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A Review on Hybrid Storage System in DC Microgrid

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Abstract: *The fast depletion of fossil fuels and the growing awareness of the need for environmental protection have led us to the energy crisis. Since the past decade, scientists have worked together to make positive progress. For example, renewable energy (RES) is being implemented in the power system to satisfy the energy need Distributed energy resources (DERs), energy storage systems (ESSs), and loads are all linked together in a microgrid (AC or DC). Microgrids powered by DC are highly regarded because of their efficiency and durability. In spite of its rapid expansion, the DC microgrid's grid design and control methods are still relatively novel.*

Keywords: *DC microgrid; energy management system (EMS); renewable energy sources (RES); distributed generators (DG).*

1. Introduction

As the global population grows, so does the need for energy on a worldwide scale. Renewable energy sources have seen a significant increase in development in recent decades. Large-scale deployment of renewable energy technology has occurred in several nations. RES, such as photovoltaic (PV) and wind energy, play a vital part in clean energy generation, therefore the notion of a microgrid is proposed to combat environmental depletion. The dependability (physical and cyber), sustainability (environmental concerns), and economic advantages of microgrid systems have been established (cost optimizing, efficiency).
Figure 1 displays the schematics of the microgrid architecture simulated in this study.

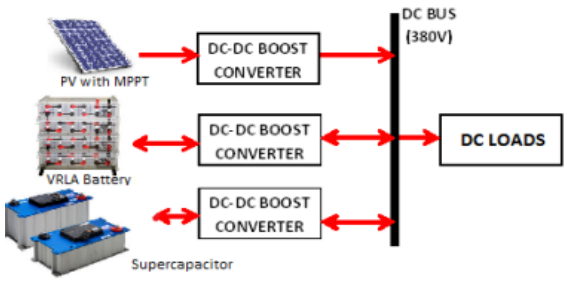

Figure 1: Microgrid architecture

In the modern microgrid idea, distributed energy resources (DERs), controlled loads such as residential consumption or electric vehicles, and different kinds of storage like batteries, supercapacitors, or flywheels comprise the core. The fact that microgrids may run both independently and in conjunction with the main grid through a point of common coupling (PCC) creates various issues when managing them. Any form of operation must be able to maintain a stable frequency and voltage, distribute the load across DGs and storage, manage flow with the network main, and reduce operating costs. In the event of major disruptions or failures, the microgrid will transition to isolated mode and must deliver power to important loads, and the control system must manage frequency and voltage in this circumstance.

1.1 Modeling of Storage Devices

Fig. 2 depicts the DC Microgrid's overall design. Various power conditioning units link a DC bus (at 380V) to distributed renewable energy sources like PV, wind, and so on, as well as energy storage devices like batteries and SC banks. The DC bus is also used to link the DC loads.
Between the uses of DC-AC converters, the microgrid may exchange electricity with the main utility grid and the microgrid itself. Microgrid essential loads are provided by distributed energy resources (DERs) and energy storage

systems (ESS) while operating in an isolated or islanded mode

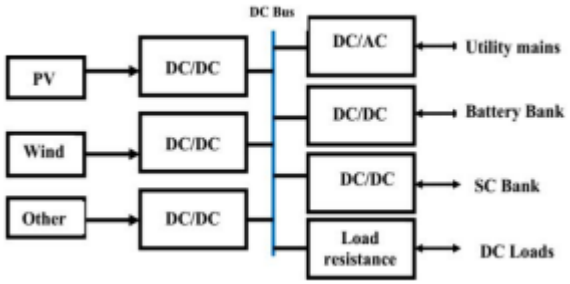

Figure 2: General schematic diagram of a DC Microgrid System

1.2 Hybrid DC Microgrid System

Fig. shows the "Hybrid DC micro grid system with Photo Voltaic Array." Distributed renewable energy sources, such as solar PV and wind turbines, and energy storage devices, such as batteries and SC banks, are the key components of this system. A DC bus connects them together (at 115V). Also, all of the DC loads are plugged into the DC bus.
It is possible for the microgrid to interchange electricity with the main utility grid through a DC bus and DC-AC power conditioning equipment. The important loads in the microgrid are supplied by the DERs and storage devices in isolated or islanded mode, with no connectivity to the grid.

