SIMULATION OF CONVENTIONAL AND RENEWABLE MODULE SYSTEM BASED ON ROBUST CONTROLLER FOR GRID SYNCHRONIZATION

Hasnain Reza[1], Deep Mala[2]

[1] *M-Tech Scholar, Department of Electrical Engineering, SRK University, MP, India*
[2] *Assistant Professor, Department of Electrical Engineering, SRK University, MP, India*

ABSTRACT

Micro-grid is the major part of future electrical power structures, referred to as "smart grids". In this context, synchronization of a micro-grid with software or other micro-grids might be a critical and common challenge throughout the electricity system operation. Based on the sturdy manipulate principles, a new approach for synchronizing micro-grid. Uncertainties of the dynamic model of micro-grids had been taken into consideration as multiplicative perturbations. Based on the unsure model, a strong controller changed into designed so that the robust stability and overall performance of the device could be maximized. The simulation effects confirmed the effectiveness of the proposed manage strategy.

Keyword: *PV, DG, MPPT, Parallel architecture, Micro-Grid, Power System.*

1. INTRODUCTION

Nowadays, distributed generations (DGs) square measure incrementally penetrating into trendy electrical distribution structures because of the very fact of exigent things such as growing demand for electricity, environmental problems, and increasing responsibility in energy structures [1-2].

In this context, a micro-grid is particularly represented as a small-scale low-tension electricity provide network, which has a minimum of one decigram and is meant to deliver electrical lots for a tiny network such as a faculty field, an industrial space, and so on. And may perform in islanded or grid-linked modes. As a micro-grid is a converter-dominated network, electricity electronic interfaces have associate degree important role in their management. Micro-grids square measure foreseen to be larger sturdy and price- powerful than the standard technique of centralized grids. However, a number of technical and regulative problems together with right strength sharing among DGs in a standard micro-grid, load frequency management, synchronization with utility, and protection in each islanded and grid-connected modes square measure to be resolved before the micro-grid will come back to be large.

Micro-grids square measure key factors to mix renewable and assigned energy assets additionally to distributed energy era systems. today electrical and electricity engineers ought to face a different state of affairs within which tiny disbursed energy generators and spread power garage devices got to be incorporated put together into the grid [9-12].

The new electrical grid, conjointly named clever-grid (SG), can provide electricity from suppliers to purchaser's victimization virtual generation to manipulate home instrumentality at purchaser's homes to store strength, decreasing fee and increase responsibility and transparency. During this feel, the expected complete power widget may well be a lot of interactive, wise, and distributed. The utilization of assigned technology (DG) makes no feel while not the utilization of disbursed storage (DS) systems to modify the strength balances [3] [13-15].

In this sense, new electricity digital system can dominate the electrical grid within the next a few years. The trend of this new grid is to show dead set be {increasingly or progressively or more and a lot of} more assigned, and

consequently the strength technology and consumption regions cannot be planned on an individual basis [1] with the help of the utilization of the slump methodology, the energy sharing is ill with the output electric resistance of the units and also the line impedances. Hence, those digital output electric resistance loops will resolve this trouble. During this feel, the output electric resistance is seen as each different management variable. [16-19]

2. LITERATURE SURVEY

In this section of discusses ton of analysis papers and draw some conclusion in terms of literature gap or analysis gap so conjointly known the matter statement. This section of the paper conjointly describes the technologies behind the idea of constitutional the micro-grid into the longer-term wattage system.

[1] Ali Akhavan et al: Quality of injected current in multi-paralleled grid- connected inverters may be a matter of concern. The present controlled grid-connected inverters with LCL filter area unit wide employed in the distributed generation (DG) systems because of their quick dynamic response and higher power options. However, planning a reliable management system for grid-connected inverters with LCL filter is difficult. In this paper, the inverters with totally different characteristics in a decigram plant area unit shapely as a multivariable system. The comprehensive analysis is carried out and the coupling result is delineated.

