grid (state grid) but they have ability to isolate themselves from the grid when power problem occurs and operate as a self-contained entity in an 'islanding' mode. They are small and can vary size from single village to small town. For the smart grid to maximize energy savings, we need buildings to work. And further, the cost effectiveness of the smart grid as a whole will rely on the materialization of building energy savings.

The smart grid is more than simply installing smart meters – by bringing an information technology to the electric grid, we will develop numerous applications that use the devices, networking and communications technology, and control and data management systems. Our nation's electrical grid is outdated and overburdened. Infrastructure investments over the past decades have not kept pace with the growing demand for electricity. In addition, the old grid has numerous problems including reliability and power quality, transmission and distribution bottlenecks, as well as environmental concerns that require the integration of renewable energy and distributed generation. This paper first provides an overview of the grid challenges and then presents a critical review of the salient reliability impacts of the four smart grid resource types identified above. We observe that an ideal mix of these resources that flattens net demand would eventually accentuate reliability issues even further.

Meeting reliability challenges requires a grid-wide IT infrastructure that provides coordinated monitoring and control of the grid. We then present an architectural framework for such IT infrastructure. The architecture is designed to support a multitude of geographically and temporally coordinated hierarchical monitoring and control actions over time scales ranging from milliseconds to operational planning horizon. Such capability is necessary to take full advantage of the modern measurement technologies (e.g. PMUs) and control devices (e.g. FACTS).The architecture is intended to serve as a concrete representation of a common vision that facilitates the design and development of various components of the IT infrastructure and emergence of standards and protocols needed for a smart grid As above shown is the economical scenario of the renewable energy sources in India state of Maharashtra now, some of the basic fundamental need for the implementation of micro smart grid in India at grass root level is as shown below the model and working of model as well as technical flow chart wit explanation.

Barriers for Advance Renewable Energy Sources:

- ✓ Low return on investment (ROI)
- ✓ High first cost
- ✓ Lack of knowledge/awareness
- ✓ Lack of interest/motivation
- ✓ Decrease in comfort/convenience
- ✓ Limited product availability
- ✓ Perceived risk
- ✓ Consumer Education
- ✓ Direct Consumer Contact
- ✓ Advertising and Promotion
- ✓ Alternative Pricing
- ✓ Direct Incentives

- Intelligent devices, such as smart meters, sensors and grid aware equipment.
- Networking technology for two-way communications, including pathways like cable, Wi-fi or power line carrier.
- Advanced control and data management systems that provide automated decision-making on the supply and demand sides, as well as meter data management systems.
- Flexible: fulfilling customers' needs whilst responding to the changes and challenges ahead;
- Accessible: granting connection access to all network users, particularly for renewable power sources and high efficiency local generation with zero or low carbon emissions;
- Reliable: assuring and improving security and quality of supply, consistent with the demands of the digital age with resilience to hazards and uncertainties;
- Economic: providing best value through innovation, efficient energy management and 'level playing field' competition and regulation.

Design Criteria of MSG (Micro Smart Grid)

The design criteria that would be employed to meet these performance specifications must address the following key power system components or parameters:

1. End-Use Energy Service Devices
2. System Configuration and Asset Management
3. System Monitoring and Control
4. Resource Adequacy
5. Operations
6. Storage
7. Communications

Demand Response / Load Management

Demand response allows consumer load reduction in response to emergency and high load demand conditions on the electricity grid. Such conditions are more prevalent during peak load or congested operation. In a micro smart grid, real-time load information enables wider voluntary participation by consumers. Demand response can be implemented through either automatic or manual response to use local power generation or use state grid power for this management we use load forecasting model and real data base model for load management which use to control load flow in micro smart grid system as well as provide control signal to operation of local generation station.

- Controller
- Demand response
- Distributed Generation
- Home area networks
- Integrated communications systems
- IT and back office computing
- Loads response
- Meters (smart meter)
- Point of Common Coupling
- Renewable energy

Smart meters :

There is no single definition of smart metering. A smart-meter system comprises an electronic box and a communications link. At its most basic, a smart meter measures electronically how much energy is used, and can communicate this information to another device.

Two-Way Communication between the Meter and the Supplier - enabling a wider range of functions known as Automated Meter Management. A further refinement of the AMM meter is an Interval Meter - a two-way meter with a capability to store and communicate consumption data by time-of-use (e.g. half-hourly intervals).they use communication with central control central by using different method like GSM, CDMA, Wi-Fi, wireless, telephone etc.

Model of micro smart grid for rural India

As per figure we define the Indian model of micro smart grid. In typical Indian rural area or remote area has major potential non-conventional energy sources are wind, solar, biogas, current hydro energy etc. which can be utilize for local generation. The local load is typically connected to the state grid which is not much reliable so by using new smart technology and local energy source we develop model to operation. For develop this model we use major design of smart grid but our model is basically focus on reliability of power by using maximum local non conventional energy sources.

