Optimization of Hybrid Renewable Energy by Using Matlab

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***Abstract*—This project proposes a Novel Methodology to Stabilize DC Micro-grid System for smart Energy delivery. The novel DC micro grid consists different sources such as PV system, Wind system, the AC source, The battery and ultra capacitor are used as the main energy storage sources all together, form DC micro grid for smart energy delivery. Therefore, grid provide good quality of power to three different loads namely 110V AC single-phase output, 100V DC output and 48V DC output, The grid is at 415Vrms with 50Hz connected to a isolator in connection with the DC bus. The Three phase output of the grid is converted to rippled DC by the use of DBR (Diode bridge rectifier) The converted DC voltage is fed to buck converter which is a DC-DC converter, making the rippled DC to constant DC with the use of a buck inductor. Proposed system analyzes in MATLAB Simulink environment.**

I. INTRODUCTION

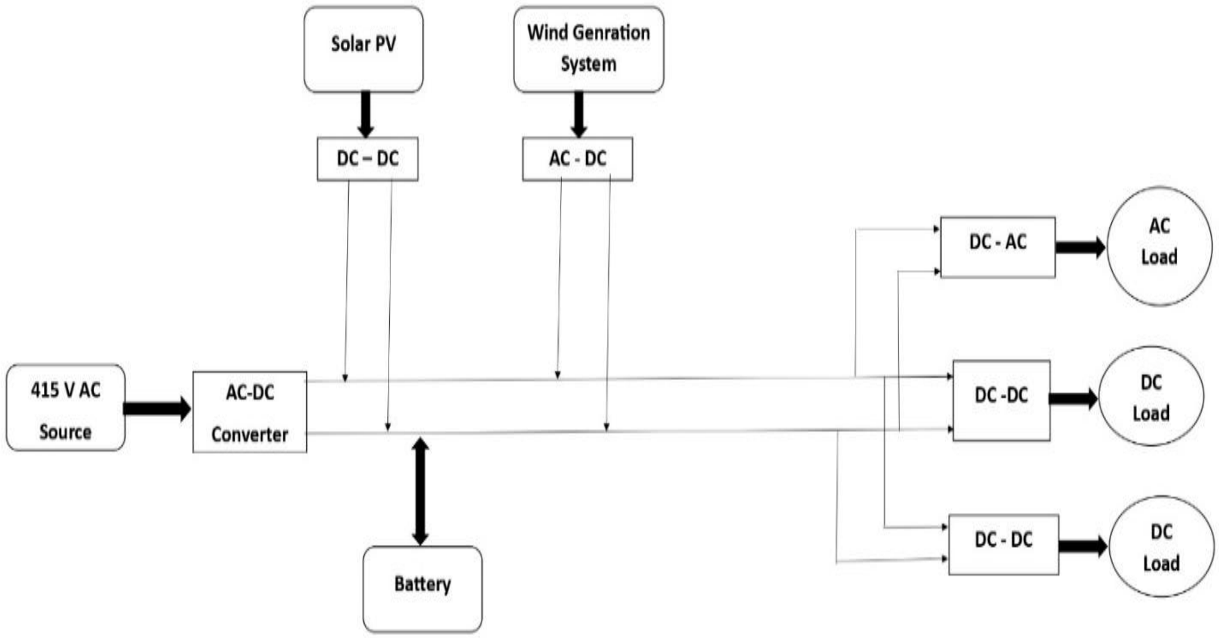
In the present scenario, DC smart grids play an important role alongside traditional power systems. The DC micro-grid system, as a subsystem of the smart grid, incorporates smart concepts into DC power distribution for intelligent energy delivery. The proposed micro-grid system is connected to a 415 V AC power source and integrates renewable sources such as photovoltaic (PV) and wind systems. The AC source, battery, and ultracapacitor are used together as the main energy storage elements to form a DC micro-grid for smart energy delivery. Hence, the proposed DC micro-grid system can not only provide high-quality power for both DC and AC loads but also achieve several special features and characteristics required for smart energy delivery. However, since smart grid concepts are still under development, DC micro-grid systems are often limited to traditional configurations, and only a few reports exist on their practical implementation. Although some studies present DC micro-grids for high-power-quality distribution, renewable energy sources are not always modeled into the grid system, making such systems conventional in nature. To overcome this limitation, a new DC micro-grid system is proposed for smart energy delivery. This system is connected to a 415 V AC source and integrates renewable energy sources such as wind and photovoltaic power, along with electric vehicles. Furthermore, the proposed DC grid adopts batteries, ultracapacitors, and EVs as energy storage devices. This project provides a detailed discussion of the system configuration, control strategy for smart energy delivery, and corresponding simulation performance.