[2] B. Kanaga Sakthivel et al: This paper describes the Simulation and analysis of hybrid energy system consisting of wind and star PV system. The wind and star PV system area unit connected to the common load through DC/DC Boost device. Generally, in low radiation PV array system electrical converter provides the lower voltage than the rated voltage that affects the power quality. It's overcome by exploitation Battery Energy Storage System.

[3] Xiaoqiang Li et al: This paper has conferred a stability analysis of an LCL-type grid-connected electrical converter within the discrete-time domain. it's been found that even although the system is stable once the resonance frequency fr is higher than common fraction of the oftenest (fs/6), a good damping theme remains needed because of the potential influence of the grid resistance.

[4] Dongsheng rule et al: during this paper, associate electrical resistance shaping technique is projected with virtual impedances, and also the current management loop is designed severally as shown within the figure two. The implementation and parameter style of the virtual impedances square measure studied below the sensible issues.

[5] Jinming Xu et al: during this paper, with the signal flow graph and response-fitting strategies, an advert technique supported the feedback of the injected grid current has been projected shown within the figure three. Then, the novel closed-loop current management needs accurately sensing the injected grid current solely, whereas no observation is required.

[6] Shao Zhang et al: An infinite supply with series inductance is typically used as a grid mortal in grid-connected distributed generation systems. Thus, high capacitance of a transmission cable (i.e., underground cable) is just too significant to be neglected. As a result, the capacitance and inductance could cause system resonance, which, in turn, challenges system stability.

[7] Moin Hanif et al: In grid connected electrical phenomenon (PV) systems, low- pass filters square measure used to scale back injected current harmonics. LCL filters have recently drawn attention for PV system grid interfaces because of their little size and that they have shown higher attenuation to shift harmonics than straightforward L filters. However, the LCL filter causes resonance leading to oscillation and in- stability problems. This paper proposes a good active damping technique by introducing a two-degree-of-freedom (2DOF) PID management structure.

[8] Alireza Kahrobaeian et al: This paper presents a strong direct single-loop cur- rent management theme supported structured singular worth (μ) reduction approach for induced-capacitor-inductor (LCL)-filtered distributed generation converters in grid-connected and isolated micro-grid modes.

[9] Weiwei Li et al: This paper investigates the feedforward schemes of grid voltages for a three-phase LCL-type grid-connected electrical converter. The full-feedforward functions of grid voltages area unit de- rived for the stationary $\alpha - \beta$ frame, synchronous d − letter of the alphabet frame, and decoupled synchronous d – letter of the alphabet frame-controlled 3-part LCL-type grid-connected inverters. The derived full-feedforward functions chiefly carry with it 3 components that area unit proportional, derivative, and second spinoff components.

[10] Jinwei He et al: during this paper, a generalized closed-loop management (GCC) theme is planned for voltage supply converters (VSCs) with LC or LCL output filters. The planned GCC theme contains a single-loop

management of electrical converter output (voltage or current) and 2 parallel virtual electrical phenomenon terms victimization further measurements.

3. SIMULINK MODEL & THEIR RESULTS

An overall diagram of a micro-grid equipped with the proposed robust controller shown in the figure 1. As can be observed, the micro-grid contains a diesel generator and an inverter-based DG such as photovoltaic, energy storage systems (ESS), etc. To design the robust controller, the micro-grid shown in figure 4.1 is considered. However, the design procedure, by considering the dynamic equations of micro-grids, can be applied to each of the desired configurations. As demonstrated in figure 1, the micro-grid consists of two DGs and local loads. The proposed robust controller has two inputs and two outputs. The inputs are voltage and frequency differences and the outputs are the control signals. The latter, as shown in figure 1, is fed to the excitation system of the diesel generator and the gate driver circuit of the inverter. The control of the inverter is associated with a digital signal processor (DSP). The control signals are demonstrated by V_R and d_R, respectively. The objective of this section is to derive the dynamic equations of the micro-grid considering these control signals.

