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

Mrs.M.PRABHA[1], Dr.I.ALAGARASAN[2], Mr.M.SIVA ANANTH[3]

[1,3]Assistant professor, Department of Electrical and Electronics Engineering,AEC,Salem
[2]Professor, Department of Electrical and Electronics Engineering,AEC,Salem

Abstract:

In this work, the operation of a microgrid-based dc grid-based wind power production system was detailed. The suggested fix gets rid of the need for frequency and voltage synchronisation, allowing wind turbines to run in parallel. Here, an ANN (Artificial Neural Networks) control technique is presented for controlling the system's reactive and actual power as well as the inverter's o/p frequency and voltage. In order to control frequency, load, and damage detection in power networks, ANN was a non-linear framework. In this system, the microgrid oscillations are controlled by using ANN to deliver continuous controlled power with quick frequency responsiveness. Numerical simulations and a number of test scenarios have been used to validate this idea.

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 capacitances, 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.

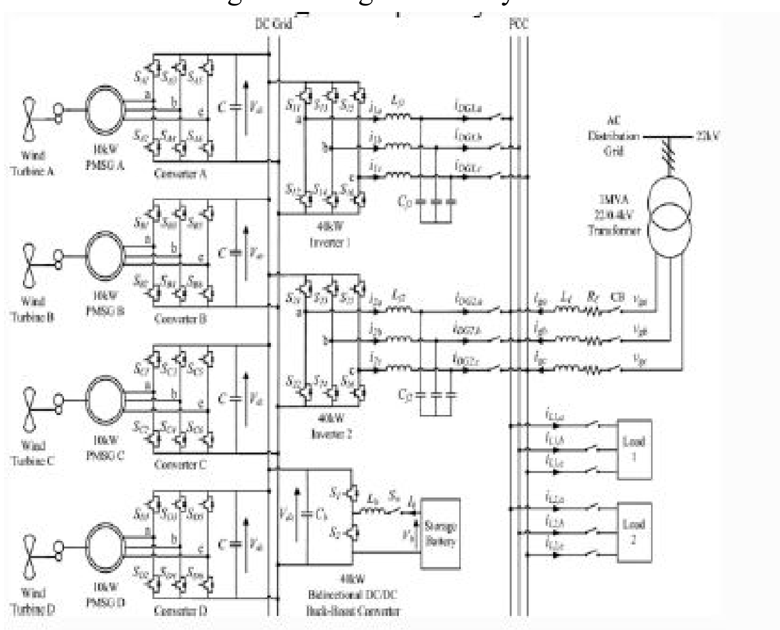

Fig.1. In a microgrid, the overall architecture of the projected dc grid-based WPG

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 singlephase 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.

II. SYSTEM MODELING

When the grid system is connected to the distributed generation, the micro grid's WTs are responsible for providing localised power to the loads, lowering the load on the power system. The SB can be configured to execute various demand side management operations such as peak reduction and valley filling based on the period of power consumption. MPC is a model-based controller that employs a receding horizon strategy, in which the proposed method computes a series of control methods to reduce the parameter optimization over the full 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 depiction of the 3 dc/ac converter and the twin 40 kW three-phase dc to ac converters that link the dc network to the PCC are similar. Kirchhoff's current and voltage laws are used to loop I and point x, etc, to generate a state-space description for the converter. As a result, a three-phase sine signal could be employed directly as the external input when functioning in the CCM. The converters will be used in the VCM during islanding mode.

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. In this case, the SB must dispatch the requisite power to make sure that the micro grid remains to function properly. The micro grid functioning is shown in the fourth case study when it is isolated from the grid. The grid system is initially linked to the power grid.

III. SIMULATION RESULTS

In MATLAB/Simulink, a simulation prototype of the planned dc grid-based wind turbine system is illustrated in Fig. 1. When the microgrid is functioning in the grid-connected or islanded method of operation, the efficacy of the proposed concept design is assessed under various operating scenarios. The values of the conversion and inverter breakdown resistance really aren't precisely understood in practical applications. As a result, these figures have been roughly calculated. :

