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DISTRIBUTED GENERATION TECHNOLOGIES

Rekha G Padaki[1], Murugesh Dodakundi [2], Anand Layadgundi [3]

[1] *Assistant Professor, Dept. of studies in EEE, University BDT College of Engineering, Davangere, Karnataka, India,*
[2,3] *PG Scholar, Dept. of studies in EEE, University BDT College of Engineering, Davangere, Karnataka, India*

Abstract: Distributed Generation generally refers to power generation at the point of end user or customer. Distributed Generation is gaining worldwide acceptance due to it's a number of benefits. Distributed Generation eliminates the cost and complexity and reduces the chances of inefficiency which occur in the transmission and distributed network [1]. Basically electricity produced is generated at large generating stations which is then send at high voltages through the transmission lines to the load centers and then through local distribution network distributed to the customers at distribution level voltage. In present scenario there is an increase in demand which is creating gap between demand and supply to fulfill this gap distributed generation can plays the significant role. The main reason for the need of distributed generation is it is clean and continuous. Distributed generation means generating power on site not centrally. Distributed generation is the best way for rural electrification. This paper will discuss the importance and benefits of Distributed Generation in near future [3].

Keyword: Distributed Generation, Transmission and Distributed network, Demand, Electrification.

I. INTRODUCTION

Over the last decade, technology innovations in power generation and a changing economic, financial, and regulatory environment of the power markets have led to a renewed interest in on-site small-scale electricity generation, also called distributed, dispersed or decentralized generation (DG).

Distributed Generation refers to power produced at the point of consumption. DG resources, or distributed energy resources (DER), are small-scale energy resources that typically range in size from 3 kilowatts (kW) to 10 megawatts (MW) or larger. A typical household's peak demand is about 3.5 kW, so the smaller resources are used by residential customers, while the larger systems are typically used by commercial and industrial customers. In addition to PV, DERs can include small wind turbines, combined heat and power (CHP), fuel cells, micro turbines, and other sources.

Distributed generation simply means small scale generation. India has the world's second largest population and rapidly growing economy. India is faced the high energy demand as the demand has always grown faster than generation capacity. Presently there are still so many rural areas where electricity is not reached yet where grid connectivity is neither feasible nor cost effective. That's why the off grid or decentralized distributed generation is a better option for electricity supply [8].

Distribution generation will lead to few changes in traditional generation. Distribution generation have some advantages over traditional generation. In distributed generation there is no need of large transmission lines which reduces losses and complexity. In distributed generation the energy generated and distributed by using small scale technology closer to its end user that's why it is also termed as decentralized generation.

The number of residential and commercial customers who have installed solar generating panels at their homes and businesses has increased in recent years. Motivated by environmental concerns and a desire to reduce their electric bills, these customers have spurred a dramatic increase in the amount of distributed generation (DG) in the United States. Advances in solar photovoltaic (PV) technology, combined with decreasing capital costs and construction subsidies, have further sparked the construction of new capacity.

The advance of DG as a complement to traditional electric service has potential benefits for electric utilities. Customers producing rather than consuming electricity at peak demand times mitigate the need to construct new generating capacity. Consumption of generation near its source could lead to lower transmission and distribution line losses and has other potential benefits for distribution and transmission systems.

DG also posses many operational challenges to electric utilities. Generators must still rely on the electric grid for backup service during periods when they are not meeting all of their electricity needs (e.g., during the early morning and evening hours, during prolonged overcast conditions, during periods of unexpected PV installation failure, etc.).

The variability of PV solar generation creates further challenges in maintaining system balance. There are also safety issues involved with customers having on-site generation, as power from DG installations can back-feed into distribution systems and cause occupational hazards for line workers [6].

DG is not a new phenomenon. Prior to the advent of alternating current and large-scale steam turbines - during the initial phase of the electric power industry in the early 20th century - all energy requirements, including heating, cooling, lighting, and motive power, were supplied at or near their point of use, technical advances, economies of scale in power production and delivery, the expanding role of electricity.