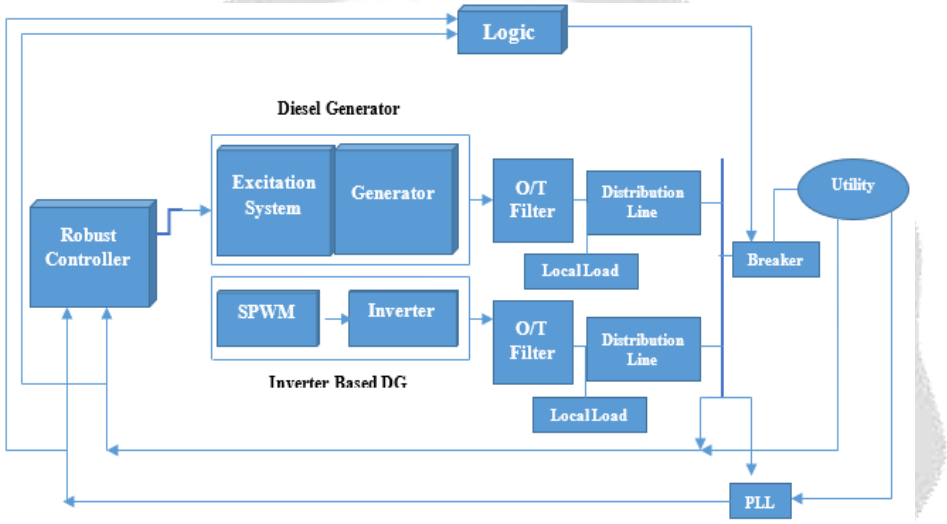

Figure 1: Micro-Grid Equipped with the Proposed Robust Controller

Table 1: Parameters for Simulink Module

A. For Diesel Generator		
1.	**Rating**	50 KVA, 380/220, 3ϕ 4-wire, 1800 rpm, 60 Hz
2.	**Exciter**	Brushless Self Exciter
3.	**K_A**	187
4.	**T_R**	0.05 Sec.
B. Inverter based DG		
1.	**Rating**	6 KVA, Vs = 400 V
2.	**Filter Inductance (L_f)**	1 mH
3.	**Filter Capacitance (C_f)**	20 μF
4.	**Filter Resistance (R_f)**	0.2 Ω
C. Distribution Line		
1.	**$R_{Line1} = R_{Line2}$**	0.01 Ω
2.	**$L_{Line1} = L_{Line2}$**	5 mH

