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SMART MICROGRID SYSTEM.

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Abstract.DC microgrids play an important role in power consumption in remote areas such as power supply to off-grid communication towers, off-grid data centers, power supply in rural areas etc. and moreover these are widely used, as these are seen as two or more integration solutions. renewable energy resources. In this paper, photovoltaic (PV) and wind energy systems are integrated with batteries and the load to make a DC microgrid standalone with high reliability and stability. Key features to consider in a DC microgrid representing power control, load sharing and battery management. In this paper, a power management strategy is proposed that combines high point-tracking algorithms (MPPT) with a power supply control method. This strategy ensures power distribution between resources and increases the reliability and stability of a small grid profile. The performance of microgrids in different ways and the behavior of the system in different operating conditions is studied by changing the radiance of the sun and the wind speed from time to time. Simulation is done with Matlab Simulink software and results are available.

KEYWORDS: SOLAR ENERGY, WIND ENERGY, MICROGRID, PV CELL, MPPT.

I. INTRODUCTION

The DC / DC converter is the main power outlet for these renewable (DC) renewable energy sources such as solar photovoltaic (PV) module, wind turbineand fuel celletc. The reason for using DC / DC boost converter is this PV power case for two reasons. First, the maximum output voltages of PV modules in standard test (STC) mode are low in range from 30 to 45 volts. Second, DC voltages are considered normal by companies such as the Emerge-alliance for lighting systems in the green energy building. The compatibility of DC / DC converters for converter facilitates the integration of various power from these converters connected to different PV power modules under different radiation and control of 48 volts DC in the loading area. To obtain the combined power from the same DC converters, this paper proposes a systematic approach to power distribution between converters under various irradiance.

The concept of microgrid gets more attention as a result increased penetration of renewable energy sources (RES) as well

barriers to power transmission capacity, losses in the rate of transmission and distribution of long distances power transmission [1]. Microgrids allow production near the end of the load increases the quality of power and reliability (PQR) provided electricity. RES can be greatly reduced the need to expand existing traditional transfers programs. Coordinating and controlling large RES numbers in the system creates a lot of difficulty from security as well work viewing area. Microgrid provides an attractive solution for effective integration for RES and reduce the regulatory load of RES on the service grid by to get the full benefits of RES. The RES covers a variety other forms of power generation such as wind, solar, hydro and fuel cell etc. Increased demand for electricity as well environmental concerns are the main drivers behind acceptance of RES generating electricity. Energy from the sun it is now used in days and is becoming one of the most versatile outstanding and promising form of RES. From the output Solar PV energy remains isolated from the Energy environment storage system (ESS) is required to minimize compression disruption of the PV solar power system. Many stages of power conversion are required integration of dc-inherent system into traditional AC service grid. Mainly ESS used with Solar PV systems such as batteries, ultra-capacitors etc. is not a natural dc. Bangu many dc-related loads such as communication systems, counting devices, LEDs, etc. they get more attention now days. For the reasons mentioned above small DC grids they provide an attractive solution with high DC input compatible energy sources, storage and loads and require less the number of stages of power conversion. There are many DC microgrid applications are available as a data center, accommodation applications, electric car etc. DC microgrid The system offers about 10-20% maximum efficiency AC systems. In addition, dc systems are very reliable due to reduced power conversion phases. In the case of DC systems power transmission cables are used most effectively for lack of active energy flow. In India, however, many homes do not have access to them electricity and some disrupted low electricity levels Power supply. Research by the Council for Energy, Environment, Water (CEEW) with six regions (Bihar, Jharkhand, Madhya Pradesh, Uttar Pradesh, West Bengal, and Odisha) and concluded that about 50% of houses do not have electricity despite having a grid connection [2].Thousands of villages in various provinces have been electrified ten years ago under local government electrification program and more than 85% of households out of five in six provinces are considered to be without or without electricity electricity less than 8 hours and a maximum load of 50 W. Other the provinces have a better situation than this but the people have less income also has a negative impact on power [3-4]. These challenges require new technology and development methods. Another option would be the adoption of a solar novel as well energy storage technology integrated with DC microgrid in low- and middle-income homes. Electrical authorities many states such as Uttar Pradesh authorities use 24 V Solar powered DC microgrid for lighting loads [4]. Many problems can be reduced with a DC microgrid with solar PV and family battery storage with access to the grid provide but you have a problem of power outages for many hours. Another advantage this is very expensive for houses outside the grid. One important function in DC power microgrids managers. Since Solar PV is not available at night, ESS is available.