II. IMPORTANCE

As of growing economy and population India needs a better cost effective and environment friendly solutions that fulfill the energy demand. Distributed Generation fulfill the needs so far. Distributed Generation is cost effective and environment friendly method to reckon with.

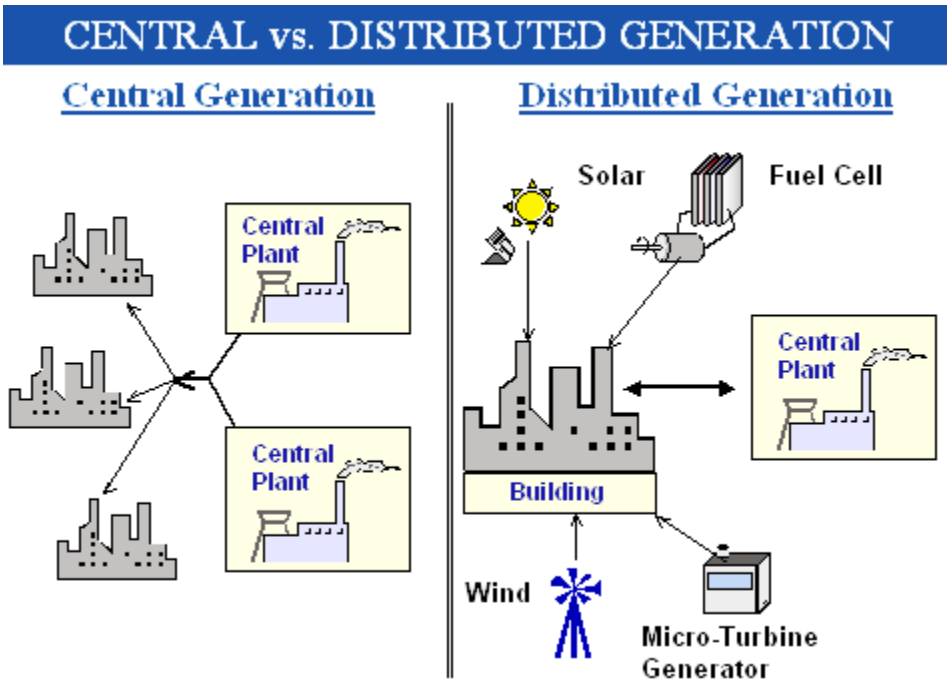
Distributed Generations provides a reliable and better power quality than conventional system. Distributed Generation have a number of technologies, some technologies are used for high efficiency. In most of the rural areas still electricity does not reach because it is not economical to set up large transmission lines in that case distributed generation is a better option to fulfill the requirement.

In India, the deregulation of the power sector has not made much alternative but the transmission and distribution losses, grid failure and the problem of remote and inaccessible regions have led to distributed generation. Distributed Generation system can employ both renewal and non-renewal technologies.

III. DISTRIBUTED GENERATION OVER TRADITIONAL GENERATION

India is a large and spread over a wide area so it's quite difficult to access electricity each and every part of the country using Traditional Generation, distributed generation in which electricity is produced at consumer end serves a better end. In Traditional Generation sometimes the grid failure leads to the blackouts while in Distributed Generation this case will not occur. Traditional Generation consist of long transmission lines which makes it costly in case of Distributed Generation there is no need of long transmission line which ,makes its cost effective .Traditional generation system are quite complex as there are very big system consisting of many parts while distributed generation is quite simple in its construction. Traditional generation is an effective method but there

are some rural areas are in India which is still inaccessible so the Distributed Generation will play a significant role in remote and inaccessible regions.



Since DG is consumed largely on site, it would presumably lower distribution, transmission, and generation infrastructure and operating costs. Another advantage of the electricity being consumed closer to its source would be a reduction in electric line losses.

IV. NEED OF DISTRIBUTED GENERATION

Currently India has grid connected total installed capacity of 215 GW for electricity Generation. To fulfill the huge demand of electricity centralized generation and extension of grid is not a good option. Distributed power generation, based on locally available energy resources and supply of this additional electricity into the rural electricity grid, can be an important part of the solution to supply reliable electricity supply to rural population [1].

