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"IMPLEMENTATION OF RENEWABLE ENERGY BASED CONTROL AND MANAGEMENT OF HYBRID AC/DC MICROGRIDS"

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ABSTRACT

Eco-friendly technologies regarding electricity production are urgent need of sustainable energy development.The renewable energy resources (RERs) have brought green revolution in mitigation of greenhouse gaseous emission resulted from traditional energy resources (TERs). Moreover, the effective utilization of these resources is influenced by pricing schemes which have limitations. Therefore, this paper aims at optimization modeling for dynamic price-based demand response (DR) which includes flexible and inflexible loads along with the effective utilization of RERs i.e. photovoltaic (PVs) and wind turbines (WTs) in a Microgrid (MG). This Thesis primary purpose is to use a multi-agent system (MAS) to develop a distributed Microgrid automation model to realize complex organize or distributed Microgrid energy management. This article introduces the energy-saving smart grid control system for network and island state control. A new concept is proposed to use distributed production (D.G.) to improve the power quality (P.Q.) in low-voltage networks. Compared to the traditional method, the conventional method requires using the committed property to recompense for power quality disturbances. The proposed idea is to form a Microgrid (M.G.) that can be isolated from the public network operate on islands when disruptions occur. This article discusses the conditions for creating islands and proposes a control strategy for a small active network of micro turbines, renewable energy, loads, or storage systems. This strategy assumes that the energy storage device is used as a network generating machine for the island operation. The central controller is used to monitor the network operation in network connection and island mode. The coordination between the agents ensures the Microgrid's current quality, power, or frequency by influential set points to improve the Microgrid's full operation. In this way, the Microgrid can efficiently integrate different D.G. resources (distributed power generation), particularly renewable power. It can provide emergency power that can be converted between island and connection states. Control and protection are the challenges .this the proposed control architecture and strategies will be performed on the MATLAB Simulink platform.

Keyword: *Solar Panel, MPPT, DG System ,AC bus ,DC-DC converter, Wind.*

I. INTRODUCTION

The power scheme is a network consisting of power generation, circulation and transmission systems. It uses forms of energy (like coal and diesel) or converts it into energy. The power system comprises equipment connected to the system, such as synchronous generators, motors, transformers, switches, conductors, etc.Power plants, transformers, transmission lines, substations, distribution lines or distribution transformers are the six main components of the distribution system[1]. The power generated by the power plant is increased or stepped down through the transformer.

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Transmission lines transmit power to various transformer stations. Through the substation, the current is transmitted to the distribution transformer, which reduces the current to a suitable value that suits the user. The power system is a network which consists generation, distribution and transmission system. It uses the form of energy (like coal and diesel) and converts it into electrical energy. The power system includes the devices connected to the system like the synchronous generator, motor, transformer, circuit breaker, conductor, etc. The power plant, transformer, transmission line, substations, distribution line, and distribution transformer are the six main components of the power system. The power plant generates the power which is step-up or step-down through the transformer for transmission.

In ac MGs, nonlinear and adaptive droop control strategies have been used in the secondary [2] and primary control level [3]–[7], for control of wind power generation unit to participate in MG frequency control [8], primary voltage/frequency stabilization, enhancing active/reactive power-sharing harmonic power-sharing and optimizing MG operation [9]. Nonlinear and adaptive droop control techniques have also been investigated for dc MGs for decentralized control, distributed control, decentralized load sharing and voltage control and load sharing .Another nonlinear control strategy based on sliding mode control (SMC) has also been reported in [15]. Nonlinear control strategies have been used for the control of interlinking converters (ICs), and hybrid MGs.In [16], a new control scheme has been introduced based on a robust nonlinear state feedback control concept for robust control of a bidirectional interlinking converter (BICs) in a hybrid ac/dc MGs.

