

MICRO GRID IN RURAL AREAS BASED ON RENEWABLE ENERGY

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ABSTRACT

This paper deals with the development of a new, smart distributed Micro-grid suitable for high-penetration which efficiently utilizes energy available from distributed, renewable generators, design of micro grid as part of Smart grid technologies with renewable energy resources like solar, wind, Tidal and Hydro etc. and discuss on the advantages and disadvantages future extensions of the micro grid.

Micro grid based on renewable energy is a system in which we generate electricity from renewable energy resources, set a transmission and distribution system for limited area at medium voltage which is desired in the home appliance like 230V. This energy is controlled by micro grid equipments (voltage controller, frequency controller, FACTS etc) and sent directly to the consumers.

Micro grids comprise low voltage distribution systems with distributed energy resources (DER) and controllable loads which can operate connected to the medium voltage grid or islanded in a controlled coordinated way.

Keywords:- Voltage controller, Frequency controller, Turbine, Renewable energy resources etc.

1. Introduction

A micro grid is composed of the distributed generation systems. It is also known as distributed storage systems. Since the micro grid has renewable energy sources like solar, wind, Tidal and Hydro etc. It is evaluated as a green power system. The micro grid has various applications, such as campus micro grids, building micro grids, village micro grids, and so on.

Micro grid is one of the solutions to present energy crisis in India. It is basically network comprising of distributed generation sources, storage system and controllable loads, which can operate in grid connected mode or in case of fault in isolated mode. Micro grid provides various advantages to end consumer's utilities and society. Various advantages include improvement in energy efficiency, minimization of overall energy consumption and improvement in service quality and reliability of power supply.

A micro-grid consists of interconnected distributed energy resources capable of providing sufficient and continuous energy to a significant portion of internal load demand. Some of the advantage of renewable energy resources (RES) such as solar, wind or hydro energy. Having micro-sources close to the load has the advantage of reducing transmission losses as well as preventing network congestions. Moreover, the chance of having a power supply interruption of end-customers connected to a low voltage (LV) distribution.

Micro grids may potentially offer various advantages to end-consumers, utilities and society, such as:

- Improved energy efficiency
- Minimized overall energy consumption
- Reduced greenhouse gases and pollutant emissions
- Improved service quality and reliability
- Cost efficient electricity infrastructure replacement

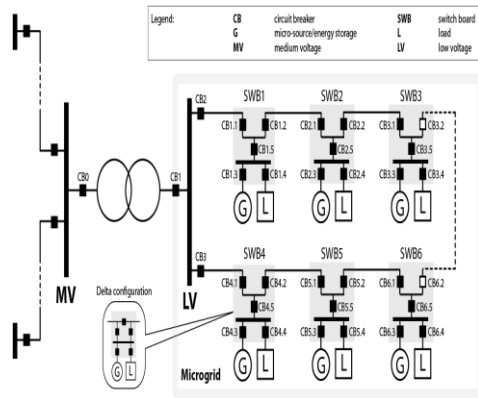


Fig. :- Typical micro grid layout.

2. Renewable Energy sources for Micro grid Technology:-

2.1 Solar Power Technology:-

Solar power in India has huge potential and it is environment friendly as it has zero emissions while generating and is obviously the most secure. Solar power technology enhances PV output by concentrating a large area into a small beam using lenses, mirrors, and tracking systems. There are several PV simulation programs which allow for series analysis for time such as PV design. Cost implication even though the cost of the plant is more manufacturers continue to reduce the cost of installation as new technology is developed for manufacturing materials. Many models exist for the calculation of the power output of a PV cell or bank. Due to varying efficiencies and numerous technologies presently available, power output is affected by environmental conditions and module specifications. The I-V characteristics model of a single cell commonly used for PV technologies shown in figure below.

