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STUDY AND MANAGEMENT OF A MICROGRID'S DC GRID-BASED WIND POWER PRODUCTION SYSTEM

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ABSTRACT

A microgrid-based dc grid-based wind power production system's operation was described in depth in this paper. The proposed fix eliminates the requirement for frequency and voltage synchronization, enabling the operation of wind turbines in parallel. Here, a method of managing the system's reactive and real power as well as the inverter's o/p frequency and voltage using artificial neural networks (ANNs) is provided. ANN was a non-linear framework for controlling frequency, load, and damage detection in power networks. In this system, ANN is used to regulate microgrid oscillations such that continuous controlled electricity is delivered with rapid frequency responsiveness. This theory has been validated using a variety of test settings and numerical simulations.

Keywords:

INTRODUCTION

In a power system network, the increasing use of non - linear loads can result in severe harmonic contamination. Complex resonance frequencies may be induced by frequency deviation, particularly in power networks with underground or subsea connections. In fact, given a nontrivial parasitic capacitance, these cables can be used to create an LC pyramid network to enhance resonances. Having the following resistors or active filters can be installed in distribution systems to reduce system reverberations. However, passive element mitigation of resonant propagation was subject to a few well-known difficulties, like power outage and additional cost. Furthermore, if a passive filter was developed or implemented without knowing the specific system settings, it may introduce extra resonances.

In the current papers, a few revised R-APF concepts have also been established. It was proposed to modify dampening levels of resistance at different fundamental orders using the discrete optimization technique. As a result, the R-APF functions as a linear resistor. The operation of numerous R-APFs was also examined, and an intriguing droop controller was created to allow parallel R-APFs to share harmonic power autonomously. RES based DG units, on the other hand, have been used to create flexible micro networks, and their interface converters can also handle various distribution network power quality problems. By altering the current management for constant current Distributed generators, the supplementary R-APF function could be easily integrated into the principal DG actual power injection function. Traditional CCM, on the other hand, is unable to offer direct constant voltage during dc microgrid landing operations. For DG units with elevated LC or LCL filters, an upgraded VCM was proposed to circumvent this constraint. The control mechanism in governs the DG unit as dissuades, which is reliant on the existing feed amplitude, as can be observed. This approach may not provide enough dampening effects to network resonance when the feeding impedance is inductive. The research analyses a basic harmonic modeling approach in which the grid system is situated at the receiving side of the feed to achieve improved operation of grid linked and islanding micro grids.

Microgrids improve the usage of renewable and dispersed energy sources, integrated power and heat absorption, and avoid wastage by putting generation near demand. In the event of a power shortfall from renewable sources, a utility grid link is used to refill energy levels. The use of a wind turbine and PV modules in conjunction with local power devices could lessen the risk of disasters. Microgrids necessitate a defined industrial customer, substation, voltage, and active power with load and production tolerances. It also determines the duration of the island, peak usage, and typical downtime. Demand management plane and load levelling are promoted by microgrids, as well as energy supply for key loads and dependability control. The microgrid has a low fuel usage and a high efficiency.

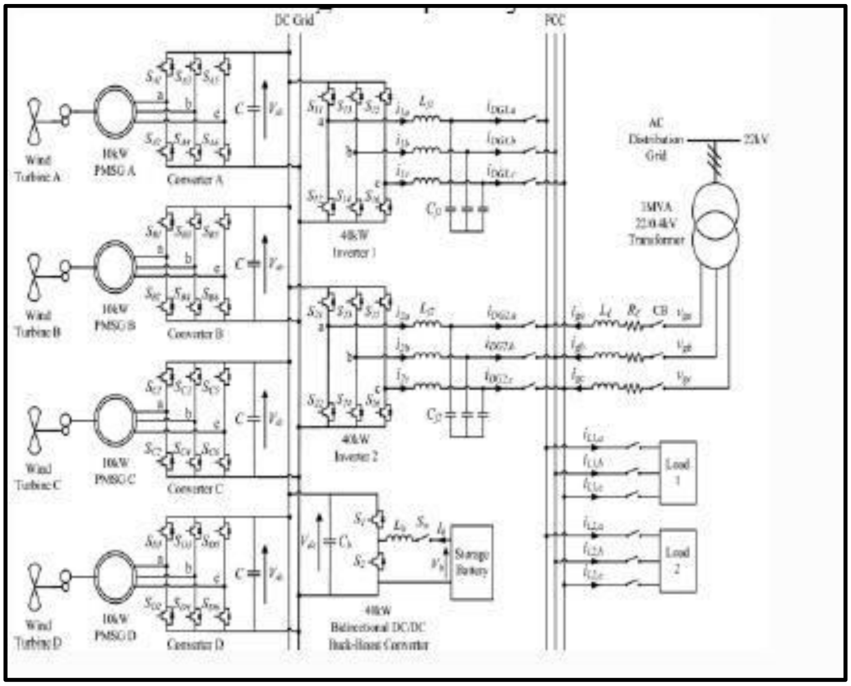

Fig.1. In a microgrid, the overall architecture of the projected dc grid-based WPG

Many studies on dc microgrids were carried out in order to make the integration of different DERs and power storage technologies easier. Each wind turbine unit consists of a multilevel inverter, a high frequency transducer, and a single phase ac to dc converter in a dc dispersion wind farm design. However, the suggested scheme adds to the system's intricacy by requiring three phases of conversion.

SYSTEM MODELING

The micro grid's WTs are in charge of supplying localized power to the loads when the grid system is connected to the distributed generation, reducing the burden on the power system. Depending on the time of day, the SB may be configured to perform various demand side management activities such as peak reduction and valley filling. The proposed methodology computes a number of control methods in MPC, a model-based controller that employs a receding horizon strategy, to simplify parameter optimization throughout the whole control horizon. The proposed dc grid-based wind sustainable energy system for the chicken farm is depicted in Figure 1.

