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Micro Grid Technologies and its Need in Distribution System in India: A Review

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***Abstract*: Smart micro-grids can provide clean, reliable, affordable, and scalable electrical power and it is required for In typical Indian rural areas. The biggest challenges being faced by the energy industry today are rising fuel costs, rare investment in old infrastructure and climate change. Use of renewable energy sources, improves the reliability, security, and useful life of electrical infrastructure. By bringing state and local governments, utility companies, public electricity regulators, and IT companies together towards a common goal can accelerate the development of basic smart grid technologies. In the specified regional level, site particular energy sources are used to generate electricity, this is constituting a Micro-Grid which is a cluster of generations serving a limited number of consumers. And either connected to the grid at a single point or can be totally independent of it. At the second level, the technologies are used and installed by an individual energy consumer. This is called Distributed Generation. These sources can be individually connected to grid.**

1. GOVERNMENT POLICY:

The Government of India has adopted an integrated energy policy which aims to provide energy security to all its citizens through conventional as well as alternative sources of energy. Some of the policies adopted by the Indian Government are as follows.

- The Electricity Act, 2003 has given a thrust to distributed generation particularly in the context of rural electrification. The Act specifies distributed generation and supply through stand-alone conventional and renewable energy systems.
- The National Electricity Policy notified on 12 February 2005 recommends under the Rural Electrification component, that to provide a reliable rural electrification system, wherever conventional grid is not feasible, decentralized distributed generation facilities (using conventional or non-conventional sources of energy) together with local distribution network be provided.

2. INTRODUCTION:

Nowadays, due to evolution about the concept of decentralization in power generation, the ability of central grid is increased by reducing the peak loads. In future both smart micro grids and decentralised generation will be making their additional revenue by selling back the generation to whom they buy the power. This will reduce the massive investments made by the organisations which will provide these renewable resources for generation of power with avoiding construction of high transmission lines. Locally based solar, wind, biomass generators, fuel cells and other decentralized generations are much more convenient sources of power thereby reducing the line losses associated with long range transmission of power.

A main feature of a microgrid has its ability to separate itself from utility in a continuous and smooth manner during utility grid undergoing less or no disturbance within micro grid with respect to the loads. The microgrid can automatically resynchronize itself when the utility grid returns to normal functioning and reconnects itself to the grid in an equally smooth fashion. Additionally, it reduces carbon emission and thus supports sustainable livelihood.

- Decentralised Generation In India

In India, many renewable energy technologies are being employed in a number of decentralized generation projects. The figure below illustrates the technology options for decentralized power generation

1. The advances micro grid integration and interoperability:
Presented by: Sandia national laboratories Albuquerque,new mexico
In this paper the author discussed that micro grid is essential part of the modern electrical grid. In this paper the laboratory has also mentioned and taken the related sources on this by ODE microgrid workshop, "The National Institution Of Standard and Technology", "Smart Grid Interoperability Panel ". A microgrid provides grade, infallible and also provides services, features and functionalities that will be improve flexibility. The advanced microgrid can also employ communication then new methods will evolve. And also this paper provides a collection of today's hardware, material and methodologies along with goals and versions for advance microgrid.

2. Operation optimization in a smart micro-grid in the presence of distributed generation and demand response.

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Presented by :-School of economics and management,china electric power university,Beijiing.-State grid Human Economic Research Institute Zhenzhou,China
In this paper the author states Micro grid, which is an stable and economic powegrid plays an important role in the demand side management as response is widely applied in the economic operation of microgrid become an important for utilization. Thus advancement should go considering distribution, generation, demand response and environmental factors. The main goal should be minimized the operation and cost of microgrid without bringing disconcert to the users. So that we can get the clear indication of the of the impact of demand response on economic operation of microgrid and development of distributed generation.Smart grid is the solution for variety of energy generation equipment and terminal user equipment. The power management and improvement of power system interaction in the new smart grid is optimized. Microgrid have ability to connected with external power grid and also has the ability to operate in off-grid independently. With the development of smart microgrid we can improve utilization of renewable energy.This paper presents a DR scheduling model for smart residential community based on the demand response strategy. The objective of the model is to minimize the operation cost. The results show that the fluctuation of natural gas price has a great influence on the demand response effect.

2. Operation and design optimization of microgrids with renewables
Bing Yan, Member, IEEE, Peter B. Luh, Fellow, IEEE, Guy Warner, and Peng Zhang, Senior Member, IEEE
In this paper the author concern with the world's increasing energy demand and growing environmental concerns, efficient utilization of energy is essential for sustainable living, predominantly renewable energy. The different distributed energy devices in microgrids are as gas turbines (GT), photovoltaic (PV) panels, and natural gas boilers, which generates and store different types of energy such as electricity, steam and hot/chilled water to satisfy time varying electricity and thermal demand. The operation of micro grid is socially hierarchical from unit commitment to economic dispatch to optimal power flow. Focusing on above, the problem which is need to take under consideration is to commit and dispatch distributed devices to minimize energy and CO2 emissions cost under the grid connected mood while meeting hourly day-ahead electricity and thermal demand. Design of micro grids, As in case of long run, determining device types and size is critical. Mathematical models and optimization methods were developed for ootimal design of microgrids in literature to minimize the total annual cost or lifetime cost. And reliability costs were rarely considered within the design framework.