Many renewable energy sources provide dc output. Solar photovoltaic and fuel cells produce integrated nonlinear hierarchical control and management for hybrid ac/dc MGs. Finally, to evaluate the proposed nonlinear control strategy's performance, offline digital time-domain simulation studies are carried out on a test MG system in MATLAB/Simulink environment. The results are also compared with previously reported methods. The simulation results and the comparisons showed that the proposed methods could properly share the power among subgrids and DGs in both ac and dc subgrids. In contrast, the proposed control scheme can prove its effectiveness and superiority over conventional controllers

II. Proposed System

This paper proposes intelligent energy-saving system architecture for Microgrid control and management. In the MAS-based intermittent Microgrid network for renewable energy optimization, the agent-based reproduction method is used to model Microgrid. The interaction between different intellectual decision-makers is examined through reproduction—the whole system. A smart grid is a system where the energy system requires a decentralized control structure. Still, it cannot quickly transform from a central control structure to a decentralized control structure. In this proposal, some new partial control architectures are designed for different types of renewable resources. In this work, generators and fuel cells can generate controlled active power as needed. Therefore, they can be used to adjust voltage and frequency under the island. On the contrary, photovoltaic systems are not planned resources because their output depends mainly on climatic conditions. This believes a hybrid Microgrid is apposite for incorporating renewable or circulated energy and includes an energy storeroom system. Figure 1 shows the schematic arrangement of a hybrid Microgrid modeled in MATLAB. There are several reasons for the Microgrid; in the Microgrid operating mode, it is most suitable as an auxiliary power source. In addition, a power-sharing technique was developed for distributing distributed generators (D.G.) in a micro-network.

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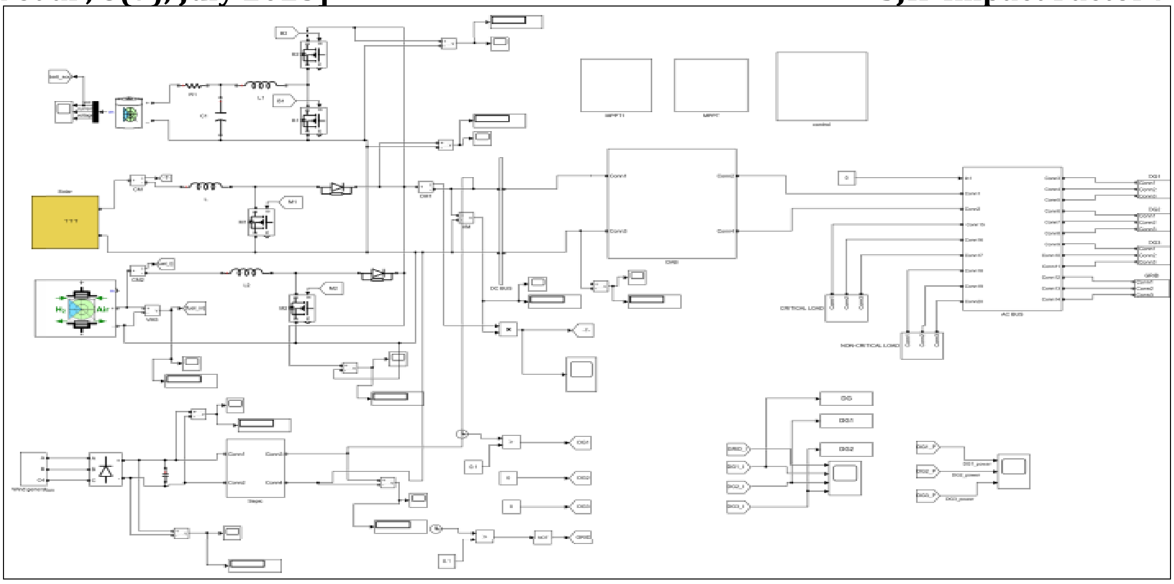

Fig.1 Proposed Simulink Model

Initial Design Parameters

Solar panel

Short circuit current--10

Open circuit voltage-----11.05

Open circuit voltage-----11.05

Voltage at Pmax 12

Fuel cell Voltage (V) =65

Maximum operating point (V,I)=133.3 -45

Number of Cell= 65

Micro grid

Nominal Power-->1000

Frequency----->60Hz

Active power------>10e3(W)