The system, which comprises of 4 10 kW PMSGs powered by speed control WTs, can be linked to or islanded from the grid system. The PMSG was discussed in this study since it does not need a controlling the dc system, which would add to the control equipment's implementation complexity.

2.1.MODELING OF DC to AC INVERTER:

The single-phase representation of the 3 dc/ac converter is comparable to the twin 35 kW three-phase dc to ac converters that connect the dc network to the PCC. Kirchhoff's current and voltage rules are utilized to produce a state-space description for the converter by looping I and point x, for example. As a consequence, when operating in the CCM, a three-phase sine signal might be used directly as the external input. During islanding mode, the converters will be employed in the VCM.

2.2.MODELING OF AC to DC INVERTER:

When the micro grid is functioning in the energy or islanded method of operation, the efficacy of the suggested design idea is tested under various operating scenarios. The distribution line's reactance are determined. The values of the inverter and converter loss impedance are not exactly understood in practical applications. As a result, these figures have been roughly calculated. Under typical operating conditions, inverters 1 and 2 convert the entire energy produced by the PMSGs at the dc microgrid and split the total energy provided to the loads.

2.3.ANALYSIS OF NUMERICAL SIMULATIONS:

When the grid system is disconnected from the transmission network, the electricity generated from the PMSGs will not be enough to meet all of the load demand. For the micro grid to keep functioning correctly in this case, the SB must dispatch the required electricity. When the microgrid is disconnected from the grid, it functions as illustrated in the fourth case study. Initially, the grid system is linked to the electricity grid.

SIMULATION RESULTS

A simulated model of the proposed dc grid-based wind turbine system is shown in Figure 1 using MATLAB/Simulink. While the microgrid is functioning in the grid-connected or islanded mode, the effectiveness of the recommended concept design is assessed under a variety of operational scenarios. Practical applications truly don't have a clear understanding of the conversion and inverter breakdown resistance values. In light of this, these numbers have been approximately computed.

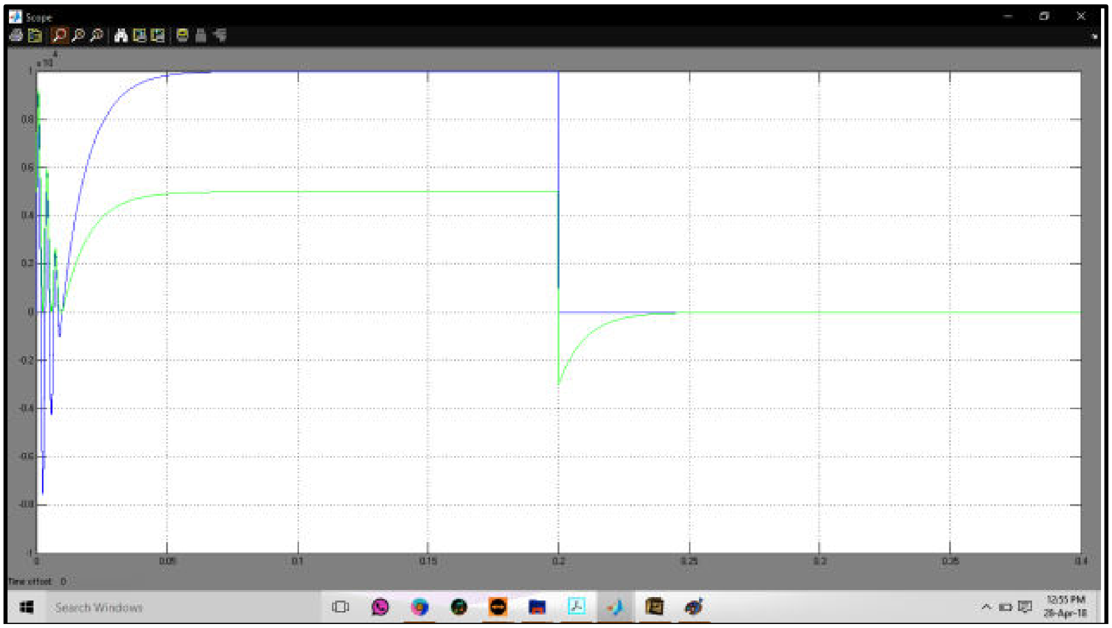

Fig. 2. Inverter 1 provides both real (top) and reactive (bottom) power.

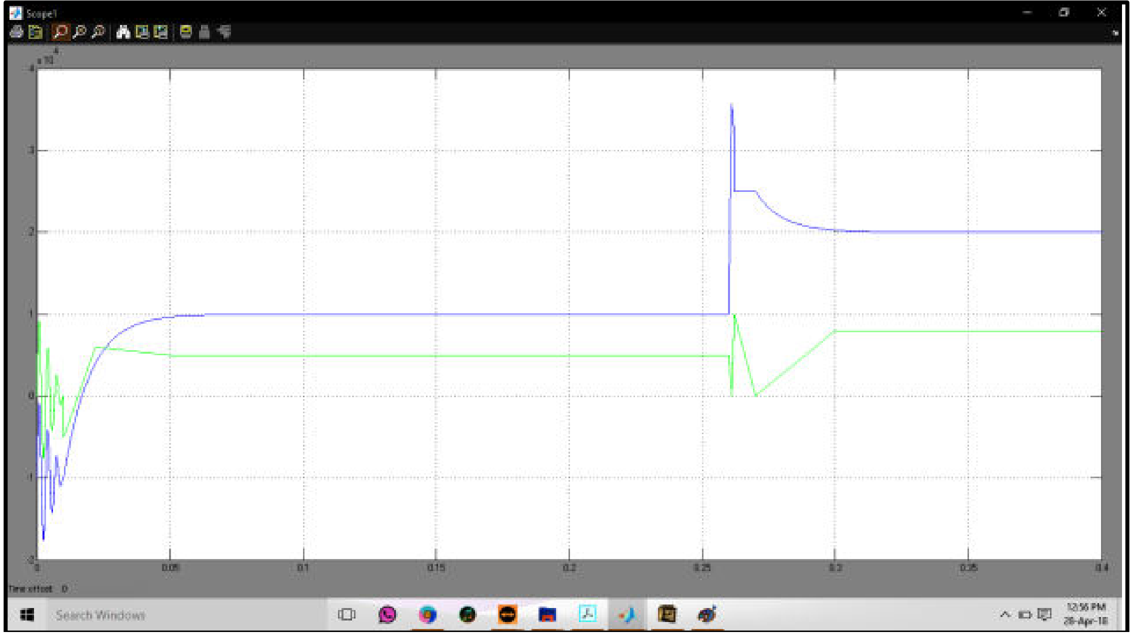

Fig. 3. Inverter 2 provides both real (top) and responsive (bottom) power.

