An Overview of the Direct Current Network Power Supply System

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ABSTRACT: - According to various figures, many sections of India, particularly rural and island areas, have little or no access to electricity. Because of their geographical position, transmission line construction is extremely costly and complex in certain regions. As a result of this issue, renewable energy sources are being used to provide electricity to these distant regions. The majority of these renewable energy sources provide DC power. In today's world, most individuals utilize an investor in their homes to store energy in a battery that may be used during power outages. While renewable energy sources generate power in the form of DC, it is transmitted in the form of AC. DC energy is used in a broad range of everyday utility items, including mobile phone chargers, computers, laptop chargers, electric vehicles, and so on. As a result, several times of conversion from AC to DC and vice versa are required to provide power from the generating unit to the consumer. As a result of this conversion loss, the overall efficiency of the power system would suffer. As a result, in this article, a suggested distribution system model is presented in order to solve the current issue.

KEYWORDS: - AC grid, DC grid, Electricity generation, Power distribution system, Renewable energy

1. INTRODUCTION

The rate of energy consumption in a unit of time is known as power. Watt is the unit of power measurement, named after James Watt, the renowned eighteenth-century scientist who developed the steam engine[1]. Mechanical power is a mix of forces and movement that is used in mechanical systems. Electrical power is the rate at which electrical energy flows through a particular location in a closed circuit in electrical systems[2]. We shall solely consider electrical power in our applications. Depending on the direction of energy flow, electrical power may be categorized as AC or DC power. The letters AC and DC stand for Alternating Current and Direct Current, respectively. AC power is generated by current flowing in both directions, while DC power is generated by current flowing in just one direction[3]. Waveform of direct current the flow of electrical charge (or, in other words, electrons) in DC (Direct Current) circuits is unidirectional, and unlike AC Current, it does not change direction on a regular basis. A pure sine wave is the usual waveform of alternating electricity, as illustrated in the diagram 1 below.

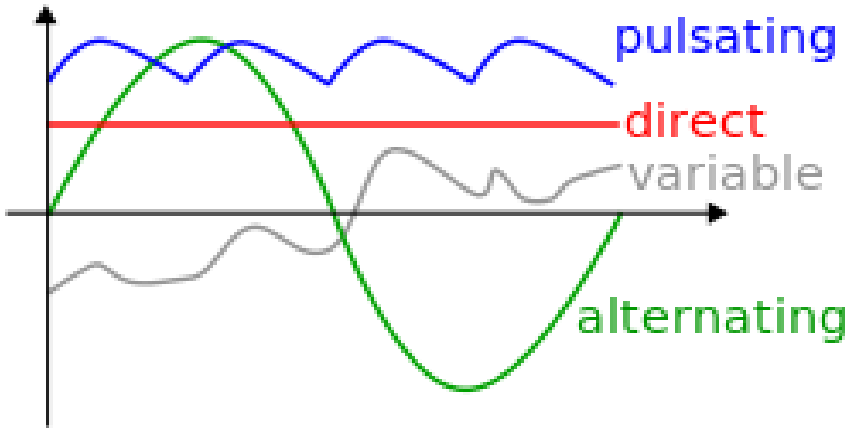

Figure 1: Direct Current (red curve). The horizontal axis measures time; the vertical, current or voltage. Source.

Solar cells, batteries, and thermocouples are the most frequent sources of this kind of energy. Low voltage applications such as charging batteries, automobile applications, aviation applications, and other low voltage, low current applications all utilize DC power. In today's world, all solar panels provide DC electricity. Portable solar systems and other off-grid products are common DC power applications in the PV sector. The cost of such systems will be lower if they do not need a solar inverter to convert DC to AC[4].

Nowadays, alternating current is often utilized for electric power distribution since it offers considerable benefits over direct current in terms of transmission and transformation. One of the most significant benefits of DC power is its versatility in application. DC electricity is utilized when AC power transmission is neither practical nor practicable across long distances. Subsea high voltage DC transmission cables are one such use. Electricity is generated in AC form, changed to DC at a switching/terminal station, transported through a subsea network of cables, re-converted to AC at another terminal station, and then supplied to consumers[5].