II. REVIEW OF DC& HYBRID MICROGRIDS

Thepaper [1] “Research on Virtual Inductive Control Strategy for Direct Current Microgrid with Constant Power Loads”, was written by Zhiping Cheng, Authors of the School of Electrical Engineering, Zhengzhou University, China. Aimed at improving the stability of DC microgrids with constant power loads, the paper introduces a new practical approach to teaching. Also, it is known that the negative aspect of permanent power outages will lead to fluctuations in the DC power supply. A simplified circuit system model was obtained for analysis by distributing resources. Unlike existing control strategies, the proposed control creates a negative input link that helps to combat the negative effects of the inductive line between the power source and the transmission line. Detailed comparisons of the proposed control functions and visual effects were performed with the MATLAB / Simulink simulation. Improved efficiency of the proposed control strategy has also been confirmed by more detailed studies and the results obtained indicate the feasibility of the proposed method.

Thepaper [2], “Development of the Island-Based Denial Procedure for Denial of Multi-Photovoltaic Operation”, by Thanh Son Tran, From the School of Engineering and Science and Department of Electrical Engineering, Shibaura Institute of Technology, Tokyo, Japan and the Department of Energy System, Hanoi University of Science and Technology, Hanoi, Vietnam. This paper discusses the phenomenon of the island phenomenon, which is one of the effects of the emergence and development of microgrids in the energy system. A common problem of frequently distributed generation (especially when using more renewable energy sources, such as the multi-photovoltaic sources mentioned in this paper) is the cancellation of injectable signals, which has a significant impact on effective ways of finding an island. This paper visualizes the issue by injecting signal interference into a multi-photovoltaic system. A confirmed solution for the cancellation of the injected signal was also proposed in the manuscript and confirmed by mathematical descriptions and simulations.

The Paper [3] , “Insulation Monitoring Method for DC Systems with Ground Capacity in Electric Vehicles”, was written by Jifei Du , From the School of Electrical Engineering, Beijing Jiaotong University, and the National Active Distribution Network Technology Research Center (NANTEC), Beijing University Jiaotong. This paper discusses the impact of low power on electric vehicles, so that the electric power of good or bad bridges gradually changes in the traditional non-standard method of DC-insulation monitoring (DC-IM). Sampling should be done when the bridge voltage is stable, in order to calculate the resistance to installation. This will definitely extend the vigilance cycle. The paper approaches a three-point escalation algorithm to reduce the monitoring cycle. The algorithm consists of electrical samples of three bridges with equal sample intervals, predicting the emergence of a bridge voltage curve. Resistance to input samples calculated at sample values will be based on actual values due to the effect of sample errors. The paper also suggests a method to solve the problem. Test data shows the effect of different parameters on the results and make comparisons with the standard method. Compared to the state of the art, the applied process can monitor resistance to instantaneous insulation and can ensure consistent monitoring cycles under different ground capacitance values, while maintaining the same monitoring accuracy.

The paper [4], "Improved Forest Microgrids Control with Hybrid Complementary Energy Storage", by Ming Yu. And comes from China, mainly from the School of Technology, Beijing Forestry University. This paper proposes a comprehensive integrated approach to energy storage management to improve energy quality and the ability to erroneously navigate the island's forest microgrid. On paper, integrated phase-based controls are adopted as the basic control system, while mixed-storage power management uses an advanced strategy. The hybrid energy storage system consists of a battery and a supercapacitor connected to the underlying wind turbine system. Given the different features of power storage units, flexible battery and supercapacitor controls are adopted on paper to smooth long-term low-frequency fluctuations and compress the high-frequency segment separately. It should be noted that predictable control of converters is adopted to achieve faster control. The wind energy unit is also investigated as a third energy storage unit. The concept involves using a large rotating force of the wind turbine kinetic to temporarily suppress large power disturbances and to avoid power outages. The paper demonstrates the imitation of a DC microgrid located on an island in forest environments, developed by MATLAB / Simulink, to ensure the efficient operation of the proposed communications control through integrated energy storage. The results obtained show that the operational features of the system were successfully developed using an improved control system.