II. RESEARCH METHODOLOGY

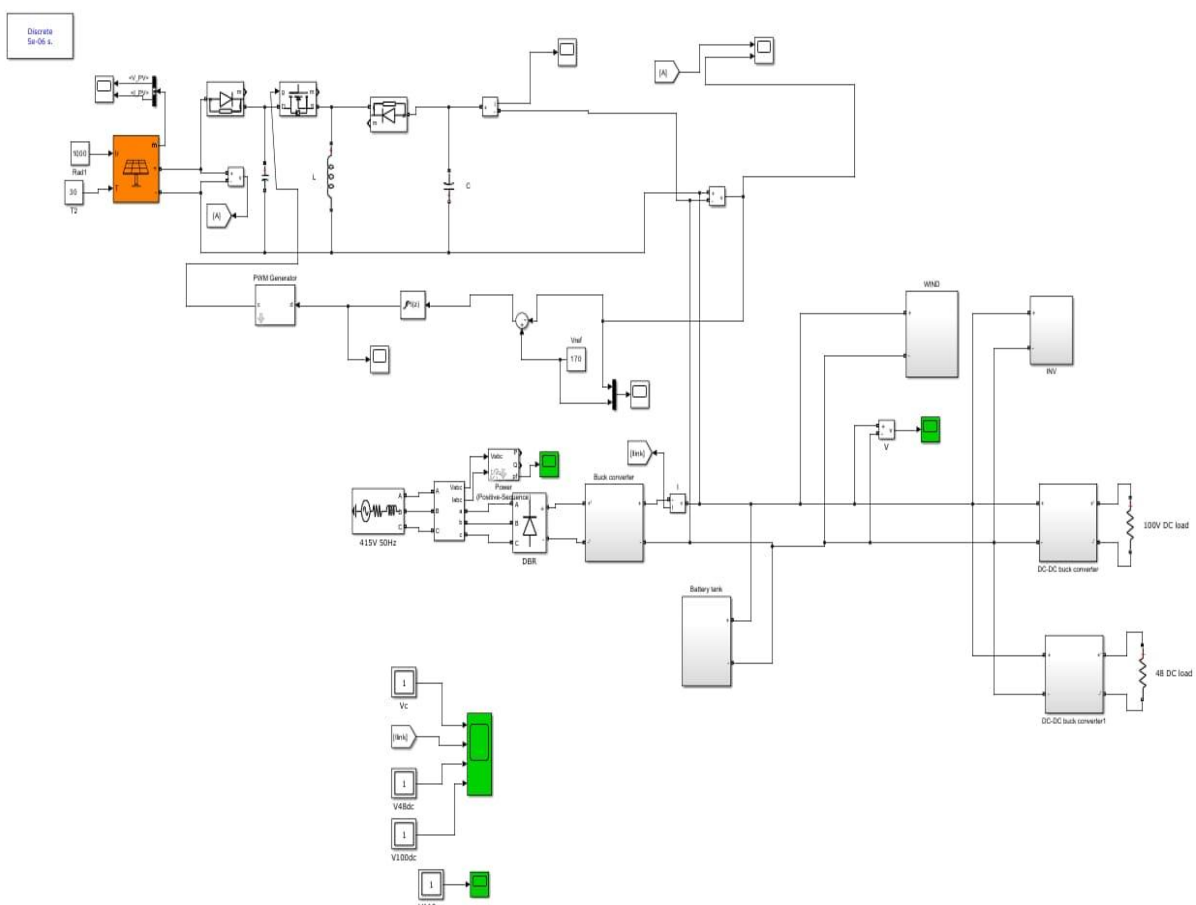
A. Energy Demand

As mentioned previously, without the analysis of the load characteristics of the system, and the definition of basic requirements to reduce the electricity cost of the building, the likelihood of achieving a cost-effective solution is null.

