



Distributed Generation: A Review

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ABSTRACT: The blackouts that occurs generally shows the weakness of the interconnected network of the power systems and forces the utilities to search for some new technologies that can meet the customers level of expectations in their demand, thrust for reliable power etc. All these things together demand some new innovations and research in this field as the traditional systems are not able to address the problems efficiently. The new kind of power system, restructured and equipped with latest technology of distributed energy sources, can help in this regard and can supply the reliable power efficiently.

KEYWORDS: Distributed generation, solar photovoltaic technology, wind power technology, fuel cell technology, etc

I.INTRODUCTION

The current interest in the growing market of green energy in the developed countries of the world is about three decades old. The electricity that we receive from the renewable sources of energy is considered “green” because it is environmentally safe causing no pollution as having zero or negligible carbon content and other polluting substances. The list currently in the market of commercial energy includes hydro, wind, solar, biomass, and geothermal. In the 1970s the decision to look for some kind of renewable sources was because of the main reason to reduce the dependency on oil. Now there is variety of goals to achieve: to minimize the emission of CO₂, that results from the burning of fossil fuels, to save our environment etc. The contribution of power from renewable sources is very small in the energy market as compared to the other power generating sources. Hydro power generation is an exception as it has very growing market in the world [1].

II.DISTRIBUTED GENERATION

Before presenting an overview of distributed generation, let us present a brief introduction and the definition of the new concept in the modern electricity market. Any kind of distribution generator that has got interconnection with the electrical power system comes under the heading of distributed generation. We can further state different categories of distributed generation technologies as renewable and non-renewable.

Renewable sources are:

1. solar, photovoltaic
2. wind
3. geothermal
4. ocean.

Non-renewable sources are:

1. diesel engine
2. combined cycle
3. combustion turbine
4. microturbines
5. fuel cell.

Distributed generation is generally confused with renewable generation, but the case is not so. This increased penetration of distributed generation technology in energy market has been the advent of an electric power production industry [2].



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III. DISTRIBUTED ENERGY TECHNOLOGY, DEVELOPING TRENDS

Distributed generation is defined as those microsources which are able to produce power at small and large scale both and have the capability to feed the local and loads located near to them [3]. The sources includes hydro, wind, solar, biomass, geothermal and ocean energy. Among all these sources fuel cell technology, wind power generation and solar power generation are the core areas where numerous no. of researches are going on and are concentrating more on improving the performance, increase of efficiency, power quality and reliability of the supply. The hydro power source is very promising and is largely developed over the last centuries. The contribution of hydro to the energy sector is approximately 21% producing nearly 700,000 MW of power. But the problem faced by the hydro sector now is that it has very limited scope to develop new sites in many countries as already the sites are being exploited. There are various hydro sites in the developing nations to look upon, but the main concern is the damage caused to the habitat of that very area, this causes non exploitation of many potential sites.

The second most important renewable source is wind and is being highly exploited in the modern world. The concept of mechanical power from the wind is very old but the recent advancements in this field has made this source of power very famous in the last 10 to 20 years and is now commercially competitive.

The other most important and the promising source is the solar energy. Energy from solar is received in two forms either as photovoltaic or thermal. These both kind of energy received from the sun is being commercially used worldwide. The latest trend in the energy market that is followed by many countries in the world are in the field of solar, wind and fuel cells because of their infrastructure, efficiency, maintenance , etc

1. Wind power technology:

This is the one of the most important renewable source and is being highly exploited in the modern world. The concept of mechanical power from the wind is very old but the recent advancements in this field has made this source of power very famous in the last 10 to 20 years and is now commercially competitive. It started from producing electricity few kilowatts to today's thousands of mega watt. It is broadly classified into two classes:

- i. constant speed constant frequency (CSCF) and
- ii. variable speed constant frequency (VSCF).