In this test scenario, a performance analysis of the microgrid is done when one of the inverters is turned off. Together, the four PMSGs produce around 22 kW of electricity, which is then transformed into active and reactive powers of 20 kW and 8 kVAr by inverters 2 and 22. The average PMSG produces 5.5 kW of actual power. The waveforms of the active and reactive power supplied by inverters 2 and 1 for 0 to 0.4 seconds are shown in Figs. 2 and 3. Each converter runs for 0 to 0.2 seconds and delivers 10 kW of actual power and 4 kVAr of reactive power to the loads.

During the starting phase, the controller checks the power standards for about four cycles, resulting in unstable readings in the power waves between 0 and 0.08 s. At t = 0.2 s, Inverter 1 stops working, the microgrid is disconnected, and 10 kW of actual power and 4 kVAr of reactive power are lost to the loads. As seen in Fig. 2, when converter 1 is removed, the excess power it produces is decreased to zero in roughly half a cycle. As seen in Fig. 6, the unsent power causes a spike in power to the dc grid, which causes an overvoltage at t = 0.2 s.

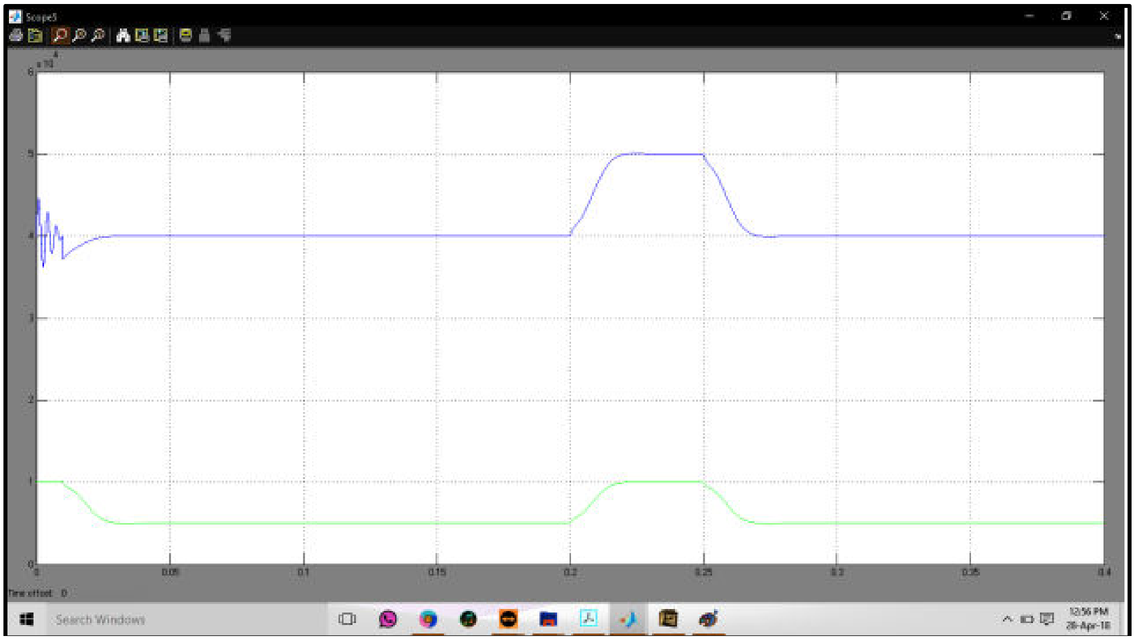

Fig. 4. The grid delivers both real (top) and reactive (bottom) power.

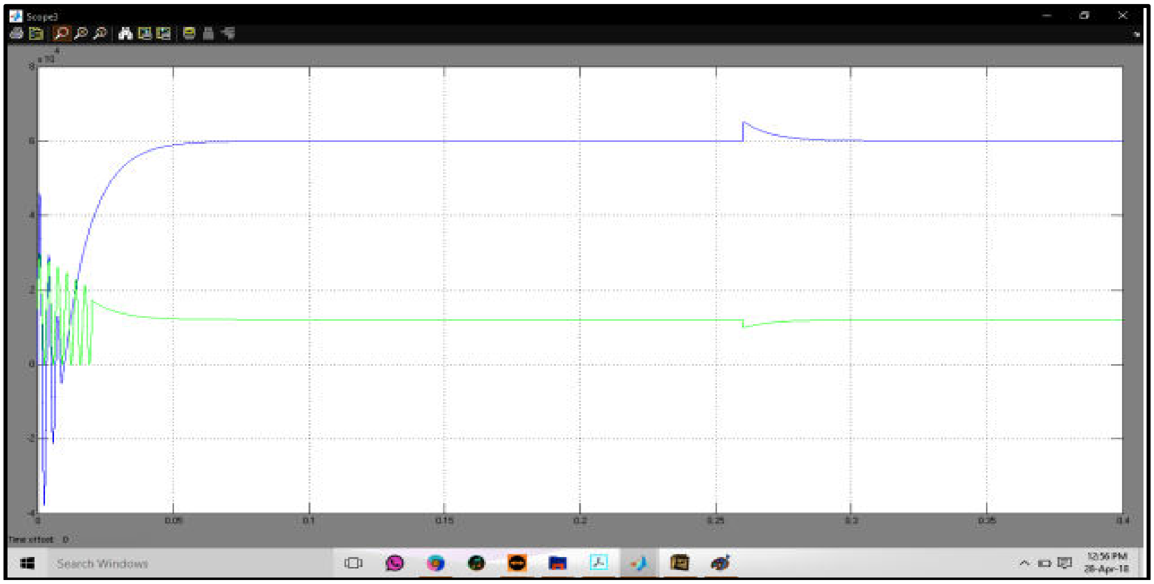

Fig. 5. Loads require both real (top) and reactive (bottom) power.