The Paper [5], “AC / DC Distribution Network Planning Problem: Genetic-Ant Colony Hybrid Algorithm Approach”, by Deyang Yin et al. graduates from the School of Electrical Engineering, University of the Southeast, Nanjing, China and the College of Energy and Electrical Engineering, University of Hohai, Nanjing, China. The paper discusses the topic of editing problem of broadcast generators (DG) accessing the AC / DC distribution network. The paper introduces a site and a DG volume model that considers a few DG costs, such as operating and maintenance costs, investment costs, system network loss costs, fuel costs, land pollution costs, and environmental protection funding. Voltage and power barriers are also considered in the model. A hybrid algorithm that combines ant colony algorithm (ACO) and genetic algorithm (GA) is proposed to resolve the presentation model, leading to the GA-ACO approach. The distribution network of the IEEE-33 node is taken as an example to ensure the basis of the proposed method and its effectiveness. Imitation results indicate that the proposed model is realistic, and the hybrid algorithm is effective in modeling, which has advantages in both the speed of assembly and the effects of mixing, when compared to single ACO and / or GA methods.

The Paper [6], “A Stability Preserving Criterion for the Management of DC Microgrids Supplied by a Floating Bus”, by D. Bosich . from Italy, from the Department of Engineering and Construction, Trieste University and Dipartimento di Elettronica, Informazione in Bioingegneria, Politecnico di Milano in Milan. One of the technologies that allows for the most important future development of microgrids is DC distribution. This is due to the easy interaction with many DC components of the modern smart grid, such as batteries, photovoltaic systems and native DC loads. The widespread use of regulated power converters raises the need for careful analysis of system stability in these power systems, as stability can be compromised in certain situations. For example, the degradation effect may occur in DC electrical systems due to the presence of inductor / capacitor (LC) filter sections that are fitted with energy quality requirements. Other stability problems may arise due to high bandwidth-controlled converters that behave as static power loads (CPLs). This issue is even more serious if the CPL is supplied only with the battery, causing the DC bus to float. An important way to study the robustness of the DC microgrid system that feeds CPLs is Lyapunov theory, which shows how the asymptotic stability (RAS) circuit decreases, as the battery charge condition decreases, and the bus power decreases. Once the accuracy of the RAS has been verified by comparing it with the actual attraction field (BA) and numerically using continuous methods, intelligent CPL power management is proposed on paper to maintain system stability, even at low bus voltage. As discussed in the paper, a well-designed condition limiting the loading capacity can ensure the flexibility of RAS and BA in each measurement area. The electric motor was also used on paper as part of a DC microgrid to check for a decrease in performance given the power limit.

The Paper [7], “Multidimensional Optimal Droop Control for DC Microgrids in Military Applications”, is written by K. J. Bunker, from the USA, from the Department of Electrical and Computer Engineering, Michigan Technological University in Houghton; Rocky Mountain Institute, Boulder; and the Department of Mechanical Engineering and Mechanical Engineering, at Michigan Technological University. This paper addresses issues of microgrid reliability when used for security applications. Droop control provides an easy option without the need for interaction between microgrid components, which increases the reliability of the control system. As discussed in the paper, a standard droop controller does not allow the microgrid to use much of the energy available from renewable solar sources, such as a photovoltaic device. The paper demonstrates the effective use of a multidimensional droop strategy for a solar-connected grid in the military surveillance to solve this problem. The paper reports the simulation and testing of hardware-in-the-loop microgrid proof of evidence to show that additional power from a solar source can be used, while keeping the bus power of the system around normal, while avoiding the need for communication between various components.

