A STUDY ON GOVERNING OF DC POWER IN DC MICRO GRID SYSTEM USING MULTIPLE RENEWABLE ENERGY SOURCE

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Abstract: Renewable energy resources (RE) incorporation into the electricity infrastructure has recently become a microgrid application. In this paper, multiple DC sources are connected to a common DC link for power-sharing to operate single or multiple loads. In a conventional test system, the sources are traditional three-phase AC sources used as power injection units for the loads connected to the system. The three-phase AC sources are connected with controlled rectifiers for stable DC voltage. The controlled rectifiers comprise IGBT switches controlled using the PWM technique. In further development the traditional three-phase AC sources are replaced with a renewable source like PVA connected through DC-DC booster converters maintaining the DC voltage at the DC link. The DC voltage is converted to three phases using inverters feeding the loads. The power-sharing and DC stabilization analysis with variation in loads is observed using MATLAB software.

Keywords: PV Array, PWM Generator, PMSG, Battery, wind, MATLAB 2016

I. INTRODUCTION

Renewable energy is expected to play a significant role in the future in order to fulfil the rising energy demand, cut CO2 emissions, and deal with environmental problems. Integration of this renewable energy is possible at both the transmission and distribution levels.

The intermittency issue of DG must be resolved if renewables are to be developed and integrated on a significant scale. We think of a storage mechanism that would help us reach our aim of widespread adoption of this energy source. But then we need a way to regulate the flow of electricity in this novel system, and that's where microgrids come in. Microgrids appear as a solution to integrate renewable energy sources, meet the requirements of network operators, and ensure the reactivity of the electrical system to unpredictable energy sources. Two different types of Microgrids can be considered:[1]

- AC Microgrid
- DC Microgrid

Keeping the internal power flow in a DC power system balanced is a challenge to assure dependable and efficient functioning. When large disruptions arise from various parts of the system, things might become complicated. DC microgrids must take into account coordinated and optimal operation with the control system in addition to implementing protective mechanisms. Even still, in the majority of security systems, this has not been thoroughly explored.[2][3]

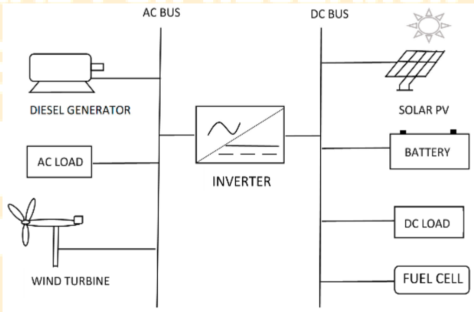

Figure 1: Energy management in microgrid

A. Renewable Hybrid Power Architecture for Microgrids

Green energy is a subset of the alternative energy sector that has emerged as a response to climate change. The three fastest-growing RE sources are biomass, wind, and solar, with Solar's rising popularity in recent years attributable to declining prices [7], [6]. If a renewable energy source is unable to maintain

24-hour power generation, a microgrid may employ a combination of two or more RE sources to ensure that electricity is always available. The sun's rays are only strong enough to allow energy production during the day, hence solar power is limited to daylight hours. By combining solar with wind or biomass, power may be created continuously. The microgrid design relies on a number of crucial components, including as converters, power storage systems, and others, to keep the device in equilibrium and functioning well.[8]

II. OBJECTIVES

This study is motivated by the challenges in the control design of DC MicroGrid systems and analysis of DC MicroGrid system's dynamic behaviour.

• Contribute to the study of decentralised energy sources in the current energy context and reduce emissions of greenhouse gases.

• Design a system that integrates the electrical network without compromising its stability.

• Facilitate large-scale penetration of renewable energy sources into the power production system.

• Design of a flexible DC MicroGrid capable of integrating decentralised generation power sources without impacting network stability.

III. RESEARCH METHODOLOGY

A. Block Diagram of Dc Shipboard Power System

In this DC SPS for power generation, diesel generators are used. It follows the HVDC working principle where the generated ac is converted into dc through converters (i.e., Rectifiers) and from DC bus again reconverted into AC near loads. The battery is used as backup. The basic block is shown in fig. 2.