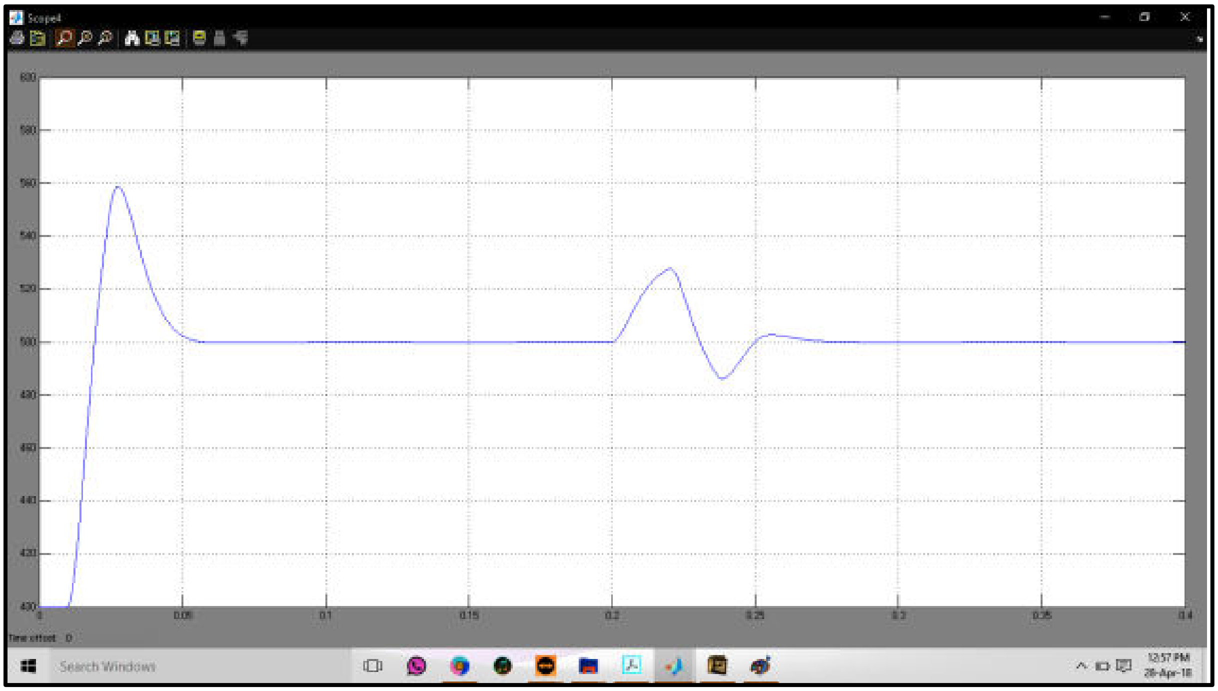

Fig. 6. Voltage on the DC grid.

B. During grid-connected operation, connect the AC/DC converter:

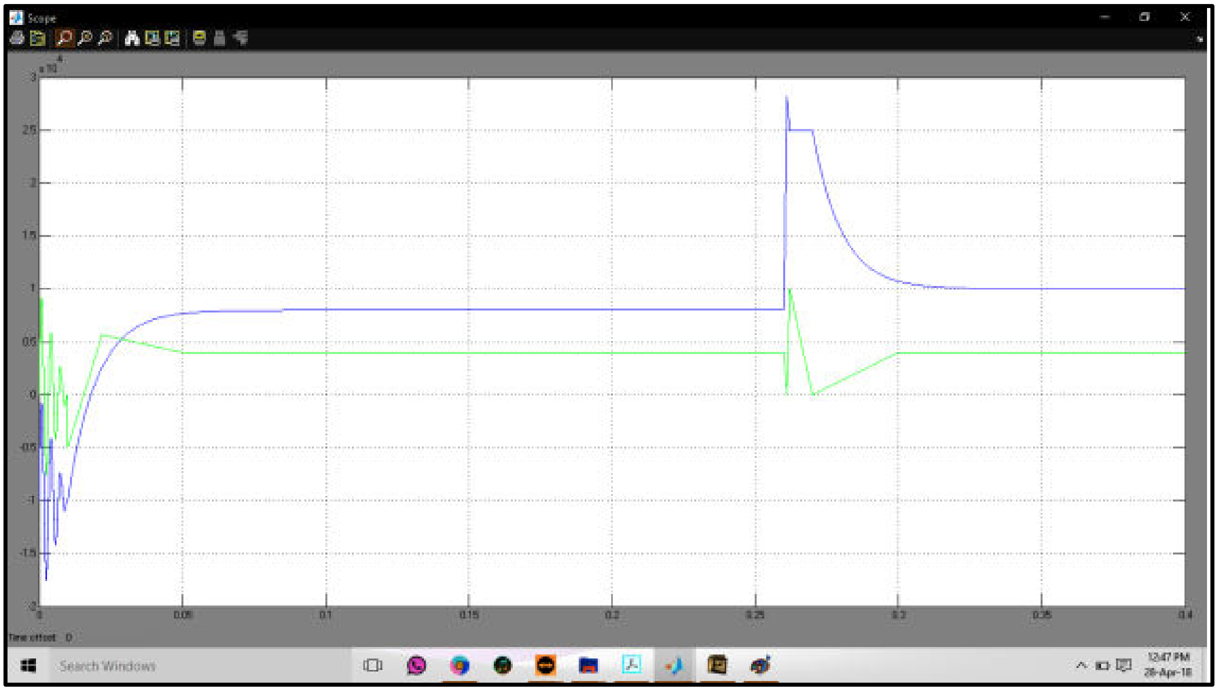

Fig. 7. Inverter 1 provides both real (top) and reactive (bottom) power..