Final research paper on special emissions [8], “Rural Energy Management Strategy 'DC Micro Grid Power System Structure with Maximum Penetration of Renewable Energy Sources”, by M. Gunasekaran, Is a collaborative team with three research teams from the Department of Electrical Engineering and Technology, SRM University, Chennai, India; Faculty of Engineering, Østfold University College, Norway; and the Department of Energy Technology, University of Aalborg, Denmark. With regard to the classic AC grid with power distribution across most DC loads, DC microgrids are ideal for providing high efficiency, consistency, reliability, and load-sharing functionality, especially when connected to renewable DC and storage resources. The primary control goal of any DC microgrid is to provide an appropriate measurement of load capacity based on distributed productive sources. Due to the temporary nature of renewable energy sources, batteries play an important role in the measurement of load capacity in the DC microgrid. Advanced energy management strategies may be able to meet the demand for load, but often such strategies are not suitable for rural communities. To address this issue, the paper addresses a DC microgrid power management strategy (EMS) to provide electricity.

III. HYBRID MICROGRID SYSTEM

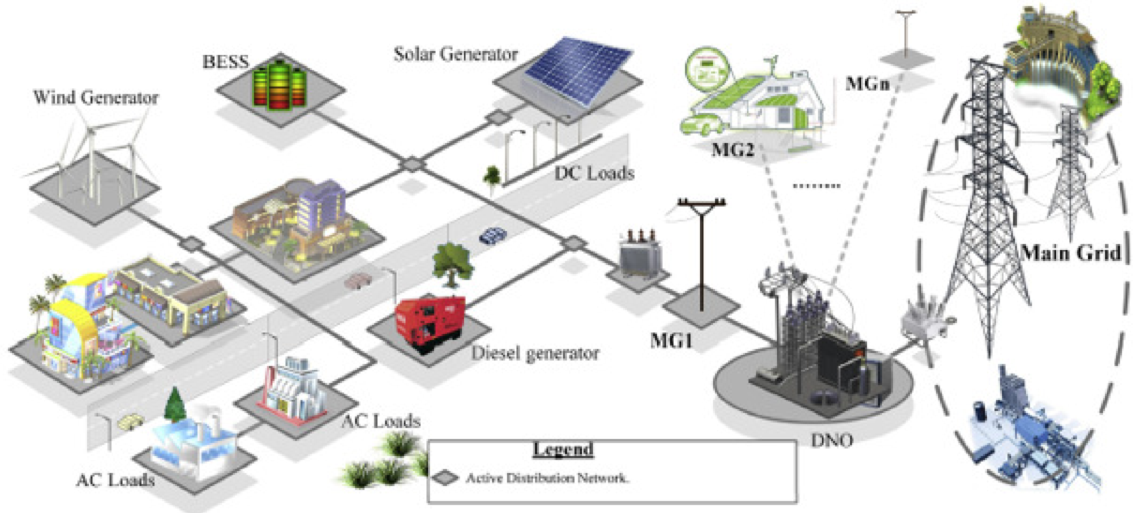

Figure: 1Hybrid Microgrids system

The Energy Management System (EMS) is a system of computer-assisted tools used by grid operators to monitor, control and improve the performance of a generation or transmission system.

Energy management is necessary to control and reduce energy consumption and this is important because it reduces costs, reduces carbon emissions and reduces risk.

A microgrid that combines renewable energy sources such as solar, wind and battery storage is considered. Microgrid can also help alleviate stress on the middle grid during peak demand times. They act as another service grid operator they can call at the moment. The microgrid is connected between local productive units such as renewable energy sources and the utility grid.

This program provides a set of technical solutions that allow for the exchange of information between consumer and distributed production facilities, meaning they need to be managed efficiently. In order to establish an effective power management strategy, the central controller takes a decision based on the nature of the load and resources. Microgrid can both reduce costs and flow of revenue for their customers. They reduce costs through proper management of power supply. They provide income by selling power and services back to the grid.