According to the World Energy Outlook 2015, approximately 17% of the global population need access to electricity at home. According to the International Energy Agency, India has a population of about 237 million people [6]. According to the CEEW (Council for Energy, Environment and Water), despite being lattice-connected, more over half of the homes in West Bengal, Bihar, Madhya Pradesh, Uttar Pradesh, and Jharkhand lack electricity.

Despite efforts over the years to charge rural regions, many family units in five of these six states have no stockpile of more than 8 hours or no inventory at all, and are reliant on power disruptions on a frequent basis. The majority of these homes relied on lamp oil for illumination. Which results in hopeless illumination. It also transports hazardous emissions, which may create fire hazards. Petroleum goods and traditional energy age methods are rapidly losing income in the energy creation market, as governments across the world emphasize the effects of global temperature change and environmental change.

To meet the globe's continuously increasing energy demand, the world is moving toward ecologically friendly electricity energy. The abundance of sunlight-based radiation and decreasing prices of photovoltaic segments make it easier to maintain and adapt, making solar-powered PV a more common source of sustainable energy. Despite the fact that the sun shines brightly for up to 10 to 12 hours every day for the bulk of the year in various parts of the country. The enormous power of transmitted sunlight-based force has not been extensively used.

The power deficit may be bridged by using sun-based energy in areas that get more than 1,400 typical peak hours of daylight each year. The Government of India has become aware of these facts and is increasing the use of sustainable power sources, particularly solar focused energy, to cover the country's supply gap. This activity has prompted researchers to look into and enhance low-voltage DC systems, which are suitable for private applications and can be easily coordinated with renewable energy sources and capacity grids [7].

Expanded interest in the combination of environmentally friendly power assets returns DC to the energy circulation grid, owing to the fact that it is far from difficult to coordinate inexhaustible sources into the lattice in such conditions [8]. Following that, a variety of tests on dc appropriation grids and their potential usage in private applications were carried out. Furthermore, the overwhelming majority of renewable energy sources provide DC electricity. In order to go to the end client, it will change over in AC.

However, the bulk of the gadgets operate on DC current, therefore it will switch back to DC to provide capacity to these devices. As a consequence of these many transformations, the intensity grid's competence will deteriorate. So, here is a review of the current model, as well as the suggested model and type of DC grid, to address the problem of transformation losses and to increase the productivity of sustainable power sources, so that expansion power demands can be met by using the best supply strategy [9].

Benefits of DC Grid over AC Grid

The benefits of a DC-lattice grid in a circulation grid may be explained in two ways. The first is the intensity of intensity and quality measurement, and the second is the monetary and ecological perspective, as outlined below.

1.1 Stability of intensity and the quality measurement: To maintain the force supply's dependability, both voltage and recurrence should be monitored and regulated in the AC grid. In any event, in the DC-matrix grid, there are no receptive force communications, thus the organization guideline is voltage-arranged as it were [10]. Both voltage and recurrence should be checked and controlled in the AC grid to preserve the force supply's dependability.

In any case, since there are no receptive force communications in the DC-matrix grid, the organization guideline is voltage-arranged [11]. To address this problem, the symphonious channels were earlier developed, followed by a wide presentation of the stage moving transformer. As a result, the grid's cost rises. By the way, moving the AC to a constant voltage in the DC-matrix grid isn't feasible, and the rectifier section in the DC network grid may be removed as a result [9]. To conclude, as compared to the AC-lattice grid, the DC-network grid has the following preferences for electricity soundness and quality.

- Unaffected by responding force (expanded force soundness).
- Not prone to recurrence (simple force synchronization).
- Appropriation of DC power (decreasing symphonious mutilations and expanding power quality).

1.2 Economic and Environmental Aspect:

The generator and neat mover combination will operate on a fixed recurrence of 50 or 60 Hz in the AC grid. By and large, the generator and center player set's actual fuel oil consumption varies depending on its heap and is designed to increase about 75–85 percent of the heap factor. When the engine is operating at a low load, the amount of real fuel oil used increases. By the way, in the DC-network grid, generator and central player sets will operate at different frequencies, allowing for a larger operating window while still being environmentally friendly. It is estimated that the DC-matrix grid would reduce fuel use and pollution by up to 20%.

1.3 Other bit of leeway:

In contrast to AC, it is also easier to transfer power in a DC structure via a transmission line because current flows on the outside of the wire in a DC structure, while in an AC construction, current flows within the wire. As a result, power losses increase in AC matrix due to conductor resistance, as opposed to DC lattice [12].