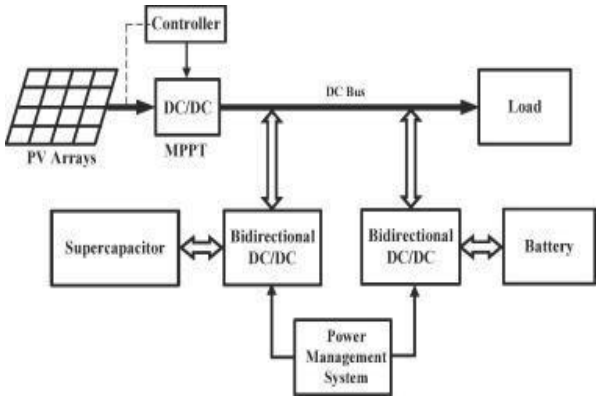

Figure 3: System of hybrid DC micro grid system with Photo Voltaic Array

2. Literature Review

P. Garcia, L. Fernandez, and F. Jurado, J. Torreglosaet.al. [1] this paper shows a hybrid power train primarily based on gasoline mobile (FC), battery, and super capacitor (SC) for the "Urbos 3" tramway, which presently operates through SC within the metropolis of Zaragoza, Spain. Due to the dynamic obstacles of the principal strength supply, a proton- change-membrane (PEM) FC, exclusive elctricity secondary sources (ESSs), battery and SC, are needed to supply the auto strength. Also, these electricity resources allow the power recuperation at some stage in regenerative braking.

S. Rael, or B. Davat, P. Thounthong et. al. [2] this paper offers flatness manages set of regulations for DC hybrid electricity being applied in electric powered car (EV). The studied hybrid model is composed of PEM gasoline unit and super capacitor. The load is installed along the DC link.

G. V. Merrett, T. J. Kaczmarski, or B. M. Al-Hashimi, A. S. Weddell et, al. [3] Super capacitors are often utilized in electricity harvesting a sensor node (EH-WSNs) to preserve harvested energy. Until now, research into the usage of super capacitors in EH-WSNs has been taken into consideration for them to be ideal or over simply wireless, with non-ideal conduct attributed to leakage currents. This paper also displays that observation that were previously attributed to leakage currents are predominantly because of redistribution of charge within the super capacitor.

Bajpai, Prabodh & Dash, Vaishalee, 2012 et.al.[4] it has become imperative for the power and energy engineers to look out for the renewable energy sources such as sun, wind, geothermal, ocean and biomass as sustainable, cost-effective and environment friendly alternatives for conventional energy sources. In the past few years, a lot of research has taken place in the design, optimization, operation and control of the renewable hybrid energy systems. It is indeed evident that this area is still emerging and has vast scope. This paper reviews the research on the unit sizing, optimization, energy management and modelling of the hybrid renewable energy system components.

S. Sinha, A. K. Sinha and P. Bajpai et.al. [5] Hybrid storage devices are used in microgrids to provide power backup solutions when the distributed energy resources (DERs) are unable to supply the load demands. Combination of battery and super capacitor (SC) banks provide an appropriate hybrid storage solution. This paper presents a comparative study of charging and discharging process of both battery and SC banks and hence depicts their application areas in a DC microgrid. Also, the rate of charge-discharge and its control to prevent over charging or under-discharging of the storage devices is also presented here.

S. Armstrong, and W. G. Hurley, M. E. Glavin, P. K. W. Chan et.al. [6] Most of the stand-on photovoltaic structures require a strength garage buffer to supply non-stop power. Normally, Valve Regulated Lead Acid (VRLA) batteries are used for this. But, offering a massive burst off, along with motor start up, degrades battery plates, resulting in destruction of the battery. An alternative way of supplying massive bursts off current is to combine VRLA batteries and super capacitors to form a hybrid storage tool, in which the battery can supply non-stop electricity and the super capacitor can deliver the proper electricity to the load. This paper proposes the function of the super capacitor in a PV strength manage unit.

P. Koseeyaporn, P. Thounthong, A. Luksanasakul, B. Davat et.al [7] A renewable energy hybrid energy plant, fed via photovoltaic (PV) and gasoline cell (FC) sources with a super capacitor (SC) storage tool that is suitable for allotted era programs, is proposed herein. The PV is used for delivery, the FC acts as a backup and the SC competencies as an auxiliary supply and a brief-time period storage device for offering the deficiency energy from the PV and the FC.
N.C. Voulgaris, E. Koutroulis, K. Kalaitzakis et. al. [8] MPPT is utilized in photovoltaic structures to maximize the photovoltaic array output energy irrespective of the temperature and irradiation situations and of the electric load trends. A brand new MPPT device has been advanced along with a dollar-type DC-DC converter which is controlled with the aid of a microcontroller-based totally unit. The principal difference between the method used inside the proposed MPPT system and other techniques used is that the PV array output electricity is used without delay to manage the DC-DC converter, thereby reducing the complexity of the gadget. The resulting device has high-performance, lower cost etc.

3. Conclusion

Developing new equipment, modelling current equipment, and using enhanced heuristic algorithms for optimum storage and generator planning are all key components of this field. In order to optimize the hybrid grid system for future demands, it is also necessary to bear in mind the high integration of DC generators, non-linear loads, and plugin hybrid automobiles. An investigation into how to better manage DC microgrid power by integrating it with an AC main grid or hybrid system may be conducted based on the aforementioned scholarly work.
It is important to thoroughly examine the various microgrids functioning in a hybrid microgrid environment in order to determine the best power management and control solutions. In addition, it provides suggestions for further study in this area.

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