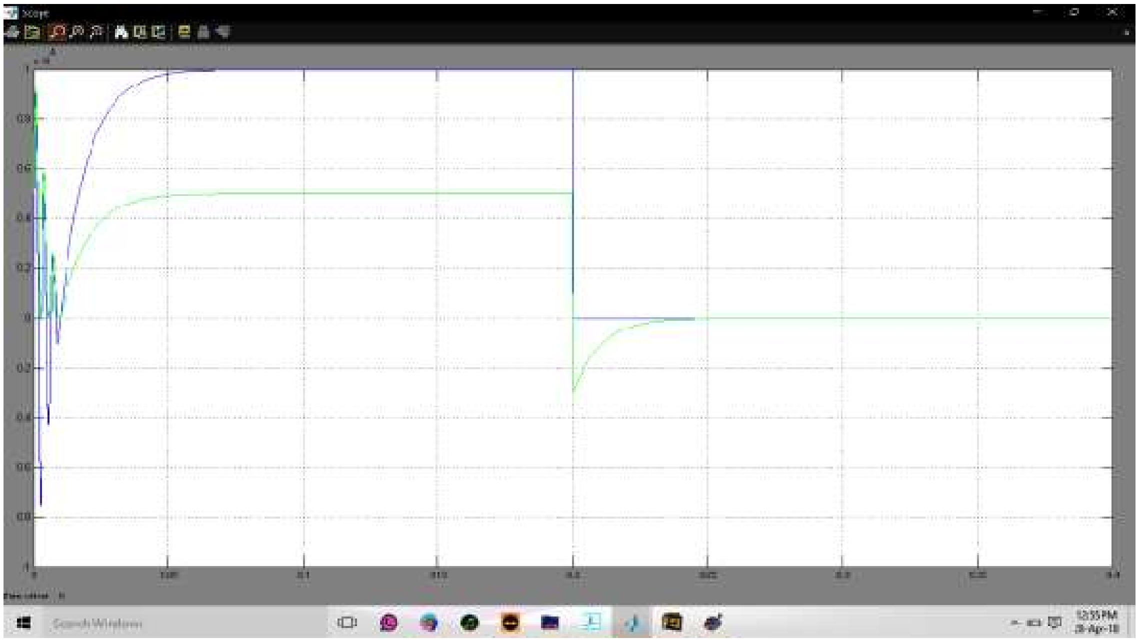

Fig. 2.Inverter 1 provides both real (top) and reactive (bottom) power..

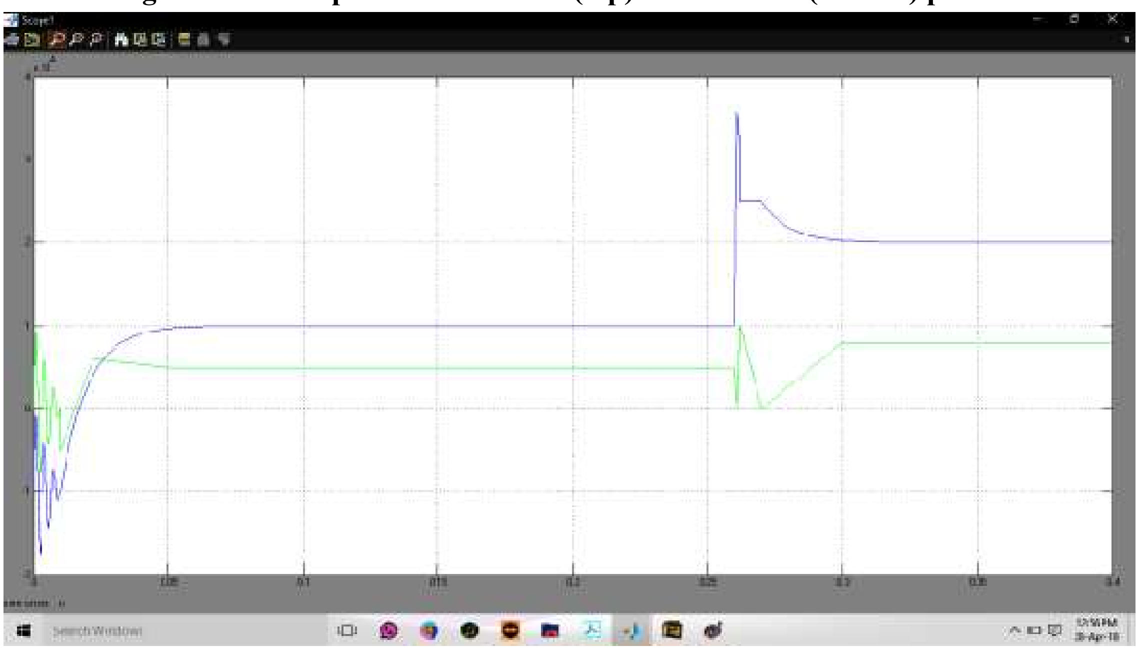

Fig. 3. Inverter 2 provides both real (top) and responsive (bottom) power.

An study of the microgrid performance when one of the inverter is turned off is performed in this test scenario. With each PMSG producing around 5.5 kW of real power, the total electricity produced by the 4 PMSGs is approximately 22 kW, which is transformed into 20 kW and 8 kVAr of active and reactive powers via inverters 2 and22. The waveforms of active and reactive powers provided by inverters 2 and 1 for 0 t 0.4 s are shown in Figs. 2 and 3. Both inverters 1 and 2 are operational for 0 t 0.2 s, and each converter delivers approximately 10 kW of actual power and 4 kVAr of reactive power to the loads.

The controller uses a time of around four cycles to monitor the power standards during the startup phase, which results in unstable measurements in the power waves for 0 t 0.08 s. Inverter 1 fails to work at t = 0.2 s, and the microgrid is unplugged, leading to a loss of 10 kW of actual power and 4 kVAr of reactive power delivered to the loads. After converter 1 is removed, the extra power provided by it is reduced to 0 in about half a cycle, as illustrated in Fig. 2. The dc grid experiences a power surges spike as a result of the unsent power, resulting in an overvoltage at t = 0.2 s, as illustrated in Fig. 6.