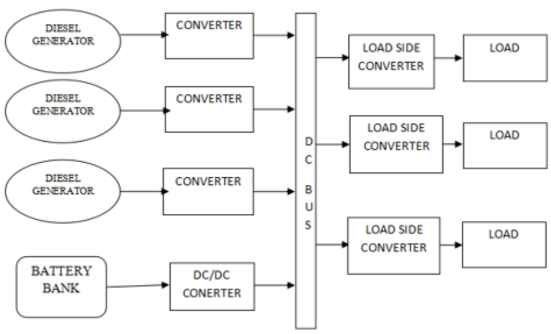

Figure 2: block diagram of dc shipboard power system

B. Proposed system configuration

During the steady-state operation, the local voltage and current at any point of the system remain well within the limits of healthy operation. However, the power tends to change at times, especially when the system experiences disturbances or faults. Hence, these abrupt changes in the voltage/current should be detected and addressed as soon as possible for reliable operation. The power system modelled in this paper includes measurement devices to continuously monitor the parameters such as voltage, current, and power locally and they are installed at the terminals of the generators, loads and at the DC bus.[9][10]

Fig. 3 shows the proposed system architecture and components used in this paper.

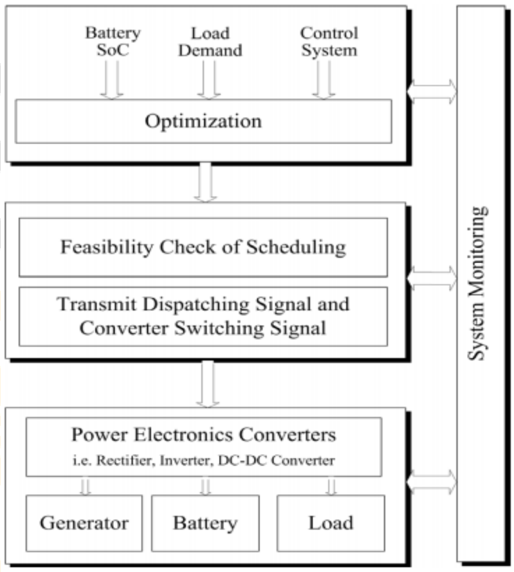

Figure 3: Proposed system configuration

IV. SIMULATION RESULTS AND DISCUSSION

The proposed method is implemented and modelled in the MATLAB version.

A. DC Power System without ESS Device

The simulation of the dc shipboard power system without ESS device is shown in figure 4.

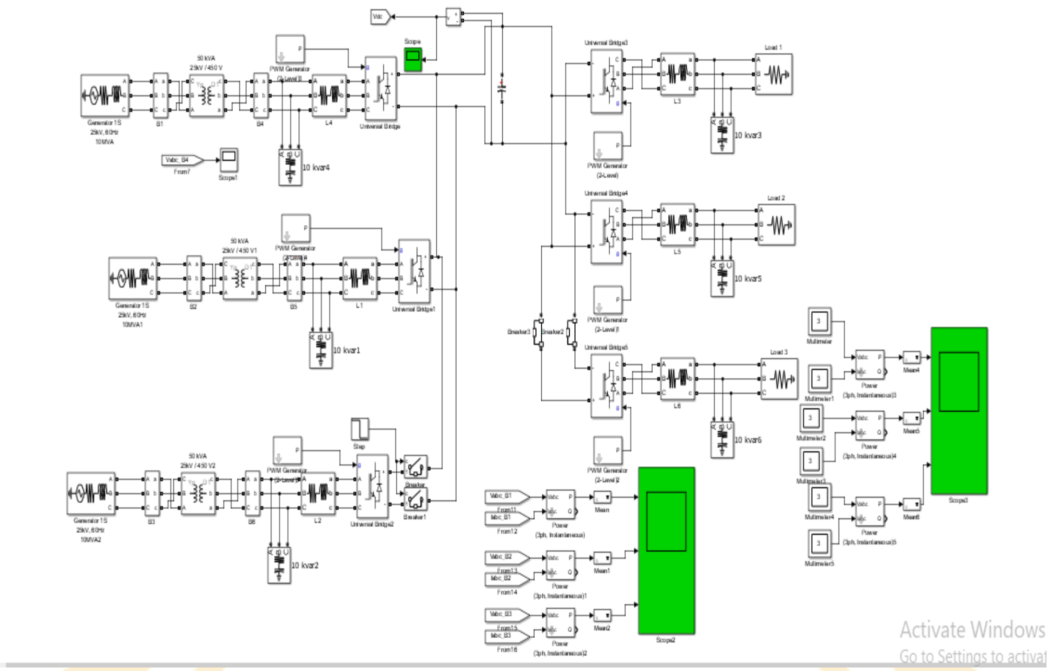

Figure 4: Simulation of DC Power System without ESS

Two disturbances are created which occur commonly in system to validate the feasibility of the proposed approach. Two disturbances are generator loss, load start. The three generators output power waveforms are shown in figure 5.