Distributed generation is clean and continuous so it is good of environment point of view, which makes it a better option.

V. TECHNOLOGIES FOR DISTRIBUTED GENERATION

There are a number of technologies are used for distributed generation. The Distributed Generation technologies are following.

1. Wind Turbines.
2. Fuel Cells.
3. Photovoltaic Cell.
4. Reciprocating Engines.
5. Combustion Gas Turbines.
6. Micro turbines.

1. Wind Turbines.

In wind turbines the wind is used to generate electricity and it does not require long transmission lines. Wind turbines can be used for on-site generation as it does not need setting of infrastructure.

Modern wind energy systems consist of three basic components: a tower on which the wind turbine is mounted; a rotor (with blades) that is turned by the wind; and the nacelle. The nacelle is the capsule-shaped component which houses the equipment, including the generator that converts the mechanical energy in the spinning rotor into electricity. Rotor blades need to be light and strong in order to be aerodynamically efficient and to withstand prolonged use in high winds.

The rotor, which spins when driven by the wind, supports blades that are designed to capture kinetic energy from the wind. Nearly all-modern wind turbines have rotors that spin about an axis parallel to the ground. The spinning rotor turns a shaft, which converts the wind's energy into mechanical power. In turn, the shaft drives the generator, which converts mechanical energy into electricity.

2. Fuel Cells.

A fuel cell is an electro-chemical cell. It harnesses the energy released when hydrogen and oxygen combine. This reaction produces electricity, heat and water. Fuel cells produce almost no pollutants and have no moving parts.

In principle, a fuel cell operates like a battery. However, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied.

The hydrogen needed for reaction in a fuel cell is typically produced from hydrogen rich fuels such as natural gas, propane, or methane from biogas recovery. These hydrogen rich fuels are run through a fuel "reformer" that converts the fuel from its original composition to hydrogen and to carbon dioxide.

3. Photovoltaic Cell.

Photovoltaic system is consisting of solar panels so it is also known as solar panels. Solar panels are made up of small cells which are connected together that catch solar radiation and convert into electricity.

A solar or photovoltaic (PV) cell is made of special materials called semiconductors, an example of which is silicon crystal. The photovoltaic cell is designed to convert light energy into electric current. It is a specially constructed diode, which is an electronic component with positively and negatively charged fields that force the movement of electric current in only one direction. The border between the negative and positive fields is called the diode junction.

When light strikes the cell's exposed active surface, a portion of the light energy is absorbed by the semiconductor material. The energy knocks electrons loose from their positive and negative sites in the silicon crystal, allowing them to flow freely. Some of the electrons have sufficient energy to cross the diode junction and cannot return to positions on the other side of the junction without passing through an external circuit. This flow of electrons is called current, and by placing metal contacts on the top and bottom of the photovoltaic cell, current can be drawn off for external use.

Since the current obtained from these devices is small and the voltage is low, they must be connected in large series-parallel arrays (solar panels) if useful amounts of energy are to be converted. Practical devices of this kind are about 10 percent to 15 percent efficient.