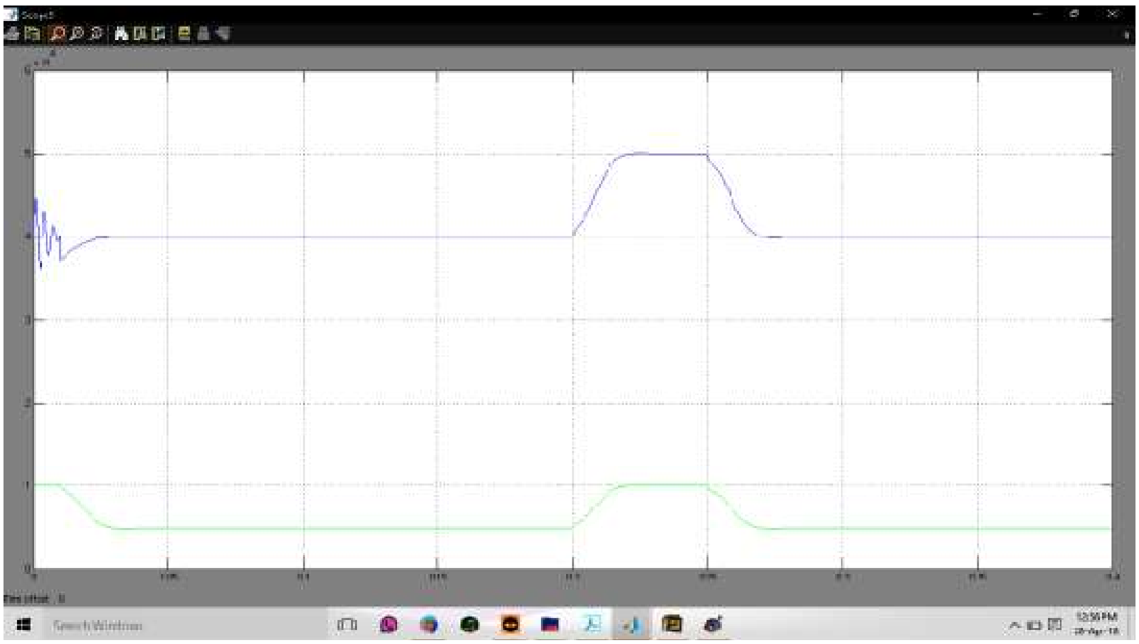

Fig. 4. The grid delivers both real (top) and reactive (bottom) power.

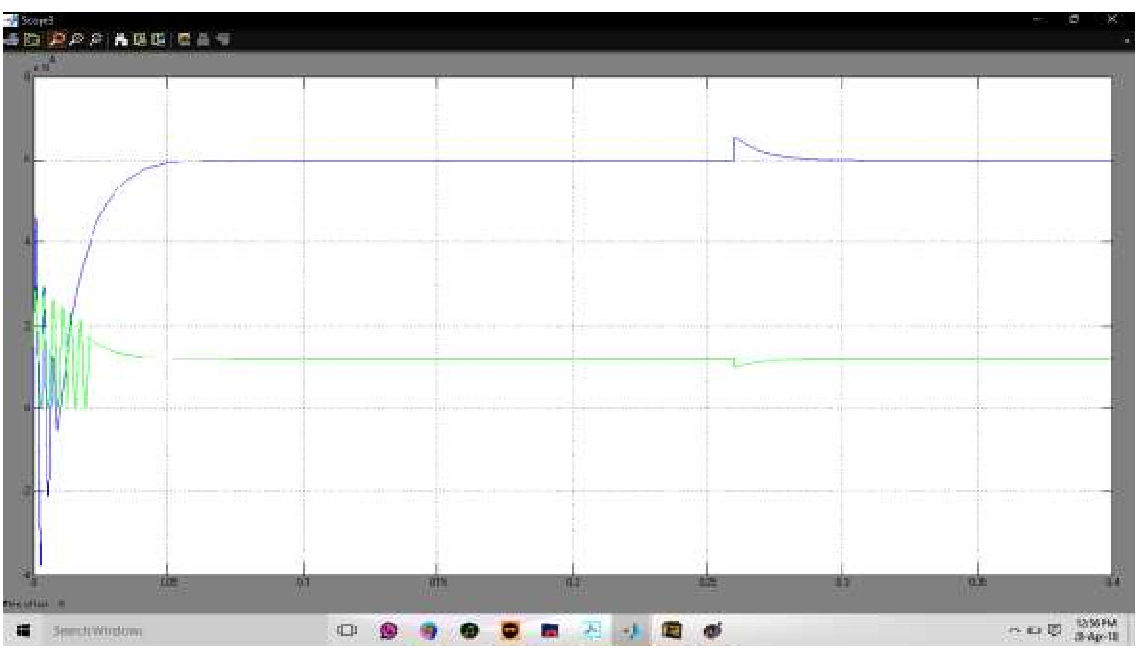

Fig. 5. Loads require both real (top) and reactive (bottom) power.