This represents a review of small grid power management manuals with renewable energy sources, as well as comparisons comparing different development goals, barriers, solutions and simulations with MATLAB.

IV. DC MICROGRID SYSTEM

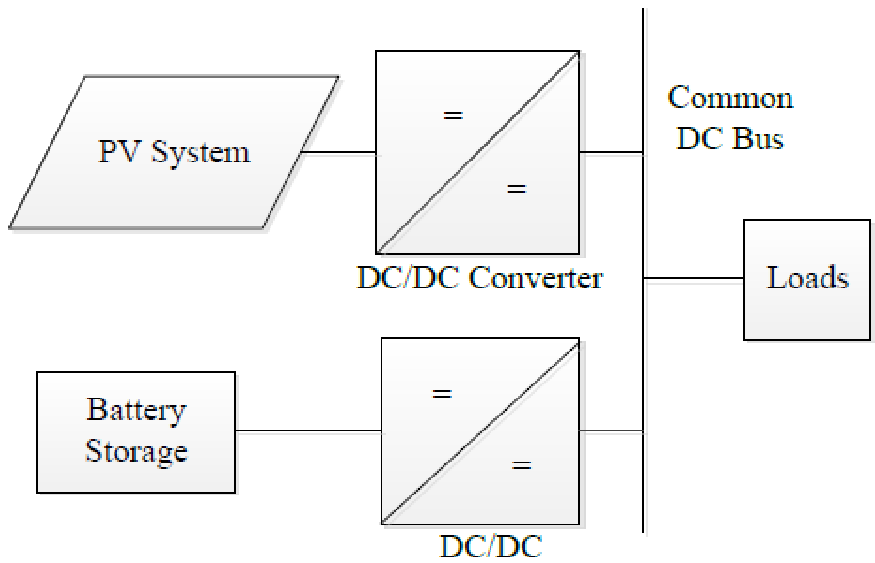

FIG. 2. DC MICROGRID SYSTEM

The DC microgrid considered for this current function consists of a PV array, DC / DC converter, battery-saving system (BESS), bi-directional DC / DC controller for BESS and various loads. The dc microgrid proposed for this project is shown in Fig.l. The battery-powered system is made up of a strong lead acid battery.

A photovoltaic (PV) series consists of a few series PV modules or a parallel connection of several PV cells. The power generated by a single PV cell is not enough to drive any application which is why PV cells are connected to receive a PV module. PV modules are also connected in the same way to gain additional power to meet the load requirement. To create a PV array, the modules were first connected to a series configuration to produce high voltage and continuously, to produce multiple current, individual modules and then to be connected to the same configuration. The most widely used model for single diode core

The solar PV cell was introduced in fig.2 followed by mathematical models for the module model [9 - 10].

Ipv

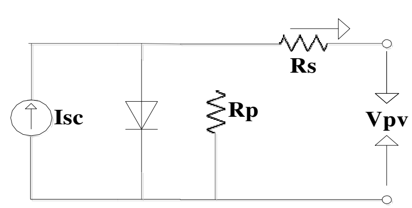

Figure 3. Model single diode of PV cell

Statistics of current exits using fig.3 can be obtained as follows:

$$I_{sc} - I_D - \frac{V_D}{R_p} - I_{PV} = 0 \qquad (1)$$

Where

$$I_D = I_{scref}[\exp\left(\frac{qVoc}{kAT}\right) - 1] \qquad (2)$$

Current current measured in terms of specific conditions depends on radiation and temperature.

So,

$$I_{sc} = [I_{scref} + K_i(T_k - T_{ref})] * S/1000 \qquad (3)$$

The above reference Isc refers to photocurrent to ampere produced from the current solar event in normal mode (25oC and 1000W / m2), Ki stands for current coefficient / short temperature in Iscref (0.00065A / K) , Tk and Tref actual temperature and reference in Kelvin, S reflects real sunlight coming over the device and 1000W / m2 light for normal reference conditions.