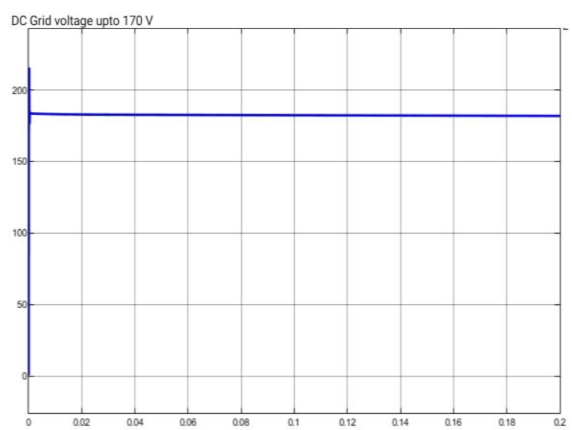
B. lock Diagram



III. SIMULATION RESULT



The proposed system is a DC micro-grid system that integrates various sources of renewable energy along with a conventional AC source. The system is connected to a 415 V 50 Hz AC source that is converted into a stable DC voltage by a rectifier and a DC-DC converter. The system is also connected to a photovoltaic system that has a PWM-controlled DC-DC converter. The system is also connected to a wind energy system that has an inverter. These sources are connected to a common DC bus that supplies power to various DC loads. The system has various devices that are connected to a common DC bus to ensure stable operation of the system. The system has a battery bank and an ultracapacitor that are connected to a common DC bus. These devices are connected to ensure stable operation of the system. The system is also connected to various DC loads such as 100 V and 48 V loads that are supplied by a buck converter. The system is suitable for smart operation due to its voltage regulation capabilities. The system is suitable for efficient operation due to its ability to improve power quality.



IV. RESULT

The proposed DC micro-grid system with integration of photovoltaic, wind system, battery, and ultracapacitor has been successfully designed and simulated. It has been observed that the proposed DC micro-grid system can efficiently convert the given 415 V AC into stable DC power with the help of a diode bridge rectifier and DC-DC converters. Moreover, it has been observed from the simulation results that the proposed DC micro-grid system can efficiently provide stable outputs at 110 V AC, 100 V DC, and 48 V DC for different types of loads.

The proposed DC micro-grid system with integration of renewable energy sources can efficiently improve the reliability and efficiency of the micro-grid system. Moreover, the proposed DC micro-grid system can efficiently maintain continuous power supply with the help of energy storage devices like battery and ultracapacitor.

V. CONCLUSION

The proposed DC microgrid design integrates various energy sources effectively. These sources include the AC utility grid, renewable energy, a diesel generator, a battery energy storage system, and electric vehicle (EV) charging infrastructure. The coordinated operation of these different sources improves system flexibility, reliability, and energy efficiency. This makes the microgrid suitable for modern smart energy applications. The system operates in four distinct modes: AC mode, Renewable mode, Hybrid mode, and Standby mode. This setup ensures an uninterrupted power supply under various operating and load conditions. In all modes, the DC link voltage is maintained at 170 V, showing strong voltage stability and effective control strategies. This stable DC bus is crucial for seamless power sharing among sources and loads, which helps minimize power quality issues. Additionally, the proposed microgrid delivers high-quality power to different load types. This includes 110 V AC loads as well as 100 V DC and 48 V DC loads. The ability to support both AC and DC loads at the same time highlights the system's versatility. It also reduces the need for extra power conversion stages, thus improving overall system efficiency and lowering conversion losses. Thorough simulation studies have been conducted to assess the performance of the proposed DC microgrid in different operational scenarios. The simulation results show smooth power flow management, minimal voltage fluctuations, and efficient load sharing among the available energy sources. The system also reliably delivers energy, even during source transitions and changing load demands, demonstrating the effectiveness of the control strategy. In summary, the simulation results confirm that the proposed DC microgrid offers a reliable, stable, and efficient solution for integrating renewable energy sources, traditional generation, energy storage, and EV systems. These outcomes validate the architecture's feasibility for future smart grid and sustainable energy applications.

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