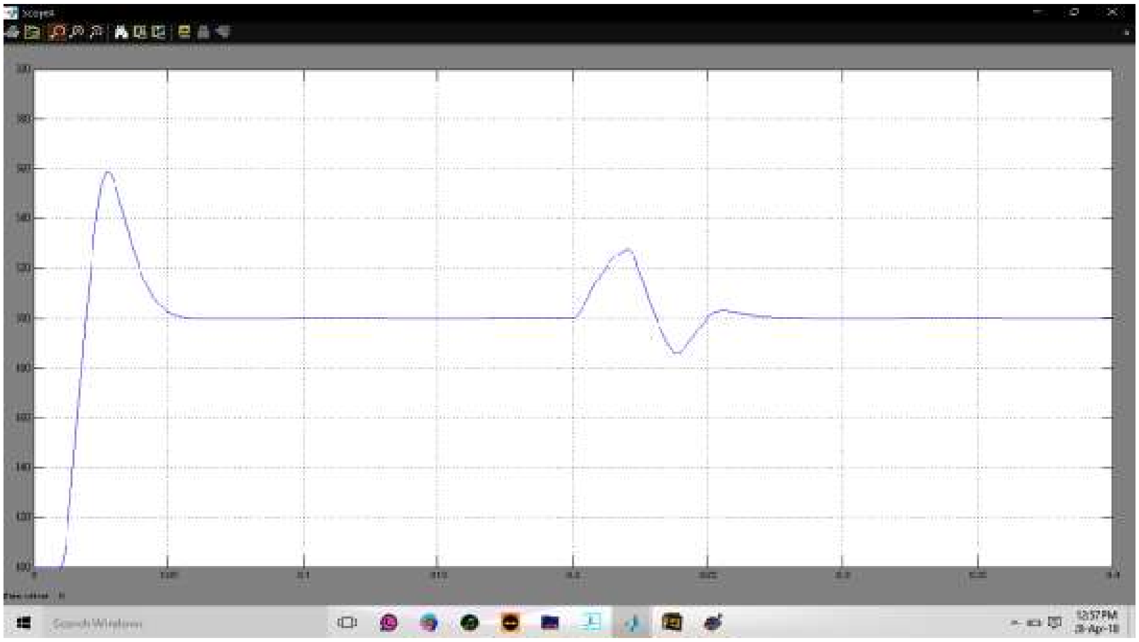

Fig. 6. Voltage on the DC grid.

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

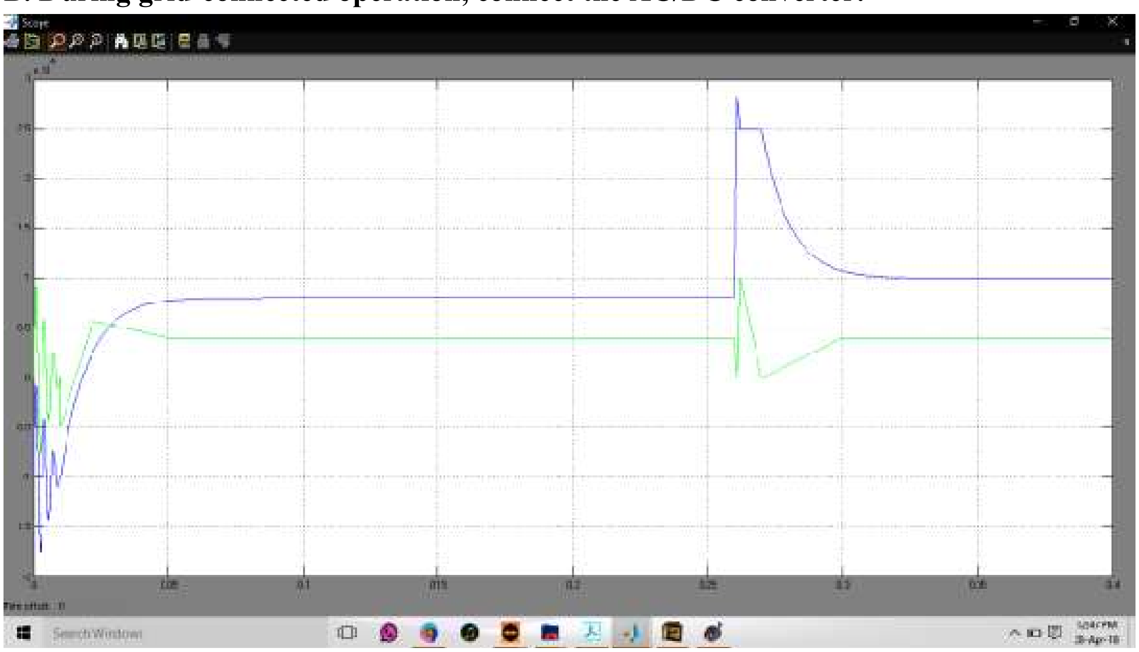

Fig. 7.Inverter 1 provides both real (top) and reactive (bottom) power..

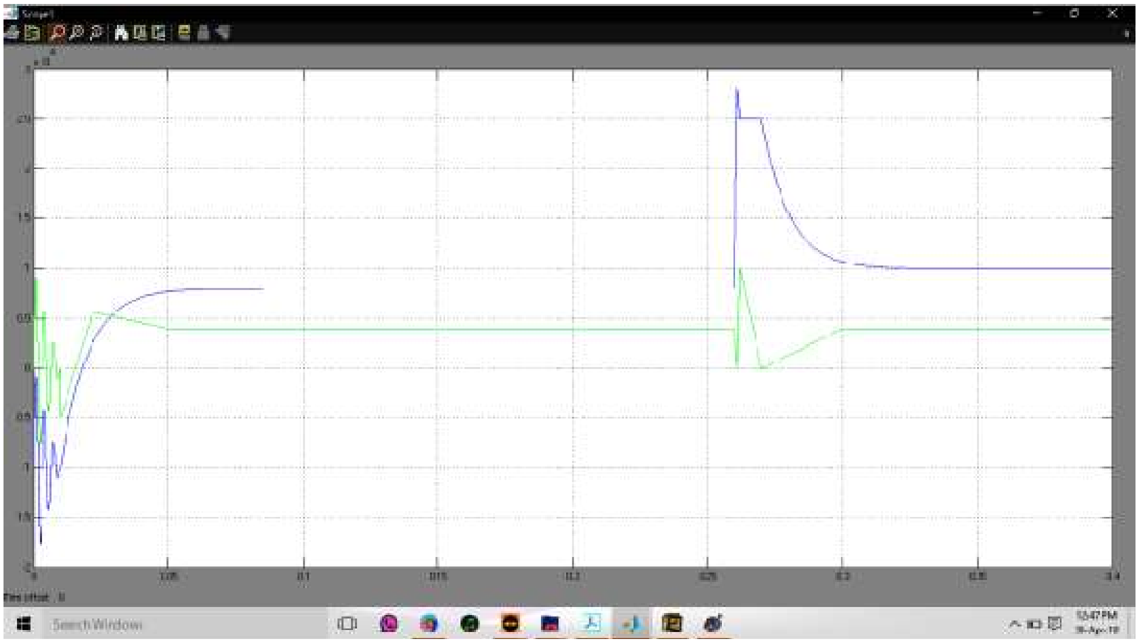

Fig. 8. Inverter 2 provides both real (top) and reactive (bottom) power.