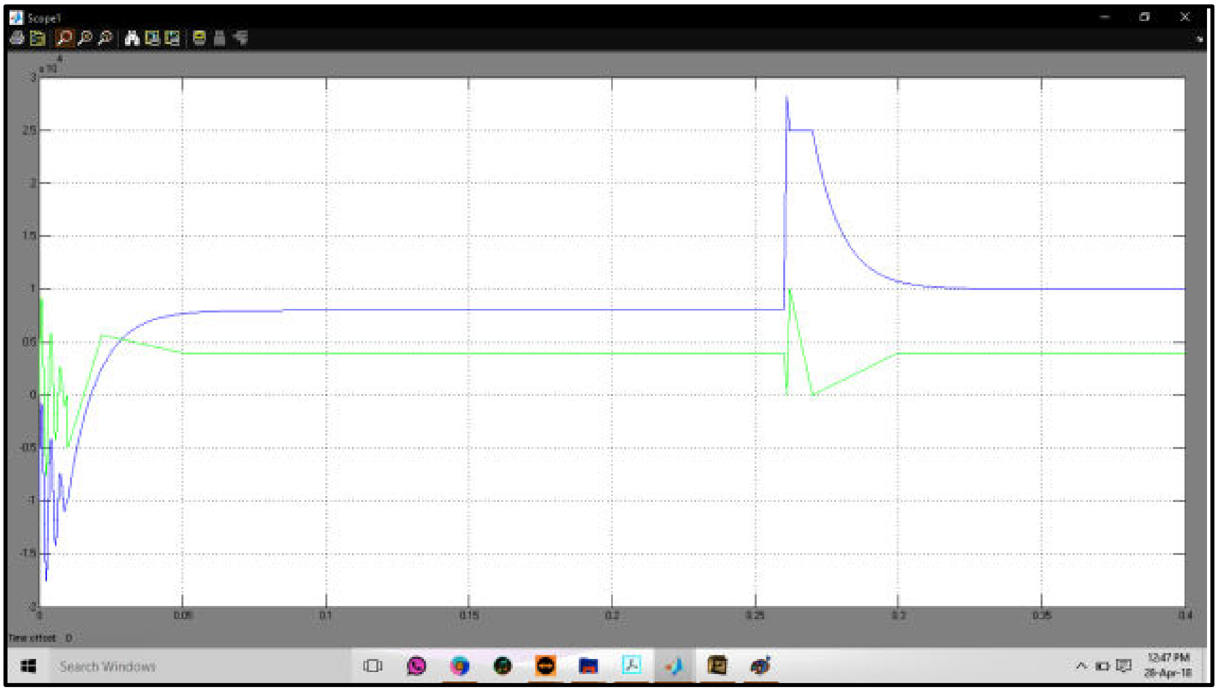

Fig. 8. Inverter 2 provides both real (top) and reactive (bottom) power.

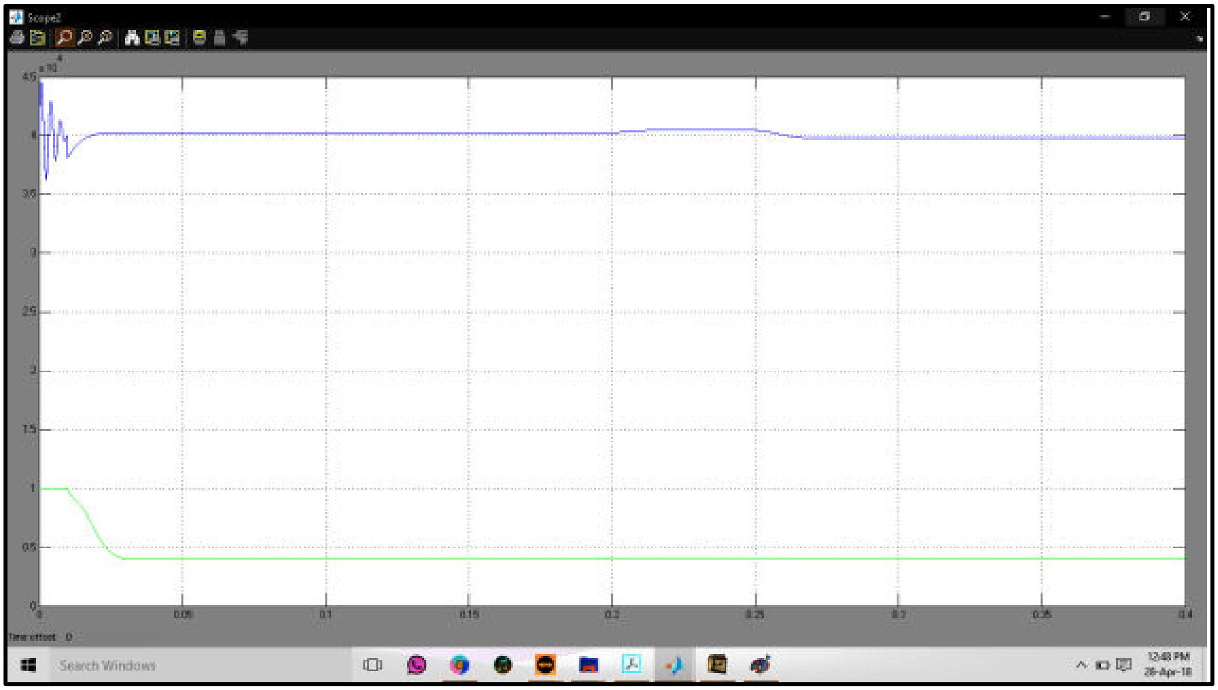

Fig. 9. The grid delivers both real (top) and reactive (bottom) power.