This green energy also gives the carbon credit as well as annual additional income to the investor about Rs.11 0000 /year /1 MW.

As above shown in the folw char the system works like this its shows the folw of operation procuder for the system we under stand this process step by step:

Step 1: when system starts it collet the data from the state grid like Voltage level (V), Frequency (f) , Power factor , phase sequence will be check and feed to the local control center

Step 2: now it check the availablity of the local power so we get idea is local generation awalable or not it use the local communication RTU for the communication and get data from the fild that how much power awalable from the renawable nergy source

Step 3: it will compare is the local generation enough to feed the local demand .? if its not enough then it will shwith ovet the loacl load on the state grid supply. And if its enough loacl generation awalable then it will get in to further step.

Step 4: when many local generation awalable at that time control system find the optimum generation solution so we can get enough and cheap as well as economical power for local suppuply

Step 5: when we get economical local genration then we swith over the local generation

Step 6: now system calcualte is the local generation enough to feed the local laod if its not neough then it will share load with the state grid and acording to that it swith on the system.and if its enough then it will go ahead.

Step 7: If local genration enough to feed loacl deman then it will swithc on the local genertion totall

Step 8: controlar check if gneration is additional mens more then local demad then it will communicate the state grid and feed the state grid if is enough then it will go to step 4 and in additional genetion we get extra revanue from selling power to state grid.

This way in close loop system this micro smart grid model works.

Operation of micro smart grid model: typically local load is connected to local substation which connected to state grid. By atomized local substation and communicate load flow database with state grids and according to that design load flow forecasting model. Which use full to operate the local power generator like solar, wind, biogas, and current hydro. In day time we can use solar for healthy condition we use wind and bio gas can be use for 24x 7. Current hydro can be use as availability of water. To switch on the local power generation we have to establish local control system which operates by a single PC based monitoring, operating & control system communication with state grid by using internet, GSM , CDMA or other communication linkup.

Micro Smart grid will

- Increase sustainability of power in local level
- Provide adequate capacity to state grid
- Create uniform grid connection increase reliability
- Provide higher security and quality supply
- Enhance efficiency & lower economical & environmental effect.
- Support and co-ordinate future developments of lager gird & technology

Why large scale smart grid not started?

- Limited pilot experience
- Limited statically proof of benefit
- Uncertainty with investment and large investment

Conclusion:

For Indian economy rising fuel costs, underinvestment in aging infrastructure and climate change are all converging to create a turbulent period for the electricity industry. A micro Smart Grid can benefit use of renewable energy sources all while improving the reliability, security, and useful life of electrical infrastructure. Despite its promise and the availability of most of the core technologies needed to develop the Smart Grid, implementation has been slow. To accelerate development, state, county, and local governments, electric utility companies, public electricity regulators, and IT companies must all come together and work toward a common goal.

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Project	**Lakh /MW**	**Rs/KW**	**O/M cost Rs/MW/yr**	**Useful life Year**	**Tariff Period Life**	**Tariff Rate Rs.**
Wind Power	525	52500	3%	25	13	4.28
hydro power	498	49800	7%	35	13	4.78
Solar PV	1400	140000	12%	25	13	17.91
Solar Thermal	1797	179700	12%	25	13	15.31
Biomass	419	41900	9%	25	13	5.78

Applications That Will Use Smart Grid Infrastructure	
Generation	Central plant, renewable, distributed generation, cogeneration, technology for improved power quality in a digital economy
Transmission & Distribution	Distribution automation/load balancing, self-healing grid operation, remote disconnect and meter-reading
Electric Loads	Demand response, energy conservation, and energy storage options

Traditional Grids	**Smart Grids**
Centralized power generation	Centralized and distributed power generation
One-directional power flow	Multi-directional power flow
Generation follows load	Loads follows generation
Operation based on historical experience	Operation based on real-time data
limited grid accessibility for new producers	Full and efficient grid accessibility Consumers participate in the market **Intermittent renewable power generation**

Table B traditional grid and smart grid system

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Preliminary Calculation of CO2 Emission Reduction for 1 MW Solar Project		
Capacity of the project	1 MW	
Emission Reduction in terms of CO2 per Annum	Tonnes of CO_2e	**1576 tCO_2e**
Expected CO_2 rate	Euro per tonnes of CO_2e	**12**
Euro/INR Conversion rate		**65**
Total Revenue generation per year	INR	**11,31,512**
Total Revenue generation for ten years	INR	**11,31,512*10=1,13,15,120**