Reverse saturation current Irs diode can be labeled as:

$$I_{rs} = I_{scref} + [\exp\left(\frac{qVoc}{NskAT}\right) - 1] \quad (4)$$

Thesaturationcurrentofmodulevarieswiththecelltemperaturewhichisgivenby;

$$I_o = I_{rs}\left[\frac{\left(\frac{T}{T_{ref}}\right)^{s} e^{qEg}}{Ak} * \left(\frac{1}{T_{ref}} - \frac{1}{T}\right)\right] \quad (5)$$

Theoutputcurrentequationcanbewrittenas:

$$I_{PV} = I_{sc}N_p - N_s I_o\left[\exp\left\{\frac{q(V_{PV}+I_{PV}Rs)}{N_s AkT}\right\} - 1\right] V_{PV} + \frac{I_{PV}Rs}{Rp} \quad (6)$$

In equation (6) k is the Boltzmann constant (1.38 x 10^{-23} JK^{-1}), q is the electronic charge (1.602 x 10^{-19} C), T is the celltemperature (K); A is the diode ideality factor, R_s the seriesresistance(Ω)and$R_p$istheshuntresistance(Ω).$N_S$isthe numberofcellsconnectedinseriesand$N_p$isthenumberofcellsconnectedinparallel.

CONCLUSION

Energy output of a unit using renewable energy such as solar and wind power flexible and random power. If the power of the unit is to produce renewable energy unpredictable, the stability of the DC will be stronger and stronger usage level will be improved. Therefore, the output power output of the renewable energy unit will focus in future work.

REFERENCES

1. Cheng, Z.; Gong, M.; Gao, J.; Li, Z.; Si, J. Research on Virtual Inductive Control Strategy for Direct Current Microgrid with Constant Power Loads. *Appl. Sci.* **2019**, *9*, 4449. [Google Scholar] [CrossRef]
2. Tran, T.S.; Nguyen-Duc, T.; Fujita, G. The Improvement of an Islanding Detection Method Based on the Perturbation Signal in Case of a Multi-Photovoltaic Operation. *Appl. Sci.* **2019**, *9*, 4054. [Google Scholar] [CrossRef]
3. Du, D.; Zheng, X.; Yan, Y.; Zhao, H.; Zeng, X.; Li, L. Insulation Monitoring Method for DC Systems with Ground Capacitance in Electric Vehicles. *Appl. Sci.* **2019**, *9*, 2607. [Google Scholar] [CrossRef]
4. Yu, M.; Zhang, J.; Liu, H. Improved Control of Forest Microgrids with Hybrid Complementary Energy Storage. *Appl. Sci.* **2019**, *9*, 2523. [Google Scholar] [CrossRef]
5. Yin, D.; Mei, F.; Zheng, J. An AC/DC Distribution Network DG Planning Problem: A Genetic-Ant Colony Hybrid Algorithm Approach. *Appl. Sci.* **2019**, *9*, 1212. [Google Scholar] [CrossRef]
6. Bosich, D.; Vicenzutti, A.; Grillo, S.; Sulligoi, G. A Stability Preserving Criterion for the Management of DC Microgrids Supplied by a Floating Bus. *Appl. Sci.* **2018**, *8*, 2102. [Google Scholar] [CrossRef]
7. Bunker, K.J.; Cook, M.D.; Weaver, W.W.; Parker, G. Multidimensional Optimal Droop Control for DC Microgrids in Military Applications. *Appl. Sci.* **2018**, *8*, 1966. [Google Scholar] [CrossRef]
8. Gunasekaran, M.; Ismail, H.M.; Chokkalingam, B.; Mihet-Popa, L.; Padmanaban, S. Energy Management Strategy for Rural Communities' DC Micro Grid Power System Structure with Maximum Penetration of Renewable Energy Sources. *Appl. Sci.* **2018**, *8*, 585. [Google Scholar] [CrossRef]
9. Saponara, S.; Saletti, R.; Mihet-Popa, L. Hybrid Micro-Grids Exploiting Renewables Sources, Battery Energy Storages, and Bi-Directional Converters. *Appl. Sci.* **2019**, *9*, 4973. [Google Scholar] [CrossRef]