Types of DC Grid

- *Smart-Grid*: In a circulation network, a smart grid is a two-path stream of intensity and data. Smart-lattice use will reduce the penetration of environmentally friendly power sources.
- *Micro-grid*: A little grid is a shrewd matrix's construction square. It has a power output range of a few hundred KW to a few MW. This grid reduces the amount of electricity that is distributed.
- *Nano-Grid:* Nano-Grids are tiny network building cells. DC In a dispersed way, nano grids work. It can generate HV-DC for circulation (around 1kv or approximately).
- *Mini-Grid:* For electricity under 11 KW, a DC small grid is used. It is used to provide basic energy management, such as lights and mobile phone charging.

2. LITERATURE REVIEW

To maintain the force supply's dependability, both voltage and recurrence should be monitored and regulated in the AC grid. In any event, in the DC-matrix grid, there are no receptive force communications, therefore the organization guideline is voltage-arranged. In comparison to the AC-lattice, the DC-grid has the benefit of ensuring consistent power quality [9].

3. DISCUSSION

Nowadays, alternating current is often used for electric power distribution because it has significant transmission and transformation advantages over direct current. One of the most important advantages of DC power is its application flexibility. When AC power transmission is not feasible nor practicable across long distances, DC energy is used. One example is the usage of subsea high voltage DC transmission cables. Electricity is produced in AC form, converted to DC at a switching/terminal station, transmitted through a subsea network of cables, re-converted to AC at another terminal station, and finally distributed to customers.

According to the World Energy Outlook 2015, about 17% of the world's population need residential power. India has a population of approximately 237 million people, according to the International Energy Agency. Despite being lattice-connected, more over half of the houses in West Bengal, Bihar, Madhya Pradesh, Uttar Pradesh, and Jharkhand lack electricity, according to the CEEW (Council for Energy, Environment, and Water).

Despite years of attempts to charge rural areas, many family units in five of these six states have little more than an 8-hour stockpile or no inventory at all, and are dependent on power outages on a regular basis. Lamp oil was used to light the majority of these houses. As a consequence, the lighting is hopeless. It also carries dangerous pollutants that may cause fires. As governments across the globe stress the consequences of global temperature change and environmental change, petroleum products and conventional energy age techniques are quickly losing market share in the energy creation industry.

To satisfy the world's ever-increasing energy demand, the world is turning to environmentally friendly power. Solar-powered PV is becoming a more popular form of sustainable energy due to the availability of sunlight-based radiation and falling costs of photovoltaic components, making it simpler to maintain and adapt. Despite the fact that for the most of the year, the sun shines brilliantly for up to 10 to 12 hours per day in different areas of the nation. The immense strength of transmitted sunlight-based force has not been used to its full potential.

In locations with more than 1,400 average peak hours of daylight per year, the power gap may be filled by utilizing solar-based energy. To close the country's supply deficit, the Indian government has become aware of these realities and is expanding the usage of sustainable power sources, especially solar concentrated energy. Researchers have been inspired by this effort to investigate and improve low-voltage DC systems, which are appropriate for private applications and can easily be coordinated with renewable energy sources and capacity grids.

Due to the fact that it is far from difficult to coordinate inexhaustible sources into the lattice in such circumstances, increased interest in the combination of environmentally friendly power assets returns DC to the energy circulation system. Following that, a number of experiments were conducted out on dc appropriation grids and their prospective use in private applications. Furthermore, DC power is produced by the vast majority of renewable energy sources. It will shift over to AC in order to reach the end customer.

4. CONCLUSION

This article presented a paradigm for DC-grid deployment in a power distribution system. This grid may demonstrate the benefits of a DC grid over conventional AC grids, with the ultimate benefit of eliminating numerous conversions from DC to AC or vice versa throughout supply transmission and distribution from the source to the consumer. The issue of rising energy consumption will be solved by expanding the usage of renewable sources for electricity generation and transferring this power in the form of DC. Installing a micro grid or Nano grid in these locations and delivering power directly to the load in the form of DC solves the issue of supplying energy to isolated locations. When compared to alternate current, it is simpler to provide electricity in the form of direct current. It is possible to save 20 to 25% of energy by implementing a DC grid. It will also lower the power tariff.

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