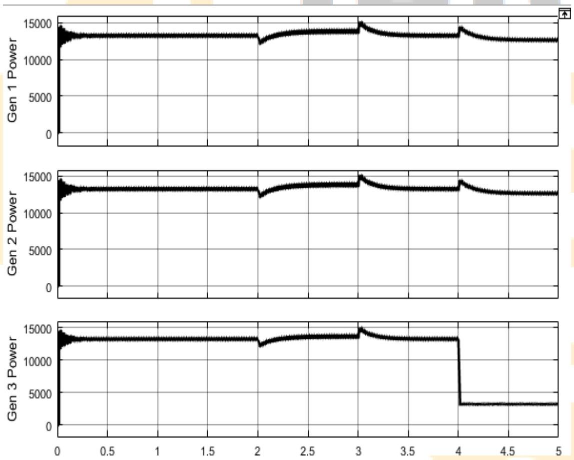

Figure 5: Waveform of Generation Power

The load power waveform is shown in figure 6. At four seconds the power is not generated due to generation fault i.e., power doesn't gets regale to the load. But in this concept all the bus bars are tied to together and a reference value is set at 750V. So whenever there is any fault occurred in generation the loads get partially regale. Because of the tied bus bar the power is distributed equally.

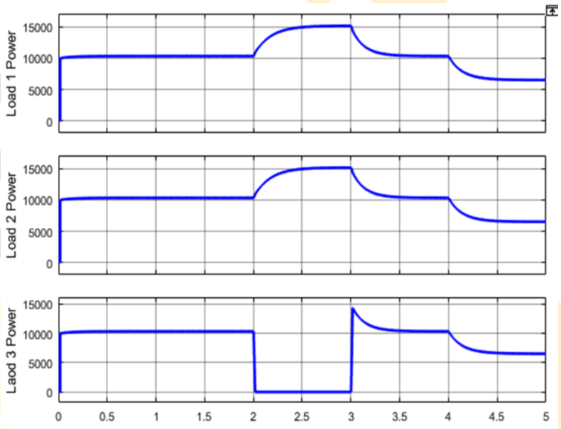

Figure 6: Waveform of Output Load Power

B. DC Shipboard Power System using multiple renewable energy sources

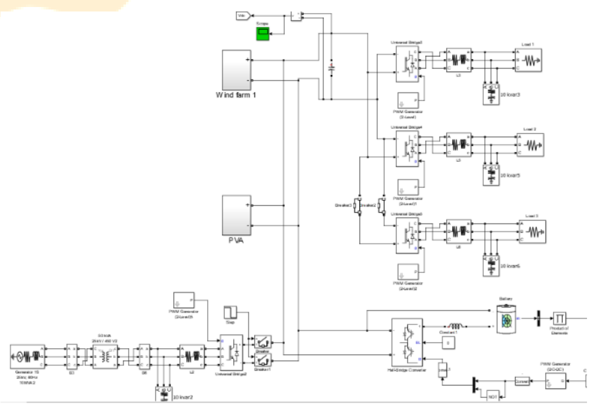

Figure 7: DC micro grid system with multiple renewable sources

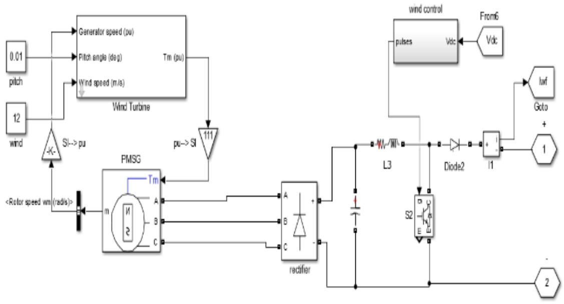

Figure 8: Wind farm Modeling

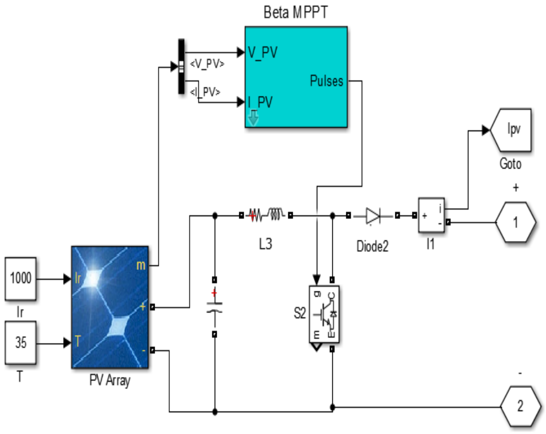

Figure 9: PVA Modelling

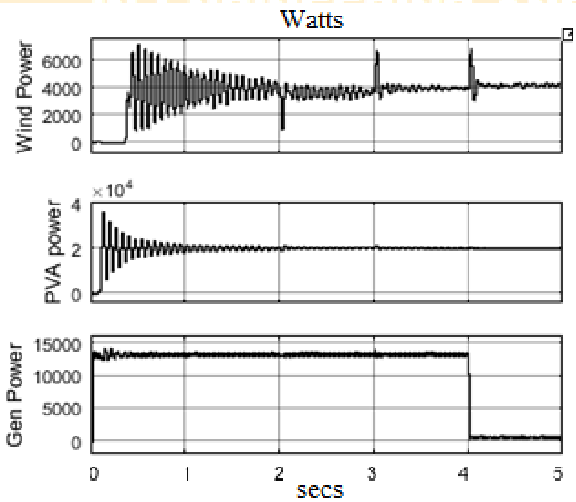

Figure 10: Power injected from sources connected to grid

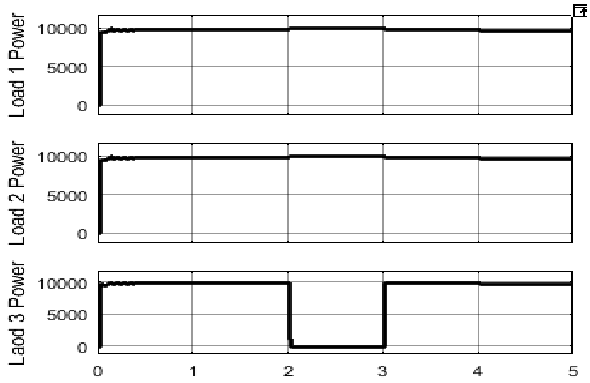

