ISSN: 2581-3404 (Online)
International Journal of Innovative Research in Technology and Management, Vol-4, Issue-6, 2020.

A Survey on stability Analysis of Hybrid Storage System in DC Microgrid

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ABSTRACT

This paper deals with the design and stability analysis of a DC microgrid employing battery-super capacitor based hybrid energy storage system. Standalone photovoltaic-based microgrid with energy storage system could be a promising solution for powering up off-grid communities. One of the major issues that hinder the development of standalone microgrid is the poor service life of the batteries. A standalone DC micro grid system is introduced with photo voltaic array feeding the load. A supportive source using battery energy storage system is connected in parallel for power injection during no irradiation or low irradiation conditions. The power from the PVA and battery are shared by the load during all irradiation levels. For sudden load change conditions, a super capacitor is also connected to ensure maintenance of DC voltage amplitude.

Keywords: PV Array, DC to DC converter, Battery, Super-capacitor, MPPT.

Introduction

An intensive research in the neighbourhood of variable-speed AC drives has been carried out over the last four decades. For an extended time, the stress of the analysis has been placed on the motor electrical converter and its management, whereas the AC to DC rectification has been accomplished by associated degree uncontrollable diode rectifier or a line commutated section-controlled thyristor bridge.

Though each these converter converters supply high dependability and easy structure they even have major inherent drawbacks. The output voltage of the diode rectifier can't be controlled and also the power flow is simplex also, the information current of the diode rectifier incorporates a nearly high bending. By overwhelming the terminating edge, the DC voltage of the Thyristor Bridge is frequently directed. Additionally, control be expected the DC feature to the AC aspect is doable, anyway because of the extremity of the DC voltage ought to be switched for this to happen, a thruster connect isn't a proper rectifier for applications wherever a snappy unique reaction is required. Truth be told, the DC voltage extremity revision isn't permitted in light of the electrolytic capacitors for the most part utilized in the DC connection of a voltage supply gadget. By interfacing two thyristor spans ant parallel, bidirectional power stream is likely without DC voltage extremity inversion, be that as it may, thus, the quantity of the power switches is multiplied. Furthermore, the power factor of the thyristor connect rectifier diminishes when the terminating edge increments and the line current twisting can be a much more terrible issue than that of the diode rectifier.

Accompanied by the previous twenty years the enthusiasm for amending units has been rapidly developing in the principle the expanding worry of the electrical utilities and complete clients

concerning the adapted Contamination in the power framework. As a result, pulse width-modulated(PWM)rectifiers are of explicit interest and that they became engaging particularly in industrial variable speed drive application within the power vary from one or two of kilo watts up to many megawatts. This is partly due to the reduced costs and improved performance of both the power and control electronics components but most of all due to the numerous benefits the using of the PWM rectifiers offers.

There has been a requirement to regulate disturbances to the provision network virtually since it had been initial made within the late nineteenth century the primary of these was British Lighting Clauses Act of 1899 that kept uncontrolled curve lights from causing flash on radiant lights. With the development of gear at interims the 1970's, it ended up important to deal with the unsettling influences caused by this expanding instrumentation. The development of customer physical science has implied that the normal home contains an excess of mains driven electronic gadgets and not just televisions. Continually these electronic gadgets have mains correction circuits that is existing purpose for mains consonant twisting. most up to date electrical and electronic hardware utilize some sort of air conditioning to dc control supply among their plan and it's these provisions that draw beats of current from the air conditioner organize all through each 0.5cycle give waveform.

Power from constant offer part leading to a big quantity of reactive current flow and generation of harmonics. Power electronic converters have become a lot of common in industrial and residential applications for reducing size and weight, likewise as for increasing performance and practicality. The domestic tariff meters do not notice this reactive current and also the match between the ability generated which used ends up in a loss of revenue to the utilities.
What is more 3-stage unbalance can be made among accommodation them entirely unexpected avenues territory unit supply on various stages. The unbalance current streams inside impartial line of a star arrangement exacting warming and in extraordinary cases cause give away of the conductor. Additionally, the receptive current shows itself as contortion of the voltage wave type of the air conditioner supply. the symphonious substance of the beating current causes more misfortunes and insulator worries in capacitors and links, expanding streams in windings of pivoting hardware and transformers and disorder emanations in numerous item, and exchange concerning early disappointment of wires and totally extraordinary good segment.

Current controlled pulse dimension modulated (PWM) inverters square measure rather more common as a result of their smart dynamic response Since most of the applications for voltage-source pulse dimension modulated (PWM) inverters have an effect control structure involving an inside current feedback circuit, their performance depends on the standards of the applied current management technique. As a result, the present management techniques for PWM voltage supply inverters square measure one of the main areas of analysis in modern power physical science. in comparison with typical open-loop PWM voltage supply inverters (VSI), current-controlled PWM inverters have the advantages of very sensible dynamics, overload rejection, peak current protection, management of the fast current waveforms, high accuracy, compensation because of impacts stack parameter changes, remuneration of the semiconductor voltage drops and dead time of the converters, pay of the dc-connection and air conditioning side voltage changes, etc.