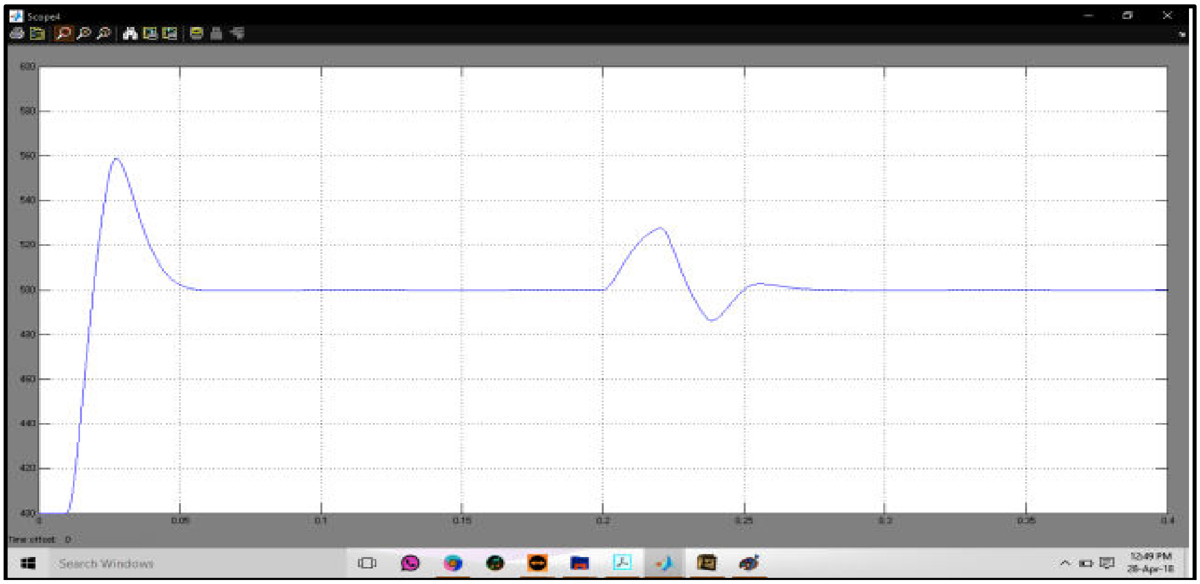

Fig. 10. Voltage on the DC grid.

The suggested dc grid-based wind production system's greatest benefit is that it enables any PMSG to be linked to the grid without the need to synchronise their frequency and voltage. This case study exemplifies this skill. Figures 7 and 8 show how another inverter provides actual and reactive power to a load of 8 kW and 6 kVAr, etc. According to Fig. 9, the grid fulfils the remaining real and reactive power needs of the loads.

C. Operation 'Islanded':

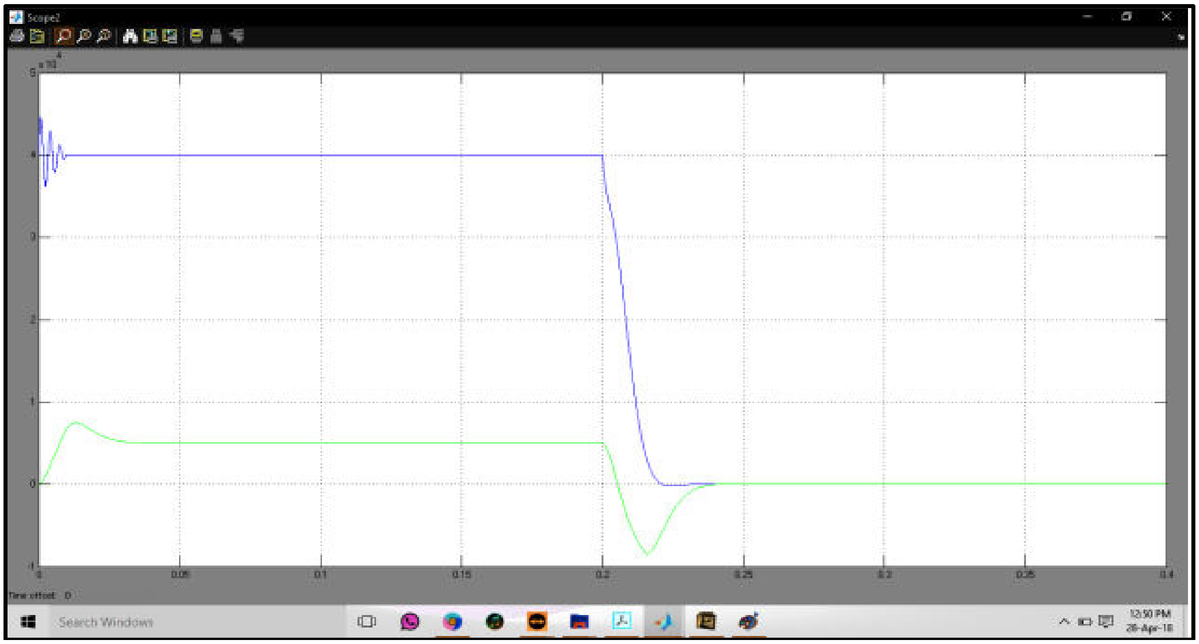

Fig. 11. The grid provides both reactive (bottom) and actual (top) power.