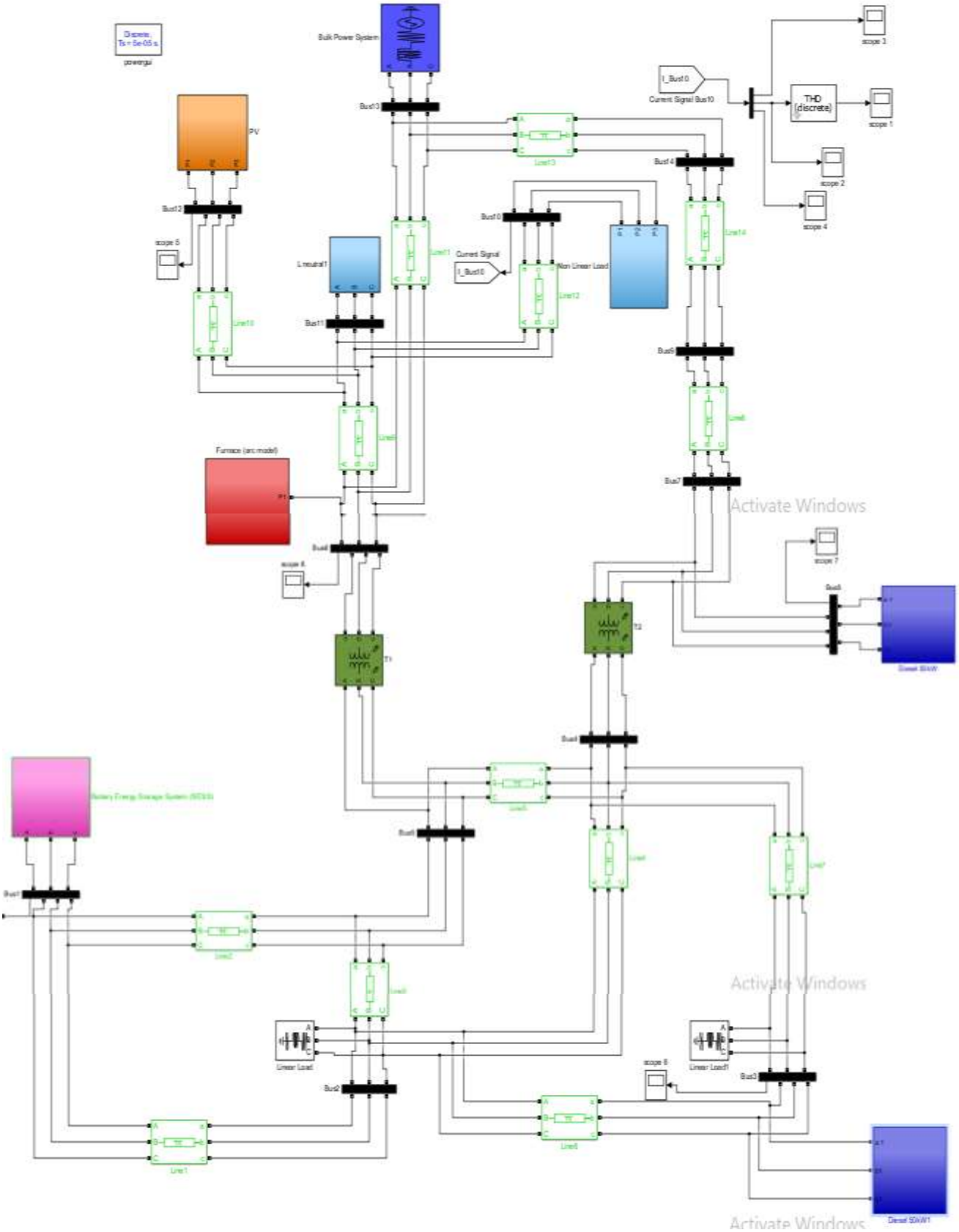

Figure 2: Proposed Robust Controller Based Model

For Linear Load

When a linear load is transferred to the load side of a structure, i.e. a diesel power plant, a diesel power plant1 and a modular photovoltaic module. In this example, the diesel generator sets the load. Linear and Photovoltaic Modular Devices The end result provides higher voltage profiles than the typical diesel generator 1 rating. Between the diesel generator set and the PV array of the equipment module, the PV modular devices provide the highest voltage configuration with the highest amplitude.