The widely used renewable sources of power in a microgrid are namely solar energy from photovoltaic cells and wind energy from wind harvesting farms. However, these natural sources are intermittent in nature. Their unreliability and fluctuating behaviour necessitate the use of storage devices. Using storage devices like battery and supercapacitor banks ensure that power supply is available to the loads even when the renewable sources are not available. Battery banks provide

long term power back up. Supercapacitors are more useful in supplying short-term high-power surges. Thus, batteries have high energy densities while SCs have a high-power density [1]. Hybrid storage in a microgrid refers to the use of battery and SC together, to provide power backup. The batteries are used in providing the base load while sudden power surges are fed from supercapacitors. These hybrid energy storage systems help to lower the battery cost and improves the overall system efficiency [2],[3]. Battery and SC have widely different characteristics and thus a microgrid needs to be supported by both these storage devices as the base load is fed by the battery and transient power requirements are met by the SC.

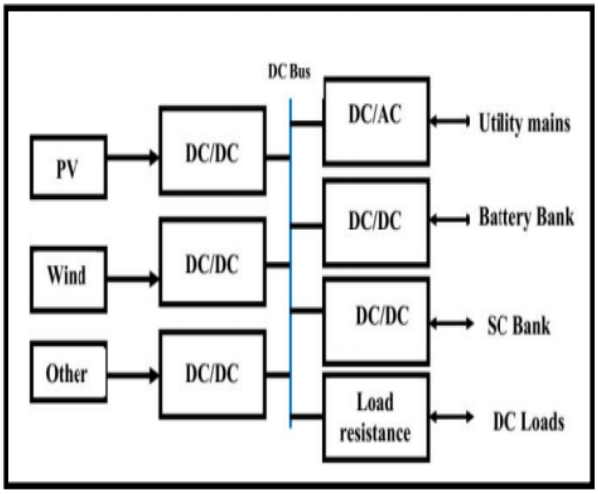

Fig.1: General Block diagram of a DC Microgrid System.

Literature Review

Here presents the literature review of various types of hybrid storage system in DC microgrid system, as well as existing approaches of energy management system. The benefits and limitations of these existing approaches are also explored and compared.

P. Garcia, L. Fernandez, and F. Jurado, J. Torreglosa et.al. [1] in this paper evaluates a hybrid powertrain primarily based on gasoline mobile (FC), battery, and supercapacitor (SC) for the "Urbos 3" tramway, which presently operates powered thru SC within the metropolis of Zaragoza, Spain. because of the dynamic obstacles of the principal strength supply, a proton-change-membrane (PEM) FC, exclusive electricity secondary sources (ESSs), battery and SC, are needed to supply the auto strength name for. moreover, those electricity resources allow the power recuperation at some stage in regenerative braking. S. Rael, or B. Davat, P. Thounthong et. al. [2] in this paper offers a flatness manage set of regulations for a DC hybrid electricity belonging applied in electric powered car (EV). The studied hybrid belongings is composed thru way of both electric powered property, the number one one is PEM gasoline mobile as the number one assets, and the second is supercapacitors %. considered because the auxiliary source. the load is installation immediately inside the DC link. The manipulate algorithm is primarily based on the flatness houses of the device. G. V. Merrett, T. J. Kaczmarski, or B. M. Al-Hashimi, A. S. Weddell et, al. [3] Supercapacitors are often utilized in electricity harvesting a sensor node (EH-WSNs) to preserve harvested energy. until now, research into the usage of supercapacitors in EH-WSNs has taken into consideration them to be ideal or oversimpliwirelessed, with non-ideal conduct attributed to leakage currents. in this quick, we display that observations previously attributed to leakage are predominantly because of redistribution of charge within the supercapacitor 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. However, the non-availability of these renewable energy resources all the time throughout the year has led to research in the area of hybrid renewable energy systems. 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. 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 supercapacitor (SC) banks provide an appropriate hybrid storage solution. The objective of this paper is to present a comparative study of charging and discharging process of both battery and SC banks and hence understand 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 presented here. S. Armstrong, and W. G. Hurley, M. E. Glavin, P. K. W. Chan et.al. [6] maximum of the stand-on my own photovoltaic (PV) structures require a strength garage buffer to supply non-stop power to the weight on the identical time as there's inadequate sun irradiation. generally, Valve Regulated Lead Acid (VRLA) batteries are carried out for this software program. but, offering a massive burst of, together with motor startup, from the battery degrades battery plates, resulting in destruction of the battery. P. Koseeyaporn, P. Thounthong, A. Luksanasakul, B. Davat et.al [8] A renewable energy hybrid energy plant, fed via photovoltaic (PV) and gasoline cell (FC) sources with a supercapacitor (SC) storage tool and suitable for allotted era programs, is proposed herein. The PV is used because the number one deliver; the FC acts as a backup, feeding best the insufficiency power (ordinary-nation) from the PV; and the SC competencies as an auxiliary supply and a brief-time period storage device for offering the deficiency energy (transient and consistent-united states of america of the us) from the PV and the FC. For immoderate-electricity packages and optimization in energy converters, 4-section parallel converters are applied for the FC converter, the PV converter, and the SC converter, respectively.