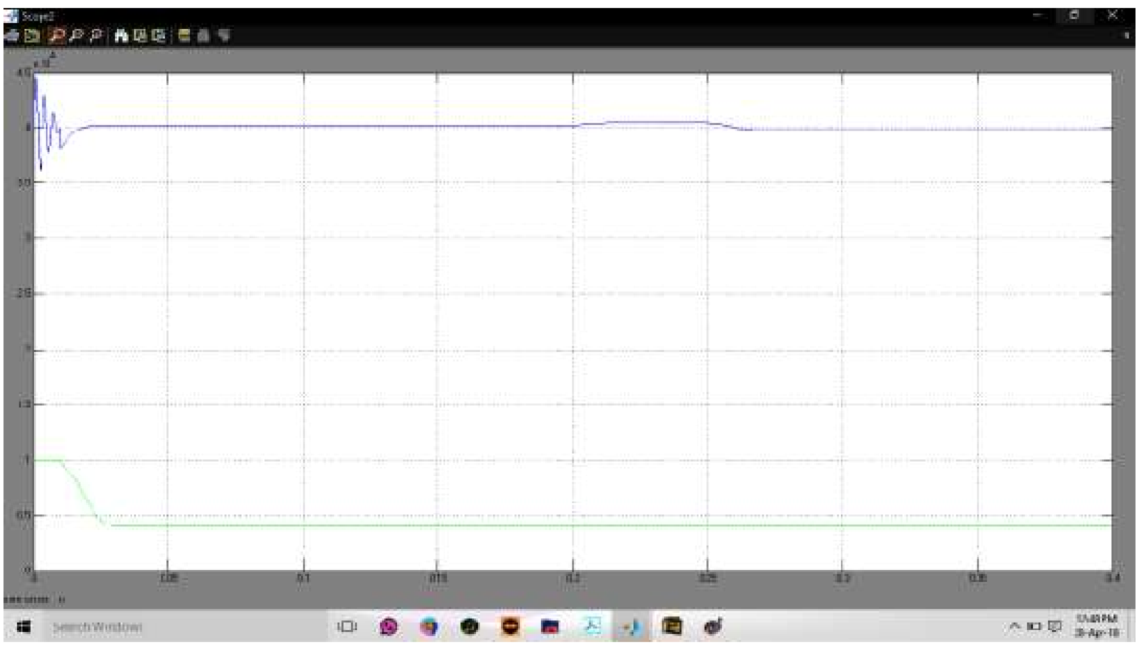

Fig. 9.The grid delivers both real (top) and reactive (bottom) power.

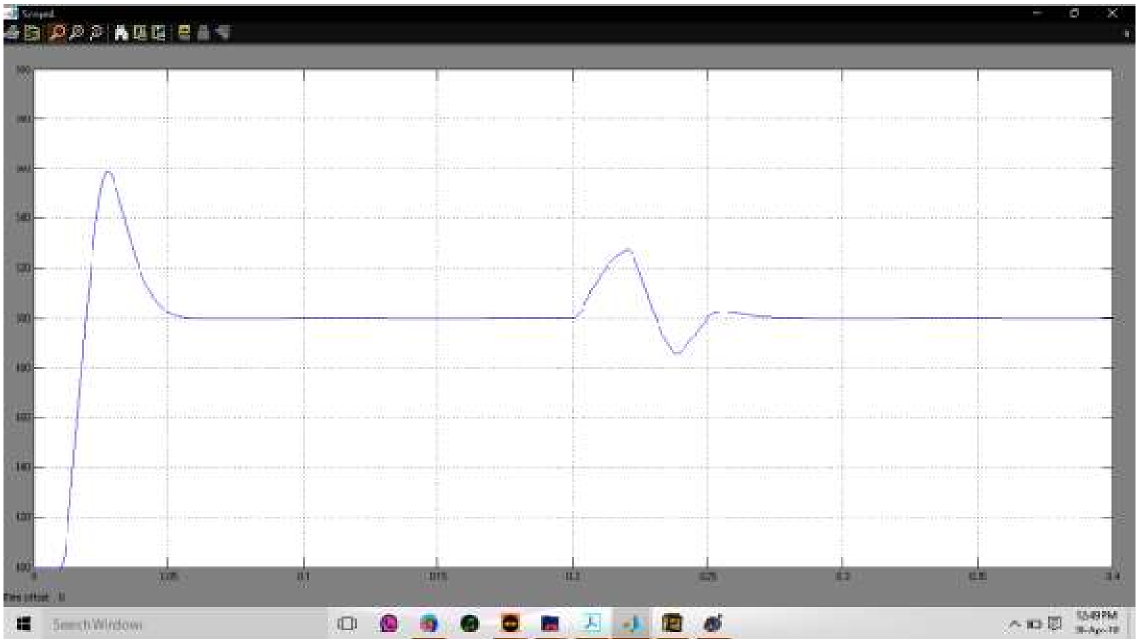

Fig. 10. Voltage on the DC grid.

The suggested dc grid-based wind generation system has the most strong benefit in that it allows any PMSG to be connected to the grid without the requirement 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. The grid supplies the rest of the actual and reactive power requirements of the loads, as indicated in Fig. 9.