4. Reciprocating Engines.

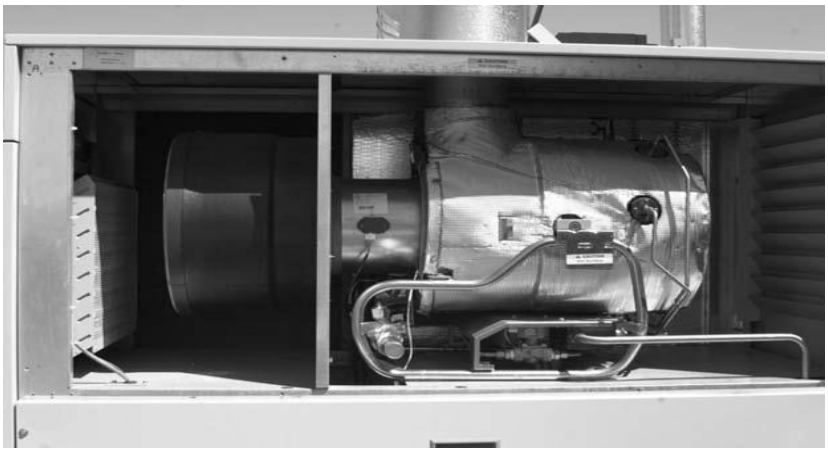
The most common internal-combustion engine is the piston-type. The confined space in which combustion occurs is called a cylinder. In each cylinder a piston slides up and down. One end of a connecting rod is attached to the bottom of the piston by a joint; the other end of the rod clamps around a bearing on one of the throws of a crankshaft; the reciprocating (up-and-down) motions of the piston rotate the crankshaft, which is connected by suitable gearing or directly to a generator.

5. Micro Turbines.

Micro turbines are scaled down turbine engines with integrated generators and power electronics. They are generally characterized by having only one rapidly moving part (moving at 100,000 rpm) supported either by air- or liquid-lubricated bearings. The micro turbine generates high-frequency AC power that is rectified by a power electronics package into utility grid-quality, three phase 400-480v AC power.

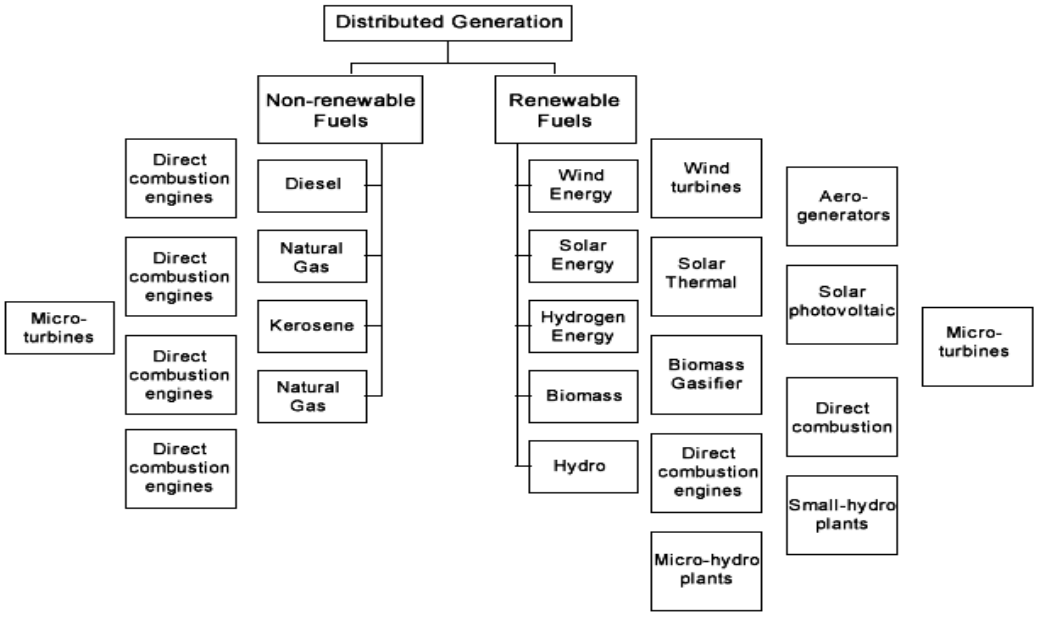
Micro turbines can operate on a wide variety of gaseous and liquid fuels, and have extremely low emissions of nitrogen oxides. Electrical efficiency of micro turbines is in the 25-30 percent range.

Ancillary heat from micro turbines can be used on-site for water and space heating, process drying, food processing and absorption chilling. Doing so delivers a total system efficiency of at least 70 percent, and use of the exhaust stream for process drying, greenhouse heating/CO2 supplementation and similar tasks yields efficiencies exceeding 90 percent.