N.C. Voulgaris, E. Koutroulis, K. Kalaitzakis et. al. [12] most energy issue tracking (MPPT) is utilized in photovoltaic (PV) structures to maximize the photovoltaic array output energy, no matter the temperature and irradiation situations and of the load electric trends. a brand new MPPT device has been advanced, together with a dollar-type DC/DC converter, this is controlled with the aid of the usage of a microcontroller-based totally unit.

Proposed Methodology

The proposed system of Hybrid DC micro grid system with Photo Voltaic Array is shown in Fig. 2 It consists of distributed renewable energy sources like PV, wind etc. and storage devices like battery and SC banks connected to a DC bus via various power conditioning units. The DC loads are also connected to the DC bus.

The main utility grid is connected to the DC bus via DC-AC power conditioning units and allows the microgrid to exchange power back to and from the grid. In isolated or islanded mode, the grid connection to the microgrid is absent and critical loads in the microgrid are supplied by the DERs and storage devices.

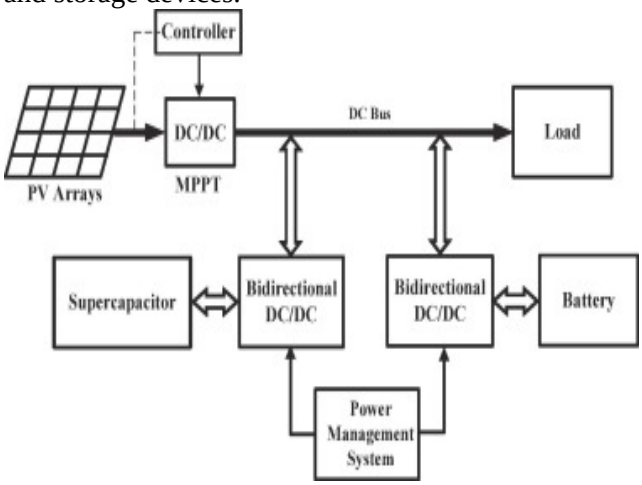

Fig. 2: Proposed System of hybrid DC micro grid system with Photo Voltaic Array.

A. PV array:

A photovoltaic (PV) system is able to supply electric energy to a given load by directly converting solar energy through the photovoltaic effect. The system structure is very flexible. PV modules are the main building blocks; these can be arranged into arrays to increase electric energy production. Normally additional equipment is necessary in order to transform energy into a useful form or store energy for future use. The resulting system will therefore be determined by the energy needs (or loads) in a particular application

In a PV system the energy produced by PV modules does not always coincide with energy demanded. A PV array that it is not grid-connected needs to store the energy excess produced by solar cells. Electrical storage batteries are often employed in Stand Alone PV systems.

B. Battery:
These are most commonly used to store energy in stand-alone applications for use at times when no irradiance is available (e.g., night, rainy day). Batteries are also used for a diverse number of applications including stand-by power and utility interactive schemes. PV batteries require tolerance to deep discharges and irregular charging patterns. Some applications may require the batteries to remain at a random state of charge for a prolonged time. The most common technology used in PV systems is the lithium-ion battery Lithium-ion batteries are chosen as storage devices in a microgrid due to their low maintenance requirements. Battery banks have a high energy density and are good options for long term power supply.

C. Super Capacitor:
Supercapacitor is a charge storage device which stores electrical charge via electrochemical and electrostatic processes. Due to their benefits as mentioned below, they have potential to replace or complement traditional batteries and capacitors in various applications. They are being used worldwide in various applications for automotive, consumer electronics, renewable energy, railways, defense, power industries etc. It is also known as ultracapacitor. Supercapacitors are high-capacity electrolytic capacitors which serve as energy storage devices in microgrids. Their charging control scheme may be divided into three possible modes: constant current, constant voltage and constant power.

Conclusion
An attempt is made to portray the information available in the literature presented by different authors. This paper gives knowledge on the hybrid system by knowing the importance of renewables and challenges facing.In this paper, we have studied the SC and battery bank models and their charge controllers indicate that the battery bank is far more suitable to provide power over a long time period. in this paper only the comparison between the storage devices and their application is discussed. The power balance between the devices and design of suitable control scheme to determine the amount of power to be supplied by the SC is yet to be explored. Also, the integration of other renewable sources to the microgrid and application and control of these storage devices in such a grid is an area of future study.

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