4. Application of microgrids in supporting distribution grid flexibility.
Presented by:-Alireza majzoobi,student member IEEE and Amin khodari,senior member IEEE
Here the author says that The distributed renewable energy resources have significance due to raise in cost of fossils,extensive federal and state incentives.this also improved load point reliability .Microgrids provide a viable solution for all distribution problems and costly investments by the electric utility on reinforcing the existing electricity infrastructure .A flexibility oriented microgrid optimal scheduling model is proposed and developed to coordinate the microgrid net load with the aggregated consumers/prosumers net load in the distribution network with a focus on ramping issues .Numerical simulations on a test distribution feeder with one microgrid and several consumers and prosumers exhibit the effectiveness of the proposed model.In this paper,the microgrid was utilized to reduce the distribution network net load variablities, resulted primarily due to simultaneous decrease in solar generation and increases in consumer's loads .The model was studied for intra-hour and inter -hour time intervals during the 24-hour day -ahead operation.Numerical simulations were carried out for various amounts of utility grids desired inter hour and intra hour ramping to show the merits and the effectiveness of the proposed model.The results showed that the grid operator can efficiently levearge the address some of the most

5. Analysis and control of micro grid system
Presented by:- Jingle Hu B.E.In shengong institute of engineering.
In the paper the author has explained how micro grid has got a new change over the years There is a drastic change to the countries. It explains the basic characteristics of micro grid. It explores the usage and author highlighted that not only in india but in many foreign countries the people have joined hands and worked by creating more micro grid projects.The achievement gave power supply not only to islands but also to remote areas. It led to increase in efficiency. It led to continuous power supply by implementing different ideas by different people. It has the guarante that any kind of disasters happening could be prevented. The study of micro grid turned out to be a huge success .It led to growth of society. It enlightened some aspects like improvement in power quality gave more reliability. In Japan micro grid projects construction keeps as a world leader. All the requirements achieved are power supply,reliability, electricity quality, energy saving and discharge decreasing. Benefits of decentralization generation Reduction of losses Connecting to remote and inaccessible areas Quick response Power management Time consumption Flexible and reliable system It elaborates the different ideas implemented to bring continuous change. It shows all achievements achieved. If some power failure or power quality occurs that may interrupt the voltage in distribution network then that is also properly managed and monitored by the usage of PCC point controller that can send signals to breakers It gives a new opportunity to combine energy storage with reduced

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- **Benefits of decentralized generation**

Decentralized generation offers numerous benefits compared to the conventional centralized system and decentralized generations are small.

No high peak load shortages- The distributed generation system is offers solution for the problem of high peak load shortages and can reduce the peak demand.

Reduced transmission and distribution losses:-The transmission and distribution losses of 35% of the total available energy is occuring in India. Thus it can reduce the losses and improve the reliability of grid network.

Linking remote and inaccessible are:-The remote and inaccessible areas can get power by the distributed generation. This play a major role in rural electrification for the country like India.

Improved supply reliability and power management

The distributed generation system provides easy maintenance of electrical parameters like power,voltage and frequency without the utility grid system. The combination of energy storage system and management system can obtain by this distributed generation with reduced congestion.

Technologies for decentralized generation

There is many technology can be implement in the decentralized due to is flexibility based on the renewable or non-renewable energy sources. The decentralized generation technologies are follows:

Micro turbines: The micro turbines are used for small scale distributed power generation system. The size of micro turbine ranges between 30 to 400kw. The micro turbine consist of compressor,turbine,combstor and a generation. The turbine used for small scale are designed of radial-flow, resemble automotive engine turbo changes. It consist of single shaft and high speed permanent magnet generation to produce variable frequency of AC power and variable voltage. The turbine operates with higher electric efficiency and designed for continuous operation.

Reciprocating engines: Almost all engines are operate in four cycles of intake,compression,combustion and exhaustion. The four-stroke are used for power generation. The reciprocating engines are available in various size ranges. They are used for backup emergency power or to supply diesel can be used as working fuel for reciprocating engines.

Combustion gas turbines: The simple cycle combustion turbine is of about 1Mw. To achivese up to 15Mw, the turbine can be configured as combined cycle power system, this is also called as industrial turbines or mini-turbines.

The combustion turbines offers advantages of low installation costs,low emissions and require less maintenance. It has limited application in combined head and power and primarily peaking unit due to its less electric efficiency. Co-generation distributed generation installation are particularly used for continuous supply of steam or hot water.

Photo voltaic(PV): The photo voltaic system are widely used and they are commonly known as solar panel. Photo voltaic panels consist of smaller cells which are connected in series and parallel to form photo voltaic panel. This panel converts light radiation into electricity in the form of DC electricity. This Dc electricity is converted to Ac by using inverters. The photo voltaic system has more reliable,emission free and less maintenance.

Fuel cells: The size of fuel cell varies from from 5 to 1000+KW range of varios types. The fuel cell include molten carbonate,solid oxide,phosphoric acid,proton exchanges member and the direct methanol. The power conversion in fuel cell takes place in the form of electrochemical process with less NOx and CO emossiom.

Wind turbines: Incase of wind turbine the wind turbine the wind energy is converted to electrical energy. It doesnot need of new tensmission lines of heavy investment. It is used to supply of electricity for remote areas.

CONCLUSION :

This is a review paper discussing the concept of microgrids based on renewable energy & its relevance from Indian perspective. It presents the needs & application areas of microgrids, which if properly implemented and exploited can provide an era of energy revolution for the world's second most populated country & meet the energy requirement of our country's millions of people, who still live in darkness along with a decades old aging power infrastructure insufficient to meet an ever increasing stress. The paper also presents the various benefits, challenges & management issues that would be faced in building any Microgrid plan. A brief discussion is also given on India's movement towards smart Microgrids, related developmental initiatives & programs which are in pipeline. At last, the author proposes a step by step procedural way for establishing a Microgrid in India or any part of world.

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