VI. DECENTRALIZED 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. In rural areas distributed generation is better for providing clean, reliable, affordable and scalable electrical power.



VII. DISTRIBUTED GENERATION FROM INDIAN SCENARIO

India has abundant, untapped renewable energy resources, including a large land mass that receives among the highest solar radiation in the world, a long coastline with high wind velocities that provide ample opportunities for both land-based and offshore wind farms, significant annual production of biomass, and numerous rivers and waterways that have potential for hydropower. Promoting renewal energy is the best to cope up with reducing coal consumption and oil bill as well which will contribute to economy. Add to this the Indian economy is expected to grow at over 5% per annum up to 2030.

Distributed Generation is a better solution for rural areas electrification. There certain aspects which lead to the adoption of distributed generation as in traditi0onal generation there T&D losses, massive grid failure and inaccessibility to remote regions. There are a number distributed technologies are used some of which are not economical for the rural areas electrification.

Some technologies like solar PV, biomass, hydro power are appropriate for such locations. Some people from electrified villages are also not satisfied with the quality of grid they can also adopt Distributed Generation [7]. For a large and dispersed rural country, decentralized power generation systems, where in electricity is generated at consumer end and thereby avoiding transmission and distribution costs, offers a better solution.

VIII. BENEFITS

- Reduces the cost as there is no use of long transmission line.
- Reduces the complexity.
- Environment friendly.
- Avoid the impact of massive grid failure.
- Easy to maintain and easy to operate as it consist of simple construction.
- Better power quality and reliability.
- The factor of high peak load shortage eliminates.
- Improves the efficiency of providing electric power.

Of, course operation cost varies on the basis of various distributed technologies are used. Distributed Generation eliminates a number of problems which occurs in traditional generation. As in distributed generation power is generated at the consumer end so the on-site power equipment can provide consumer with affordable power at a higher level of quality [5].

IX. CONCLUSION

This paper gives quick review of Distributed Generation in India, its need, importance in near future. And also provides how Traditional Generation is differing from Distributed Generation. According to present condition the India is on the right track for the development of distributed generation. There are different technologies in which the distributed generation works to get effective output that can be renewal and non-renewal. Distributed generation from Indian scenario it is a better option for providing rural electrification and also provide energy security. Fuel delivery is quite tough in developing countries like India so power generation from renewal energy resources may be justifiable. In this paper I am trying to focus on the point that in future Distributed Generation will play a significant role in providing rural electrification.

REFERENCES

[1] Sweta, Mohamed Samir, "A Generalized Overview of Distributed Generation", International Journal of Emerging Research in Management & Technology ISSN: 2278-9359 (Volume-2, Issue-12).

[2] M. Vaziri, M. Zarghami, S.Vadhva, "Review of Concepts to increase Distributed Generation into the Distribution Network", 2014 Sixth Annual IEEE Green Technologies Conference.

[3] Lucian Ioan Dulau, Mihail Abrudean, Dorin Bica, "Distributed Generation Technologies and Optimisation", The 7th International Conference Inter disciplinarity in Engineering (INTER-ENG 2013).

[4] Du Yi, Jiang Daozhuo, Yin Rui, HubPengfei, Wang Yufen, "Modelling and Simulation of DC Distribotion Network Based on Distributed Energy", 2nd International Symposium on Instrumentation and Measurement, Sensor Network and Automation (IMSNA).

[5]Dulău LJ. Hybrid Wind and Solar Power System, 2nd IFAC Workshop on Convergence of Information Technologies and Control Methods with Power Systems, Poster Session; 2013.

[6] Kansal S et al. Optimal placement of distributed generation in distribution networks, International Journal of Engineering, Science and Technology, 2011; 3(3).

[7] Padhi P et al. Distributed Generation: Impacts and Cost Analysis, Special Issue of International Journal of Power System Operation and Energy Management, 1(3).

[8] Rani PS et al. Optimal Sizing Of Dg Units Using Exact Loss Formula At Optimal Power Factor, International Journal of Engineering Science and Technology, 2012; 4(9).