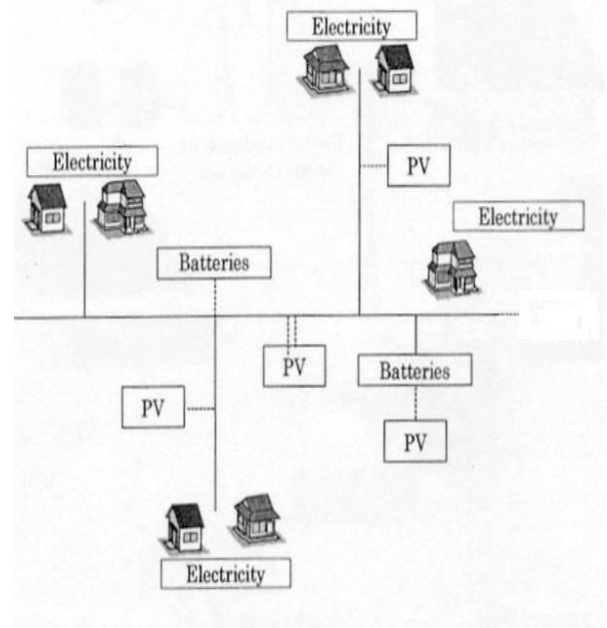


Fig. :-DC electricity distribution system via solar

2.1.1 Problem with solar energy:-

Cloudy or rainy day gives variable voltage and this also gives the variable frequency. These create the problems at the grid to connect the different energy sources. The solar energy output of a site will drop quite suddenly (especially for photovoltaic arrays) when a cloud wanders between the collectors and the sun and then surge back on when the cloud floats away and the sunshine returns to irradiate the mirrors or PV modules of the site. Solar energy also cycles with seasonal variations in the incident solar irradiance and of course the sun does not shine at night.

So, solar panel produce variability problem in energy generation.

2.2 Wind Turbine Technology:-

A wind energy conversion system is a complex system in which knowledge from a wide array of fields comprising of aerodynamics, mechanical, civil and electrical engineering come together. The principle components of a modern wind turbine are the tower, the rotor and the nacelle, which

accommodates the transmission mechanisms and the generator. Wind/Diesel combinations are, in principal, built up in the same way. From a perspective of financial competitiveness, they can be applied in regions where average wind speed is around 3.5 m/s already. If wind speed is sufficient, the wind turbine is in charge of the provision of energy. During short periods of time with low winds, the battery maintains a stable system, being replaced by the diesel generating set when low winds occur over longer periods of time.

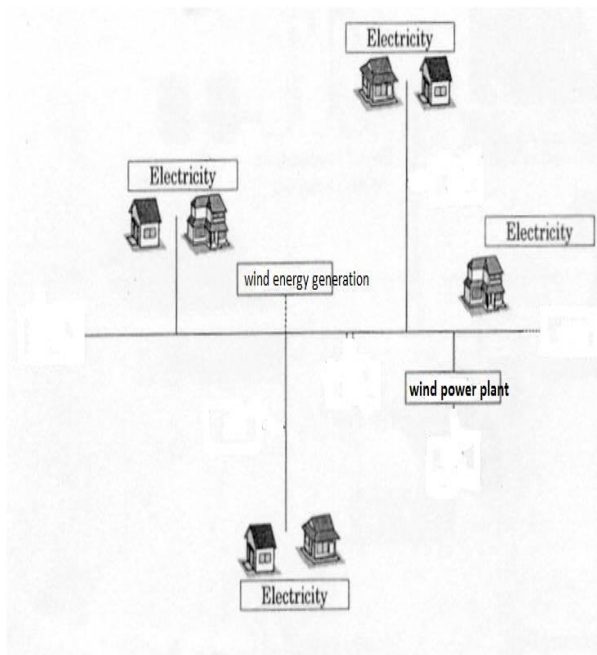


Fig.:- electricity distribution system via wind in small area

2.2.1 Problem with wind energy:-

As we know that the strength of wind is not constant and it varies from zero to storm force. So the variable speed of wind produces variable frequency and variable voltage of electricity. Variable frequency & voltage also create the problems to connect the grid because all the renewable energy sources have its own frequency and voltages.

This causes the variable frequency problem in the renewable energy sources.

2.3 Tidal Energy Technology:-

Tidal energy is one of the best available renewable energy sources. In contrast to other clean sources, tidal energy can be predicated for centuries. It is a clean source of energy and of renewable nature.

Gravitational forces between the moon, the sun and the earth produce tides in the sea. The moon exerts more than twice as great a force on the tides as the sun due to its much closer position to the earth. As a result, the tide closely follows the moon during its rotation around the earth, creating flow and ebb of tides. The periodic rise and fall of the water level of sea is called *tide*. When water is above the mean sea level, it is called flood tide and when the level is below the mean sea level, it is called ebb tide.

Tidal generation uses the energy of moving water to spin a generator and may produce power from water moving in two directions: inward on the flood tide and outward on the ebb tide. To utilise tidal energy, water must be trapped at high tide behind a dam or barrage and then made to drive turbine as its return to sea during low tide. A dam is built at the mouth of the sea. A tidal basin is formed which gets separated from the sea by dam.

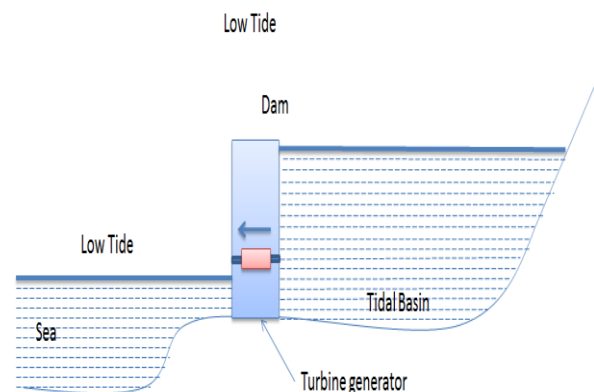


Fig: - Principal of tidal power generation

2.3.1 Problem with tidal Energy:-

Tides are predictable, but power station only generate power when the tide is flowing in or out of the basin, which only happens during certain times of the day or 10 hours in a day. Barrage may across river estuaries can

change the flow of water and because of that the place for birds and other wildlife could be in danger. There are limited construction locations. Barrage may affect the tidal level.