VSCF power generation technology has the following advantages:

- i. exploiting to the maximum limit of wind power,
- ii. the wide rotation of the wind blades,
- iii. adjustable real and reactive power of the system and
- iv. Highly efficient PWM control technique,

There is a large scope of research in this section of the power generation and large no. of researches are going on and some of the latest developmental trends are shown as: [4]

- i. larger rated power,
- ii. variable blade pitch,
- iii. variable speed constant frequency (VSCF),
- iv. Absence of gearbox
- v. Advanced converter technology,
- vi. low voltage ride through,
- vii. Smart control control and so on.

2. Photovoltaic technology:

Direct conversion of solar energy to electricity with the help of solar cells is known as the solar photovoltaic technology. This kind of system is classified into isolated photovoltaic systems and grid-parallel photovoltaic system. This technology utilizes two type of power converters.

- i. DC / DC converter: This helps in the transformation of the photovoltaic voltage and MPPT control by using the boost step up circuitry.



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- ii. Voltage Source inverters: these are used to convert the direct current into alternating current and are connected to the utility grid. Also the inverter injects the reactive power to the utility and controls the DC constant voltage.

The biggest challenge in this field is the cost of the solar cells, which is very expensive. So the thrust area of the researchers in this context is to minimize the price while having the best possible efficiency, high reliability, durability of the cells.

3. Fuel cell technology:

It is the latest technology in the field of distributed energy sources. In this the power from chemical energy is directly converted to the electrical energy. The fuel cells are the highly efficient. The process for this transformation of energy utilized is the electro-chemical process. This technology has got some of the best advantages as:

- i. Highly reliable
- ii. Highly efficient technology
- iii. Low noise production
- iv. Less maintenance required
- v. Clean exhaust
- vi. No discharge of polluting substances [5].

IV. BENEFITS OF DISTRIBUTED GENERATION

A no. of benefits are associated with the distributed energy resources. The benefits provided by DGs are categorized under three main sub headings as: technical, economic, and environmental advantages.

1. Technical Benefits:

When the distributed energy resources are integrated together and to the main utility grid, there are large no. of advantages provided by this system and are listed as:

- 1- Reduced power losses.
- 2- Improved system reliability.
- 3- Improved voltage levels.
- 4- Enhanced network security.
- 5- Alleviation of congestion at substations and conductors.
- 6- Improved system overall efficiency.
- 7- Improved system quality.
- 8- Improved power reliability

2. Economic Benefits:

Economic benefits gained from the integrated grid with distributed energy sources plays a crucial role in reducing power system expenses for either long term or short terms.

- 1- Deferring the investments due to system upgrades, expansions, repair and maintenance
- 2- Reduction in operating costs as DGs are working during peak load intervals.
- 3- Declination in energy prices as there is limited use of fossil fuels.
- 4- Reduction of the maintenance cost.
- 5- Minimizing the cost of spinning reserve requirements.
- 6- Increase of revenue.
- 7- Increased employment



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3.Environmental Benefits:

The strong motivation for using the renewable sources for the power supply is basically the environmental issues caused by the large usage of fossil fuels. The need of the hour is to use that source of energy which will be producing clean and green energy. The benefits we receive from this kind of system are as follows:

- 1- Reduced carbon dioxide emissions CO₂.
- 2- Reduced health care costs.
- 3- Reduced land use
- 4- Clean and green energy source
- 5- Safe environment [6].

V.CONCLUSION

The emission from the burning of fossil fuels is very harmful to the environment and indirectly to us. The fossil fuels are at the stage of depletion so there is a global concern to address this issue therefore more and more countries are now looking towards the installation of renewable energy sources. Also there is huge demand for the power and the sources are not enough to meet the load demands, if not properly utilized and hence researches are going on in advancement of the technology to utilize the sources efficiently so that there can be power reliability. Therefore the injection of the distributed energy sources to the existing infrastructure or new installations is the current field where several no. Of studies are going on. As there are enormous no. Of benefits from distributed sources so why not to go for them?

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