Table C carbon credit chart

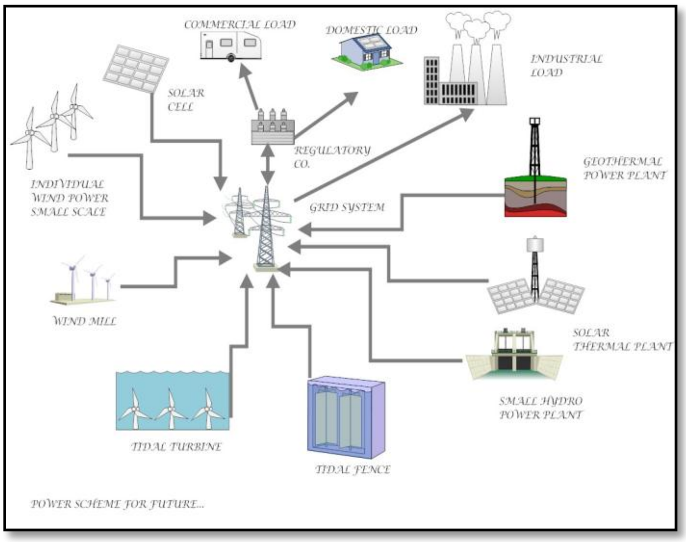

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Figure A Renewable Energy Source in MSG

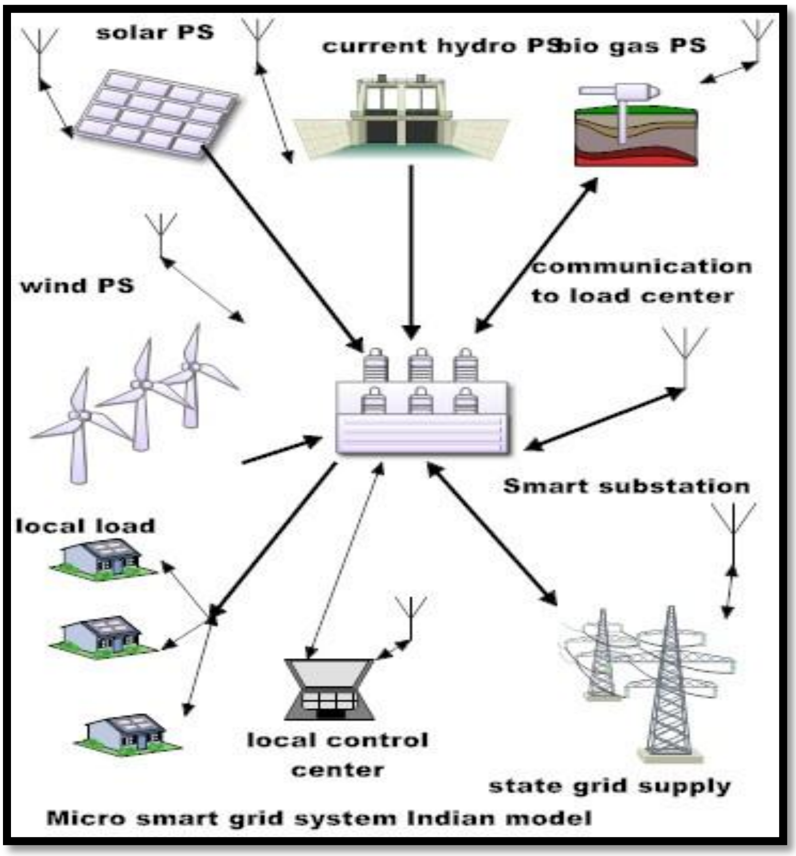

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Figure B Micro smart grid with non-conventional energy sources

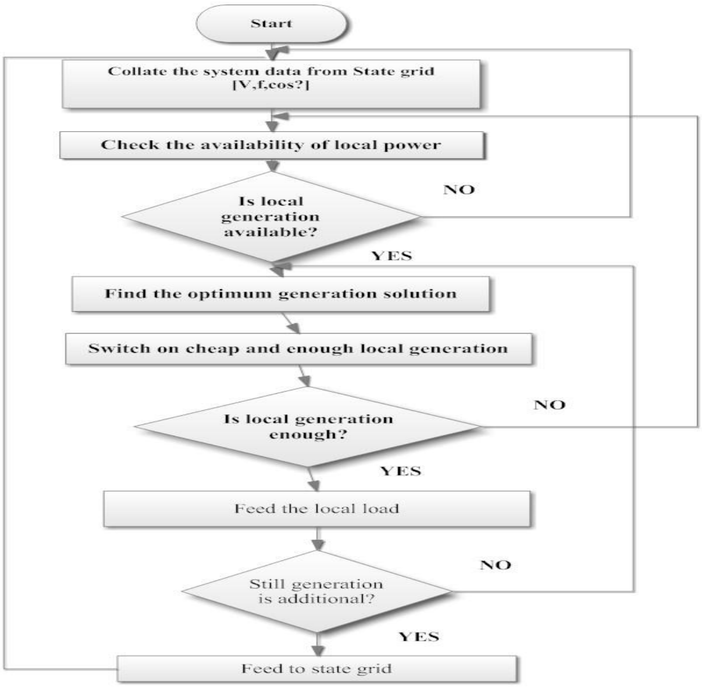

Figure C flow chart of MSG