Figure 11: Load power consumption changed at 2sec and 3sec

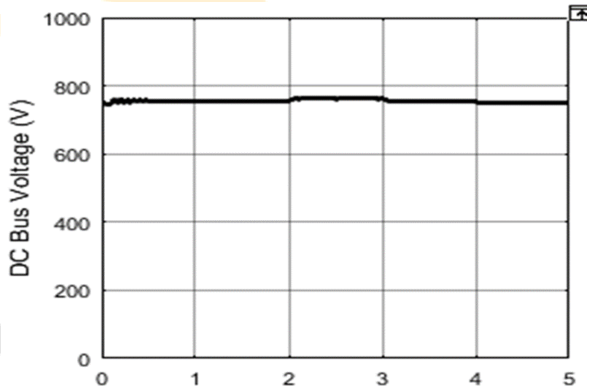

Figure 12: DC bus voltage at DC link

With the above modeling of the renewable modules interconnected in parallel to the grid feeding variable loads maintaining the DC voltage at PCC it is clear that the controllers adopted for the operation are in optimal working condition with fewer ripples in DC voltage.

V. CONCLUSION

This research article provides information on hybrid microgrid for renewable energy in the grid, off-grid, control strategies and economics. Solar photovoltaic and wind energy are usually combined in a hybrid system, which essentially support each other.Different cases are considered with sudden load change and sudden grid isolation using circuit breakers tripping at specific time interval and graphs are recorded. The power graphs show the injected active power from PVA, wind farm and grid along with three loads consumption with respect to time

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