C. Operation 'Islanded':

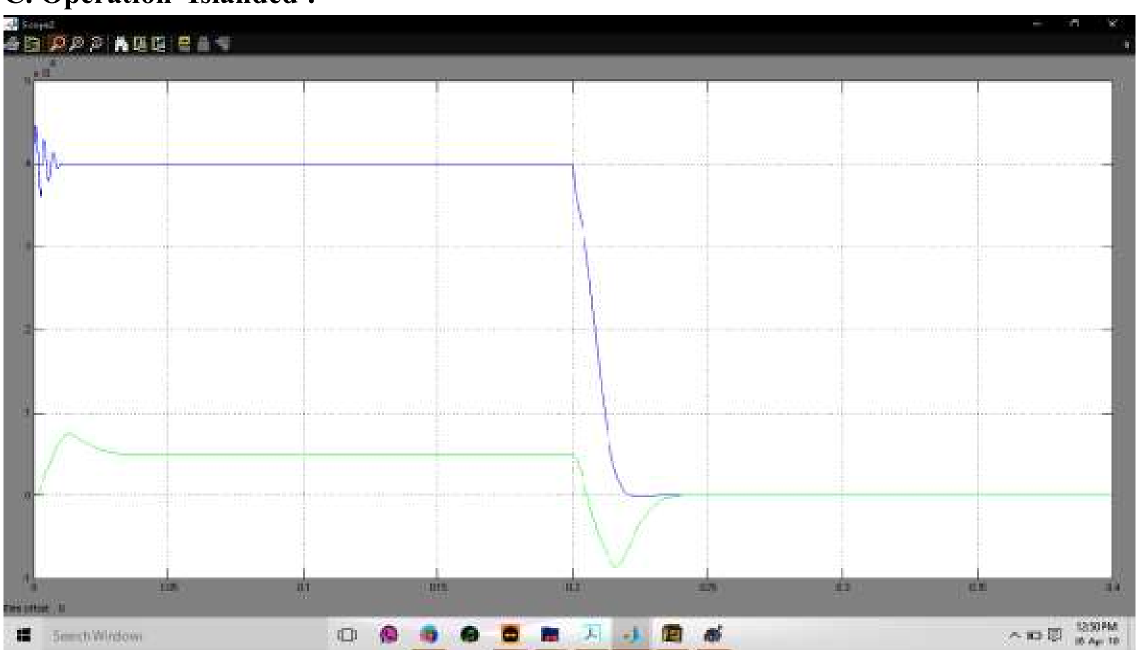

Fig. 11. The grid delivers both real (top) and reactive (bottom) power.

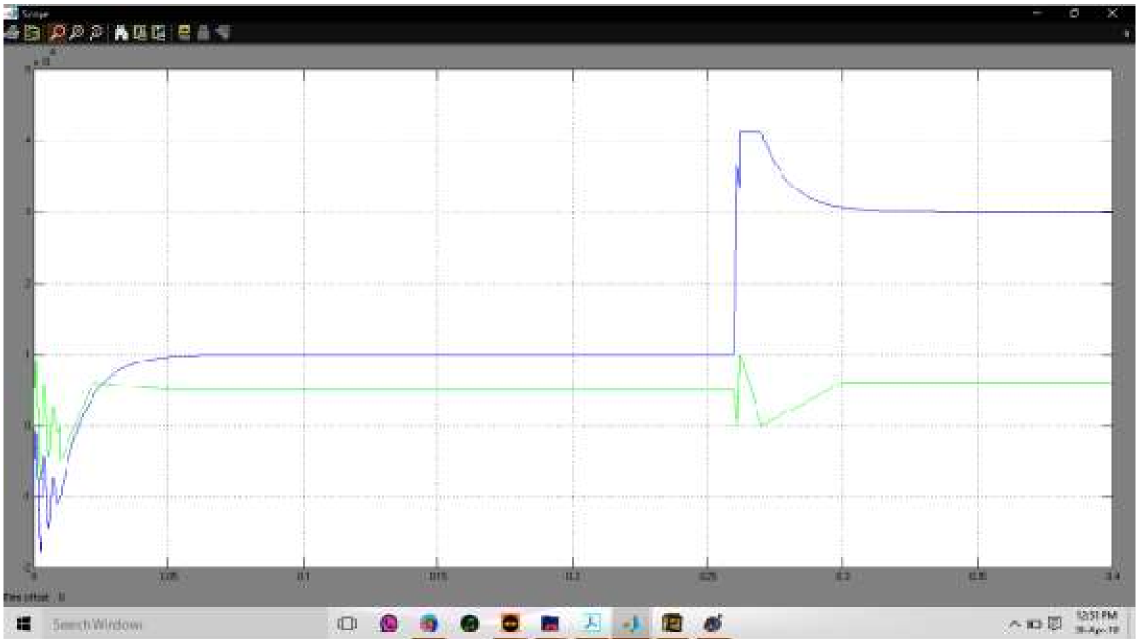

Fig. 12. Inverter 1 provides both real (top) and reactive (bottom) power.