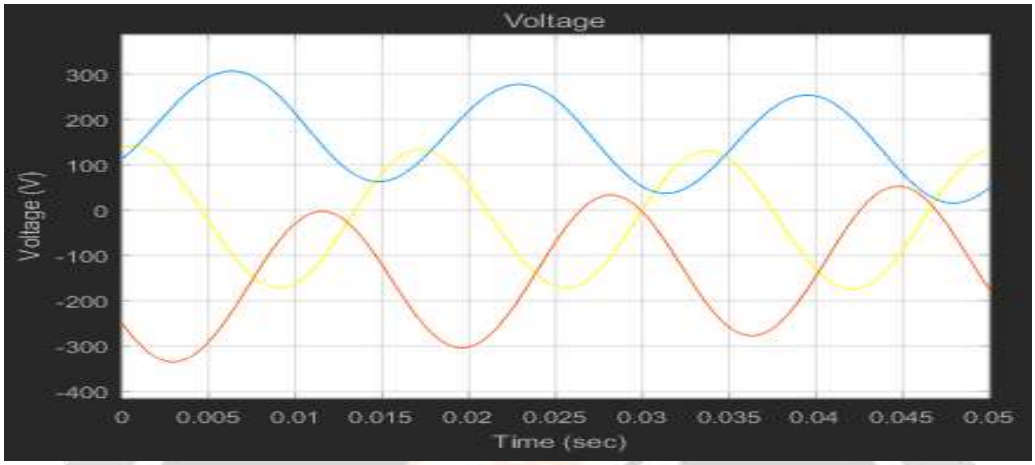

Figure 3: Voltage Response Waveform Simulink DGP-1 Module for Linear Load

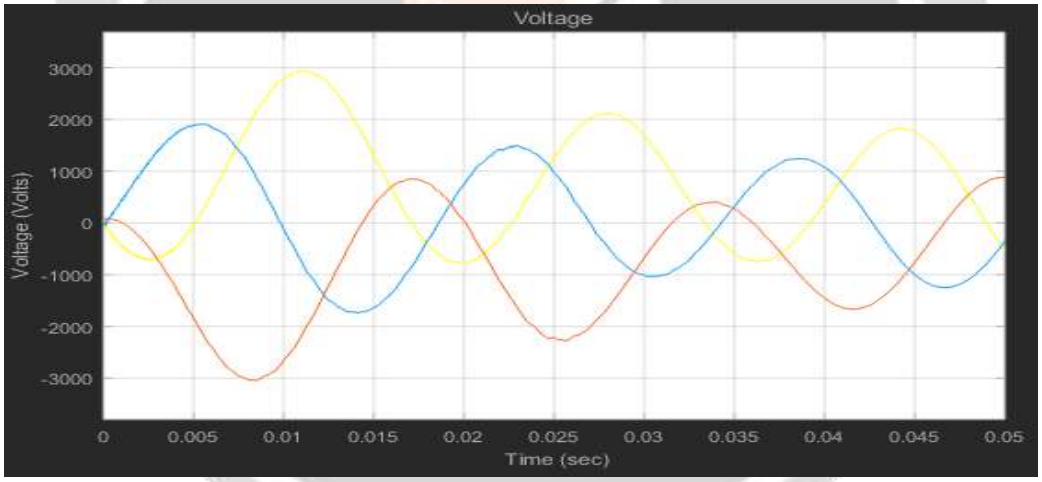

Figure 4: Voltage Response Waveform Simulink DGP Module for Linear Load

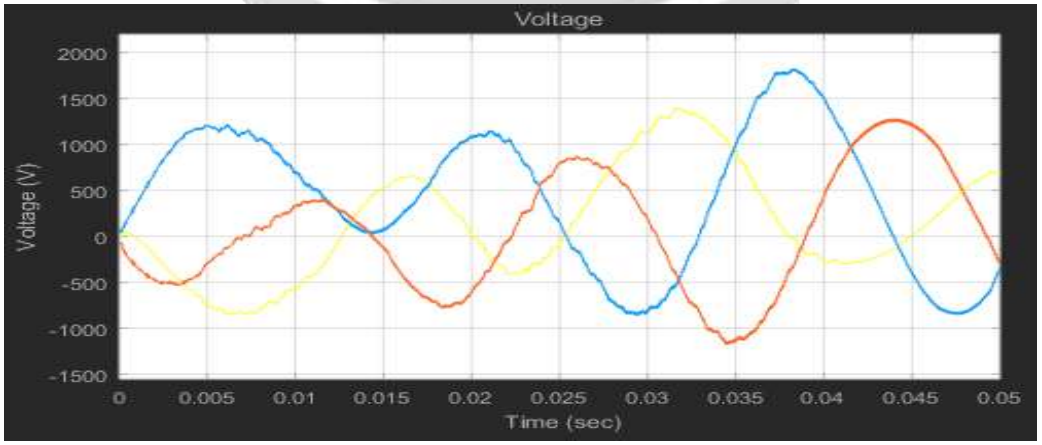

Figure 5: Voltage Response Waveform Simulink PV Module for Linear Load

For Non-Linear Load

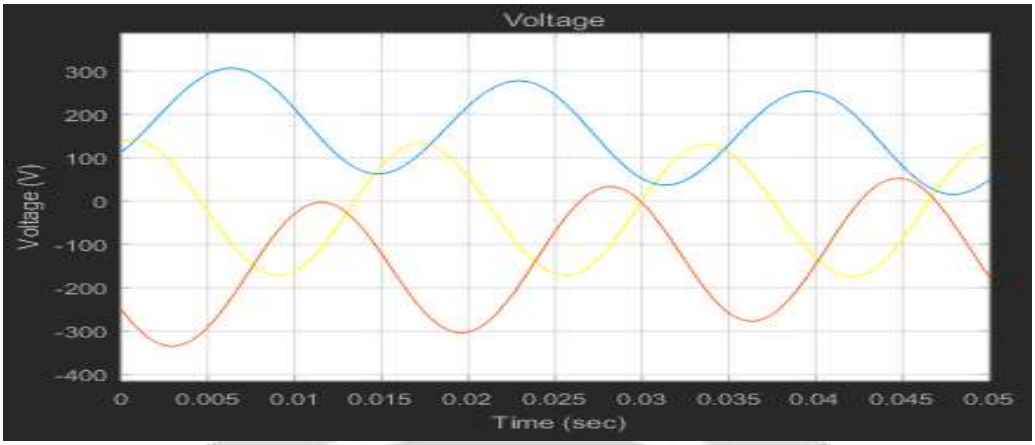

Figure 6: Voltage Response Waveform Simulink DGP-1 Module for Non-Linear Load

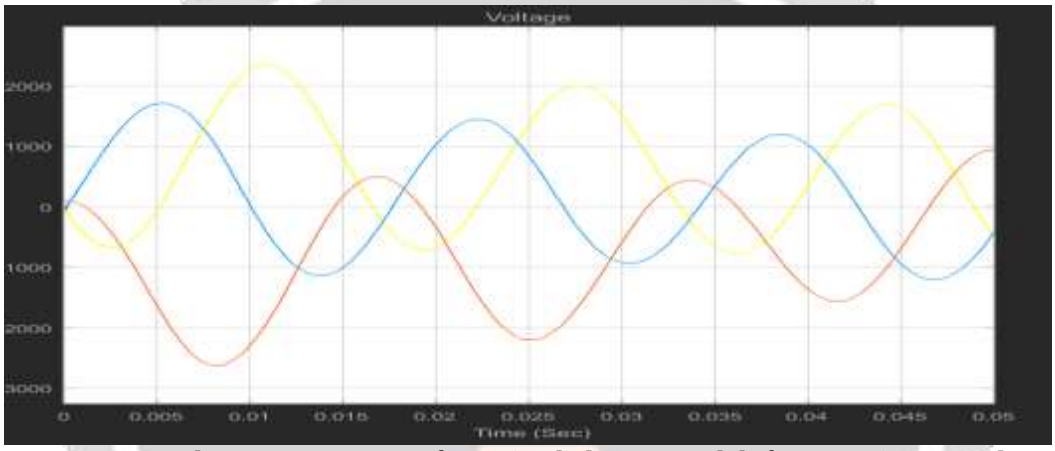

Figure 7: Voltage Response Waveform Simulink DGP Module for Non-Linear Load

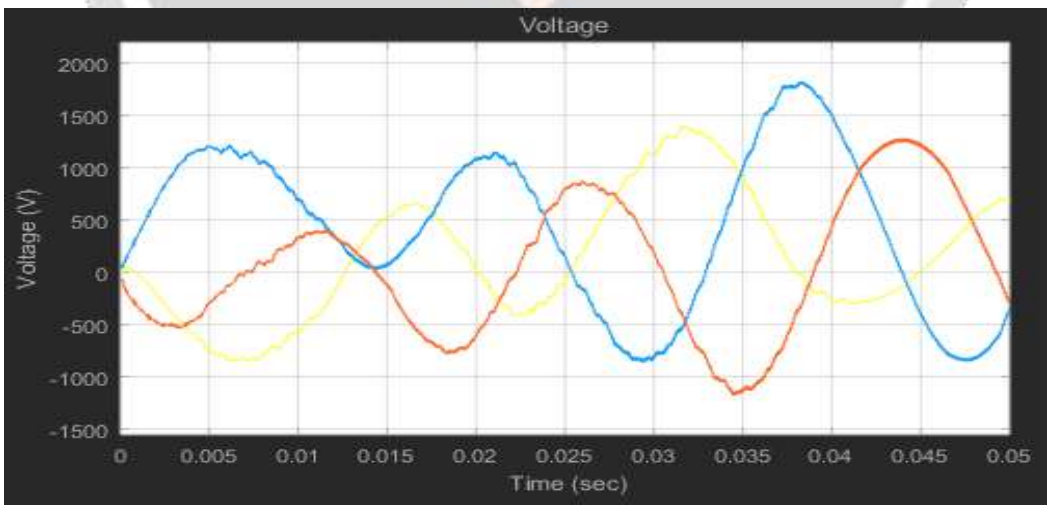

Figure 8: Voltage Response Waveform Simulink PV Module for Non-Linear Load

When non-linear loads are carried out on the load side of the structure, i.e. diesel power plants, diesel power plants1 and PV module equipment, in this situation, the diesel power plant gives non-linear loads, the solar module and computer provide a higher level -resulting voltage profile, as has been tested on conventional diesel -Generator Set 1. Between the diesel generator set and the PV array module, the PV array modules provide the highest voltage configuration with the largest amplitude.

4. CONCLUSION

Micro-Grid play a major role in the future electrical power system and important aspect to compensate the voltage profile and get better stability for the system. These techniques must make the system more reliable and efficient during the network delays or system uncertainties. In this context, a new approach based on robust control principles was proposed in this thesis which made the micro-grid much sturdier in the presence of system delays or uncertainties. The un-modeled dynamics of the system was considered multiplicative uncertainties with the nominal model of the system. Simulation results confirm that the new method will reduce frequency and power fluctuations and maintain microgrid stability during long delays or network modifications in device parameters.

5. References

[1] Ali Akhavan, Hamid Reza Mohammadi, and Josep M. Guerrero, "Modeling and Design of a Multivariable Control System for Multi-Paralleled Grid-Connected Inverters with LCL Filter", in International Journal of Electrical Power & Energy Systems. IEEE Transaction January 2018.

[2] B. Kanaga Sakthivel and Dr. D. Devaraj, "Modelling Simulation and Performance Evaluation of Solar PV-Wind Hybrid Energy System", 978-1-4799-7678-2/15/$31.00 © 2015 IEEE.

[3] Xiaoqiang Li, Xiaojie Wu, Yiwen Geng and Xibo Yuan, "Wide Damping Region for LCL-Type Grid-Connected Inverter with an Improved Capacitor-Current-Feedback Method", 10.1109/TPEL.2014.2364897, IEEE Transactions on Power Electronics 2014.

[4] Dongsheng Yang, Xinbo Ruan, and Heng Wu, "Impedance Shaping of the Grid-Connected Inverter with LCL Filter to Improve Its Adaptability to the Weak Grid Condition", DOI: 10.1109/TPEL.2014.2300235, IEEE Transactions on Power Electronics · November 2014.