3. Micro Grid Model Based On Renewable Energy Resources:-

Generally renewable energy has its own site (location). The purposes of micro grid are to generate electricity. Because as we know that in rural and remote areas connecting the electric grid is very uneconomical to carry out. Therefore in those areas micro grid is more economical to electrify by renewable energy sources available locally. The configuration of micro grid represents the energy distribution architecture from the producing sites to consumers and eventually the interconnection between several sites and several consumers.

Electricity from renewable energy resources set a transmission and distribution system for limited area at medium voltage which is desired in the home appliance like 230V. This energy is controlled by micro grid equipments (voltage controller, frequency controller, FACTS etc) and sent directly to the consumers.

So we develop DC distribution system near renewable energy generation point. All the renewable energy such as solar, wind, tidal, geothermal, and hydro power plant is situated near each other.

For the DC electricity transmission and distribution, we develop a DC distribution system i.e. called Micro-grid through which all renewable energy is connected.

This transmission of renewable energy transmitted electricity at LV with micro grid to the consumer.

Distributed Generation (DG) is an approach that employs small-scale technologies to produce electricity close to the end users of power. Today's DG technologies often consist of renewable generators, and offer a number of potential benefits.

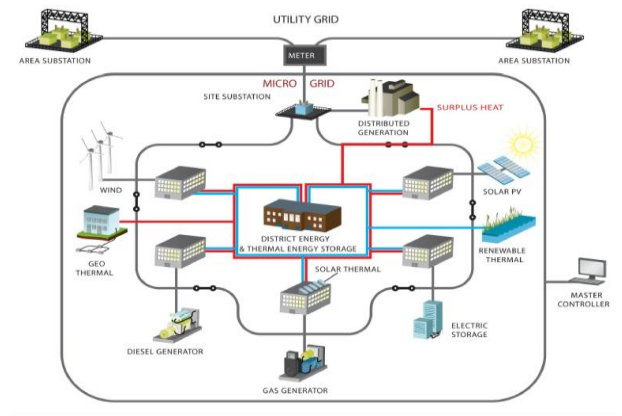


Fig: - DC distribution system based on renewable energy

4. Characteristics, advantages and disadvantages of Micro grid:-

The flexibility of micro-grids comprises important benefits, but their efficient implementation poses very challenging problems, as below:-

- The benefits Micro-grids provide to power system operation and planning need to be quantified and incorporated into an appropriate commercial and regulatory framework, so that a level playing field for all energy technologies can be established.
- In order to achieve the full benefits from the operation of Micro- grids, it is important that the integration of the distributed resources into the LV grids, and their relation with the Medium Voltage (MV).
- The coordinated control of a large number of distributed sources with probably conflicting requirements and limited communication imposes the adoption of mostly distributed intelligence techniques.
- The design of Micro-source Controllers enhanced with advanced frequency and voltage control capabilities and possessing ride-through capabilities is essential for

the stable operation of Micro-grids, especially in islanded mode of operation.

- The design of smart Storage and Load Controllers able to face the stringent requirements posed by the islanded operation and especially during transition from interconnected to islanded mode is also crucial.

4.1 Renewable energy options are meant to provide the micro grid with following:-

- Remote utilization and storage of the renewable energy resources output
- Facilitating give-and-take of the energy from the system
- Redistribution/reallocation of unused power from grid-connected renewable energy sources
- Facilitating storage off grid-generated and RER –generated by back up storage technologies at customer end.

5. Conclusion:-

Micro grid provides the on-site production of the power without transmission and distribution losses of electricity. Integration of the renewable energy sources will give much effective and more reliable, efficient power supply to consumer. The future extension of the paper can explain integration other renewable sources like Bio-mass and fuel cell models of the micro grid

This work showed that the micro grid architecture is a viable solution for including distributed generation in a power system. This novel approach requires some features such as plug and play and peer to peer for each of the units in the subsystem to operate correctly.

Loads are located near each of the sources and on the long cable that separates them. The connection with the utility is realized with a static Switch.

That is, having demonstrated the technical feasibility of micro grid functions, optimization efforts are now needed to

accelerate commercial deployment. The work will pay special attention to the economic drivers outlined in the solicitation: “economic dispatch responsive to pricing signals and demand management programs, customer willingness to pay premiums for increased power reliability and quality, etc.”

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