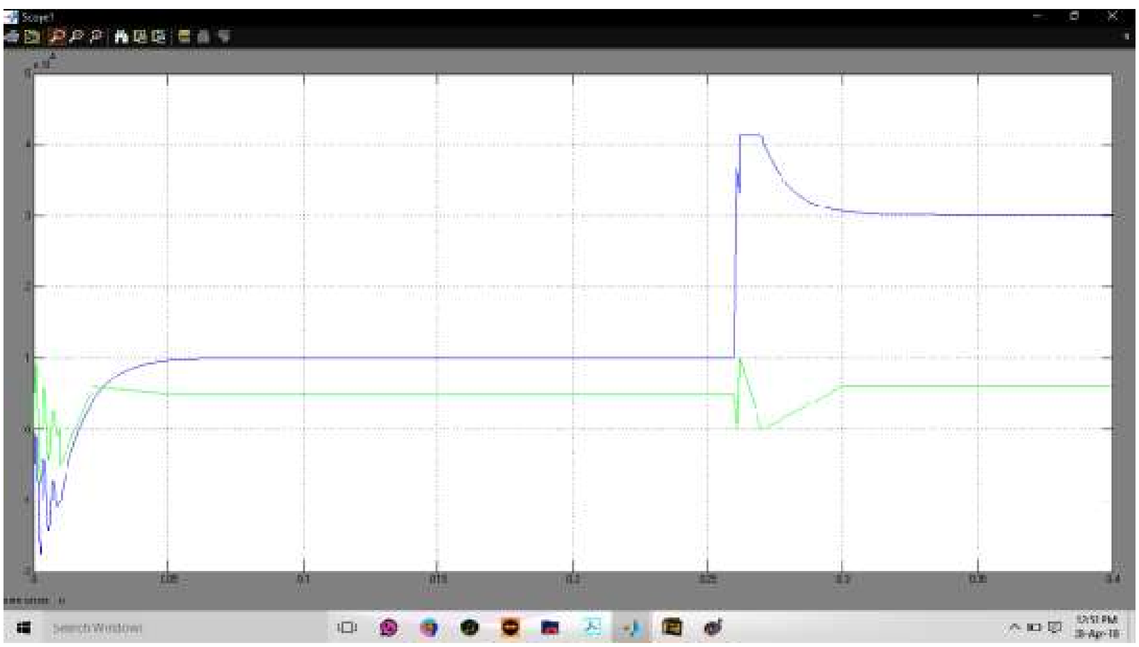

Fig. 13. Inverter 2 provides both real (top) and reactive (bottom) power.