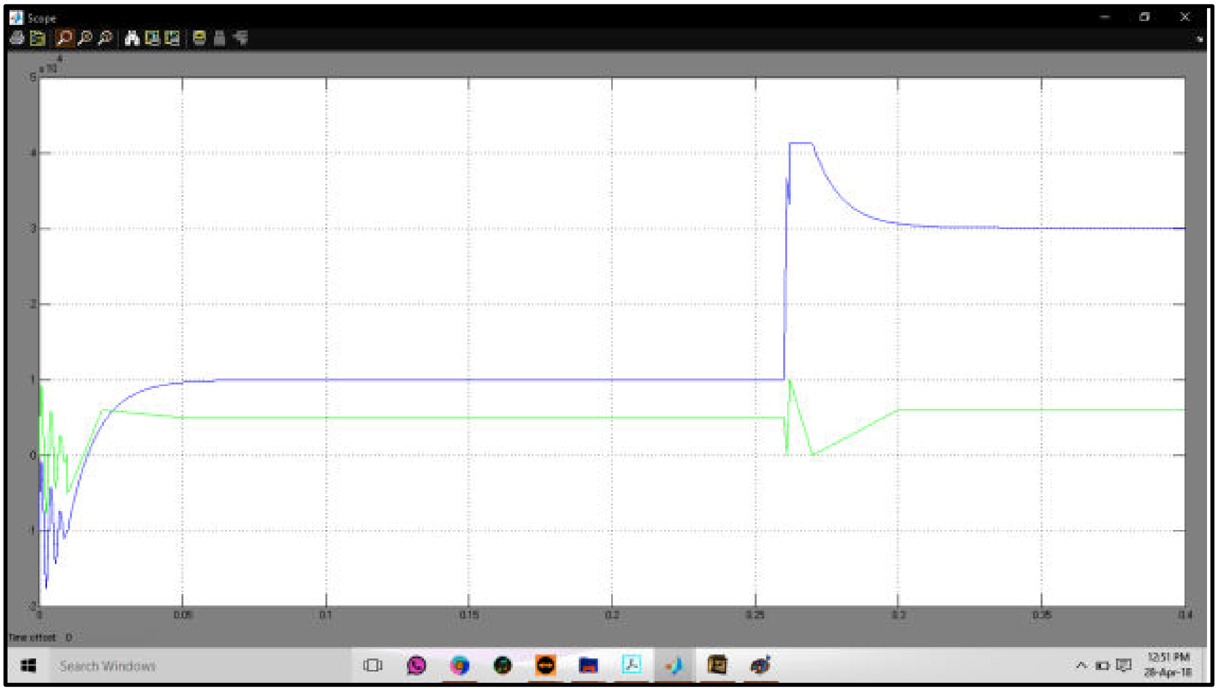

Fig. 12. Both real (top) and reactive (bottom) power are provided by inverter 1.

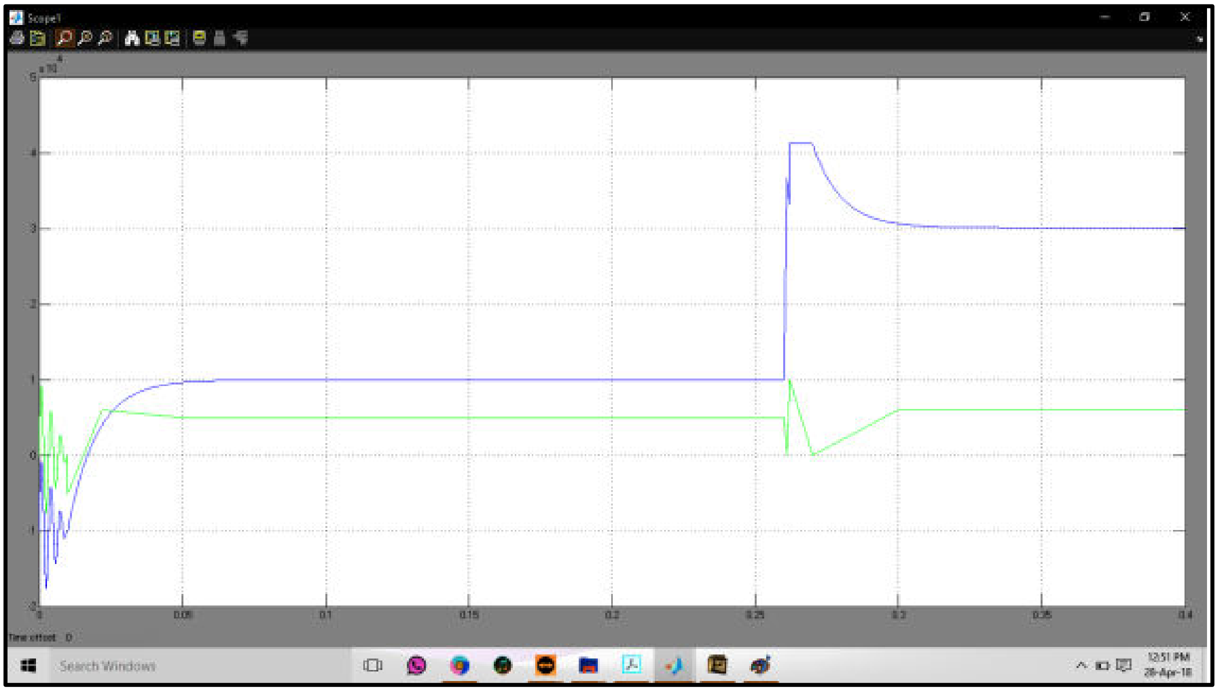

Fig. 13. Inverter 2 provides both real (top) and reactive (bottom) power.