[5] Jinming Xu, Shaojun Xie and Ting Tang, "Active Damping-Based Control for Grid-Connected LC L-Filtered Inverter with Injected Grid-Current Feedback Only", Pp. 4746-4758, IEEE Transactions on Industrial Electronics, Vol. 61, No. 9, September 2014.

[6] Shao Zhang, Shuai Jiang, Xi Lu Baoming Ge and Fang Zheng Peng, "Resonance Issues and Damping Techniques for Grid-Connected Inverters with Long Transmission Cable", Pp. 110-120, IEEE Transactions on Power Electronics, Vol. 29, No. 1, January 2014.

[7] Moin Hanif, Vinod Khadkikar, Weidong Xiao and James L. Kirtley, "Two Degrees of Freedom Active Damping Technique for LCL Filter-Based Grid Connected PV Systems", IEEE Transactions on Industrial Electronics, Pp. 2795-2803, Vol. 61, No. 6, June 2014.

[8] Alireza Kahrobaeian and Yasser Abdel-Rady I. Mohamed, "Robust Single-Loop Direct Current Control of LCL-Filtered Converter-Based DG Units in Grid-Connected and Autonomous Micro-grid Modes", IEEE Transactions on Power Electronics, Pp. 5605-5619, Vol. 29, No. 10, October 2014.

[9] Weiwei Li, Xinbo Ruan, Donghua Pan and Xuehua Wang, "Full-Feedforward Schemes of Grid Voltages for a Three-Phase LC L-Type Grid-Connected Inverter", IEEE Transactions on Industrial Electronics, Pp. 2237-2250, Vol. 60, No. 6, June 2013.

[10] Jinwei He and Yun Wei Li, "Generalized Closed-Loop Control Schemes with Embedded Virtual Impedances for Voltage Source Converters with LC or LCL Filters", IEEE Transactions on Power Electronics, Pp. 1850-1861, Vol. 27, No. 4, April 2012.

[11] Jinwei He and Yun Wei Li, "Generalized Closed-Loop Control (GCC) Schemes with Embedded Virtual Impedances for Voltage Source Converters", Pp. 479-486, 978-1-4577-0541-0/11/$26.00 © 2011 IEEE.

[12] Algorithms for Synchro phasor Enabled Digital Relay in Differential Protection Scheme, Proceedings of International Conference on Recent Advancement on Computer and Communication, Lecture Notes in Networks and Systems 34, Https://Doi.Org/10.1007/978-981-10-8198-9_4, Book Id: 448040_1_En, Book ISBN: 978-981-10-8197-22018, Springer Nature Singapore Pvt. Ltd.

[13] A Review on Different Types of Wind Generation, Anusandhan, Rabindranath Tagore University, Volume: 7, Issue: 14, Month: Sep, 2018. Http://Aujournals.Ipublisher.In/I/A/57827

[14] Impact Assessment of Wind Farms on IEEE 14 Bus System for Small Signal Stability Analysis, 2018 IJRAR, Volume 5, Issue 4, December 2018

[15] Grid Side Converter Modeling In PMSG For System Level Studies in Average Value Model, JETIR, Volume 5, Issue 12, December 2018

[16] D-fig Based Wind Farm Integrated to Power Systems for Small Signal Stability Analysis." JETIR, Volume 5, Issue 11, November 2018

[17] Cyber Physical Systems and Resilience in Micro Grid, Anusandhan, Rabindranath Tagore University, Volume: 7, Issue: 14, Month: Sep, 2018. Http://Aujournals.Ipublisher.In/I/A/57822

[18] Sustainability and Resilience of Micro-grid In Rural Environment, JETIR, Volume 5, Issue 11, November 2018.

[19] Converter Interfaced Micro Sources among Rural distributed Generation for Resilience in Micro grid, IJRAR, Volume 5, Issue 04, and December 2018.