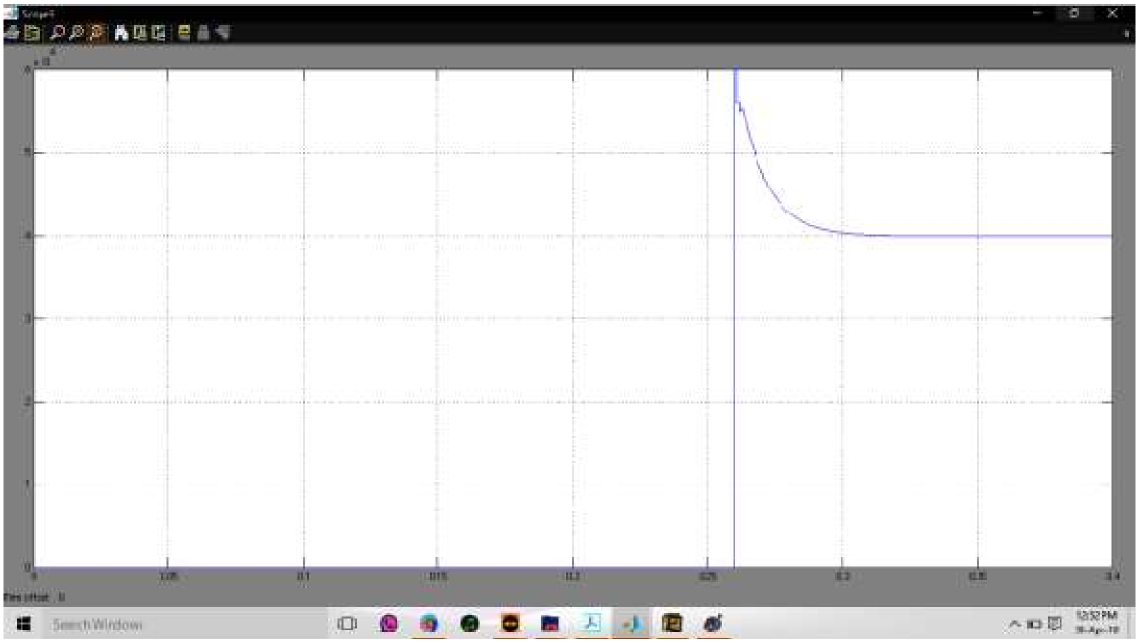

Fig. 14. SB Real power

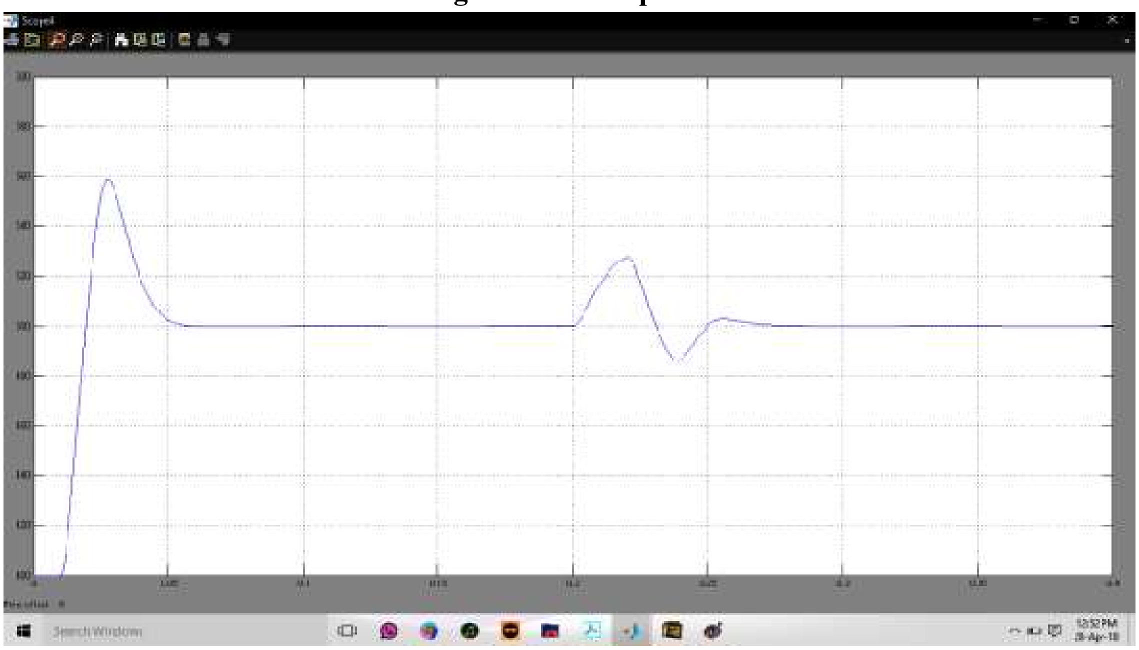

Fig. 15. Voltage on the DC grid.

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:

This workdescribes the operation of a dc grid-based renewable generator device in a dc microgrid, which enables for the parallel operation of 4 wind generators. This approach has the advantage of not requiring power or wavelength sync, allowing rotor turbines to be switched on and off with minimum disturbance. This idea is backed up by a number of studies that show the micro grid's functioning and also simulation findings that show the system's ability to operate in a reliable and flexible manner. An ANN-based control strategy is employed instead of a PI controller because it reduces the various fluctuations that a PI controller cannot rectify while concurrently regulating the speed and strain of the system.

References:

1. Yehia, Doaa M., Diaa-Eldin A. Mansour, and Weijia Yuan. "Fault ride-through enhancement of PMSG wind turbines with DC microgrids using resistive-type SFCL." *IEEE Transactions on Applied Superconductivity* 28.4 (2018): 1-5.
2. Kim, Jaewoo, SooHyoung Lee, and Jung-Wook Park. "Inertia-free stand-alone microgrid—Part II: Inertia control for stabilizing DC-link capacitor voltage of PMSG wind turbine system." *IEEE Transactions on Industry Applications* 54.5 (2018): 4060-4068.
3. Reddy, D. ChinnaKullay, S. Satyanarayana, and V. Ganesh. "Design of hybrid solar wind energy system in a microgrid with MPPT techniques." *International Journal of Electrical and Computer Engineering* 8.2 (2018): 730-740.
4. Wang, Qingsong, ShuangxiaNiu, and T. W. Ching. "A new double-winding vernier permanent magnet wind power generator for hybrid AC/DC microgrid application." *IEEE Transactions on Magnetics* 54.11 (2018): 1-5.
5. Tiwari, Shailendra Kumar, Bhim Singh, and Puneet Kr Goel. "Design and control of microgrid fed by renewable energy generating sources." *IEEE Transactions on Industry Applications* 54.3 (2018): 2041-2050.
6. Chauhan, Priyesh J., et al. "Battery energy storage for seamless transitions of wind generator in standalone microgrid." *IEEE Transactions on Industry Applications* 55.1 (2018): 69-77.
7. Hemanand, T., N. P. Subramaniam, and M. Venkateshkumar. "Comparative analysis of intelligent controller based microgrid integration of hybrid PV/wind power system." *Journal of Ambient Intelligence and Humanized Computing* (2018): 1-20.
8. Lawan, M. M. G., et al. "Wind turbine and batteries with variable speed Diesel generator for micro-grid applications." *2018 7th International Conference on Renewable Energy Research and Applications (ICRERA)*. IEEE, 2018.
9. Gowtham, K., et al. "A Management of power flow for DC Microgrid with Solar and Wind Energy Sources." *2018 International Conference on Computer Communication and Informatics (ICCCI)*. IEEE, 2018.
10. Marhaba, Mohammad Saleh, et al. "Reactive power sharing improvement of droop-controlled DFIG wind turbines in a microgrid." *IET Generation, Transmission & Distribution* 12.4 (2018): 842-849.
11. Liu, Wenzhou, et al. "Smart micro-grid system with wind/PV/battery." *Energy Procedia* 152 (2018): 1212-1217.

12. Tavakoli, Mehdi, et al. "A two stage hierarchical control approach for the optimal energy management in commercial building microgrids based on local wind power and PEVs." *Sustainable Cities and Society* 41 (2018): 332-340.
13. Dawoud, Samir M., Xiangning Lin, and Merfat I. Okba. "Hybrid renewable microgrid optimization techniques: A review." *Renewable and Sustainable Energy Reviews* 82 (2018): 2039-2052.
14. Zheng, Dehua, et al. "Short-term wind power prediction in microgrids using a hybrid approach integrating genetic algorithm, particle swarm optimization, and adaptive neuro-fuzzy inference systems." *IEEJ Transactions on Electrical and Electronic Engineering* 13.11 (2018): 1561-1567.
15. Dulău, Lucian Ioan, and DorinBică. "Optimization of generation cost in a microgrid." *Procedia Manufacturing* 22 (2018): 703-708.