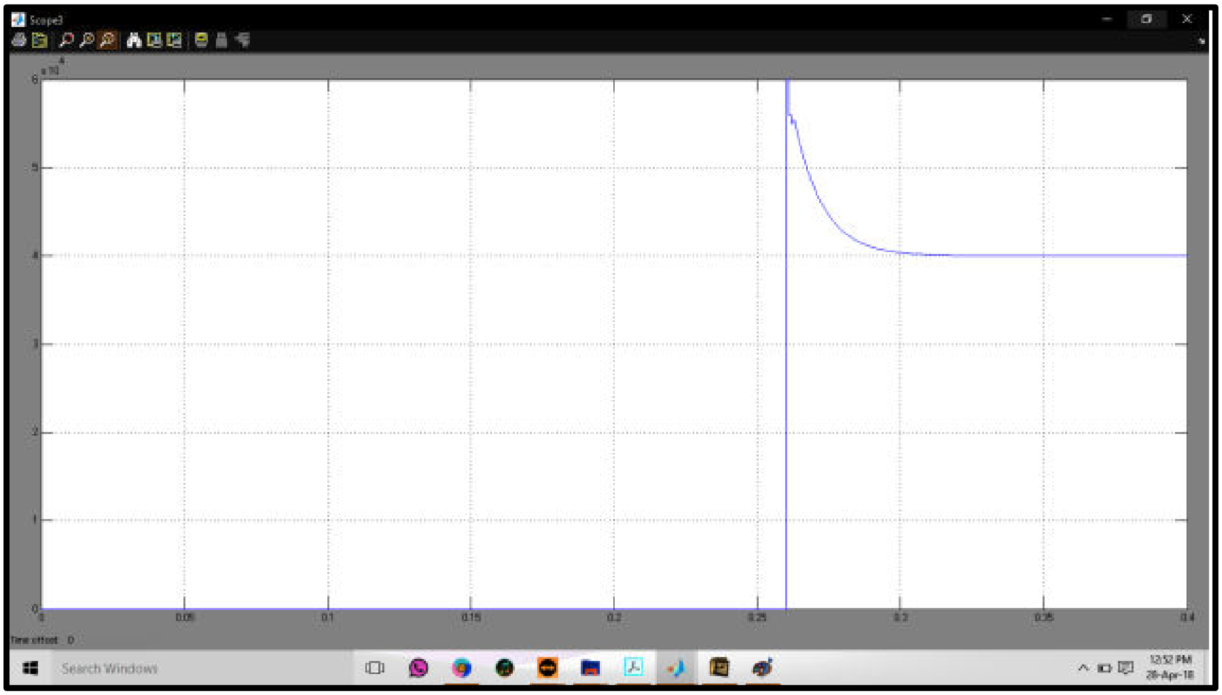

Fig. 14. SB Real power

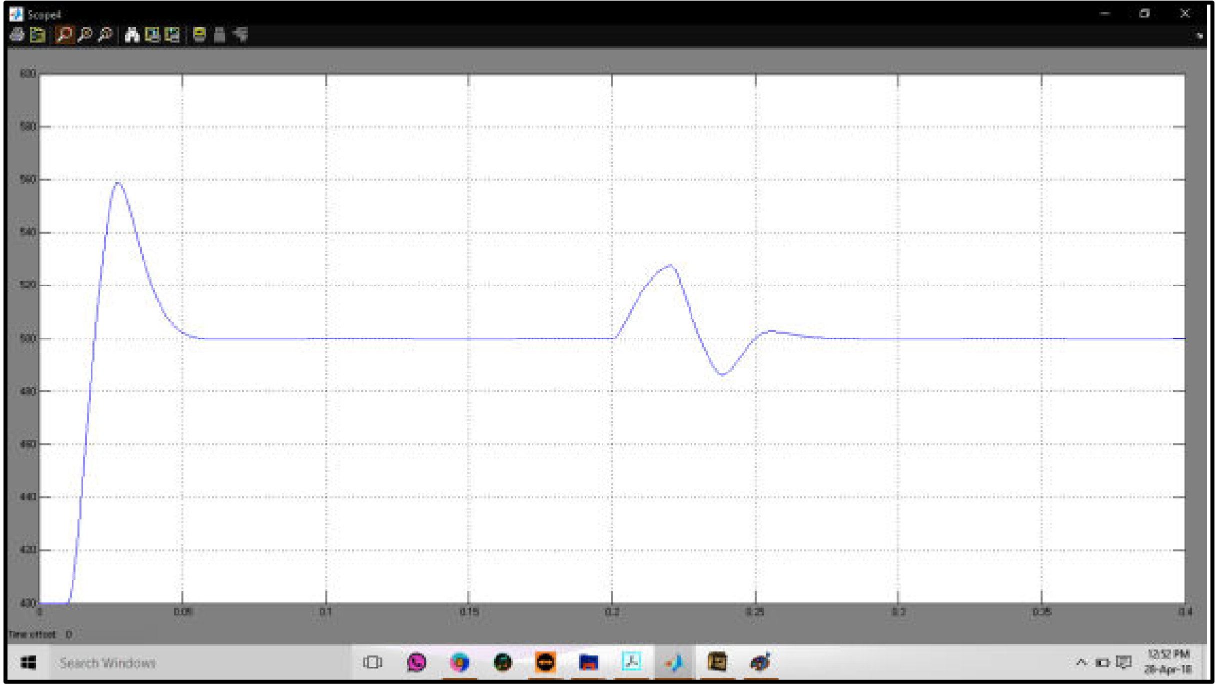

Fig. 15. Voltage on the DC grid.

The electricity generated from the PMSGs would be inadequate to satisfy all load requirements when the enclave is decoupled from the distribution network. The SB is needed to deploy the appropriate power to make sure that the grid keeps running reliably in this situation. The microgrid functioning is shown in the third study case when it is isolated from the grid.

Conclusions:

In this study, the functioning of a dc microgrid-based renewable generating device that permits the simultaneous operation of four wind generators is described. This method has the benefit of not requiring power or wavelength synchronisation, enabling rotor turbines to be turned on and off with the least amount of disruption. Numerous studies that demonstrate how the micro grid works and simulation results that demonstrate the system's capability to operate in a dependable and adaptable manner support this theory. Instead of using a PI controller, an ANN-based control approach is used since it can lessen the different fluctuations that a PI controller cannot correct while also managing the system's speed and strain.

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