Boost Converter: A boost converter is a switch-mode DC-to-DC converter where the output voltage is superior to input power. It is also called a boost converter. The boost converter gets its name because the input voltage, like the boost transformer, is boosted to a level superior to the input power. According to the law on energy saving, input power must be equal to the output power (provided that there is no loss in the circuit).[19-20]

$$\text{Input power } (P_{in}) = \text{output power } (P_{out})$$

Since $V_{in}<V_{out}$ In a boost converter, output recent is less than input present. Then in the boost converter.

$$V_{in}<V_{out} \text{and } I_{in}>I_{out}$$

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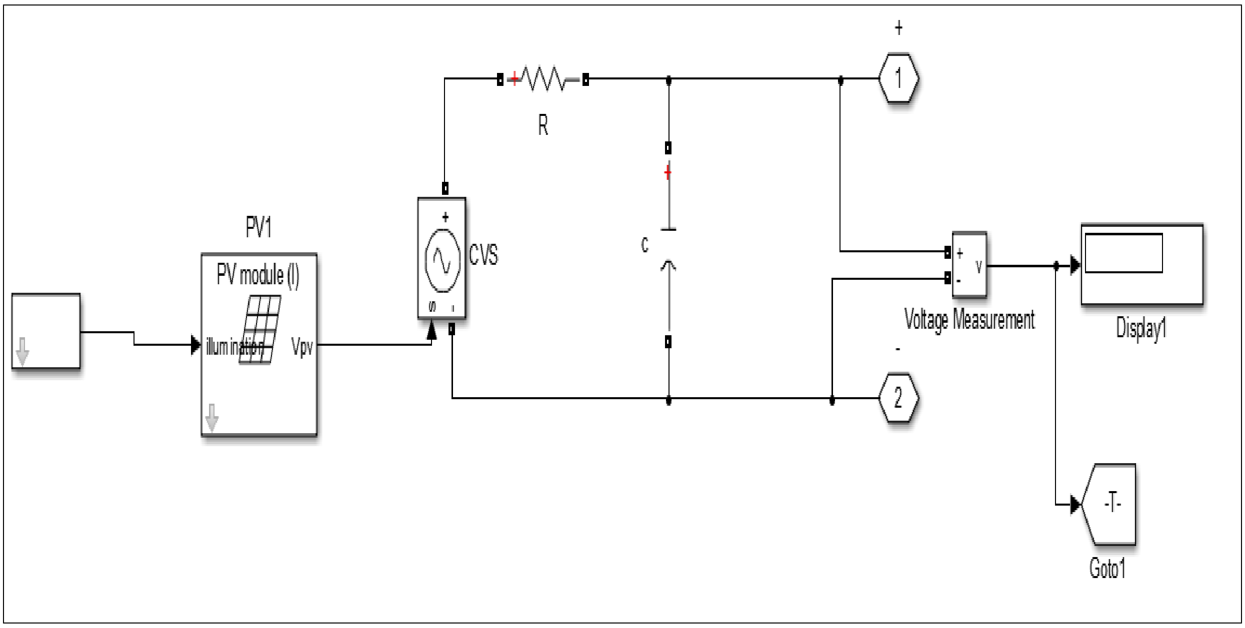

Fig 3 Solar Panel

Operation is shown in Figure 3 The model gives the solar cell model as it is now, a combination of 2 exponential diodes and a corresponding resistor Rp, and related in series with resistor Rs. The production wave I provide is

$$I = Iph - Is*(e^{((V+I*Rs)/(N*Vt))}-1) - Is2*(e^{((V+I*Rs)/(N2*Vt))}-1) - (V+I*Rs)/Rp$$

Is or Is2 are diode diffusion current, and Vt is thermal power, N or N2 are quality factors (diode emission coefficient), or Iph is the current production by solar energy.

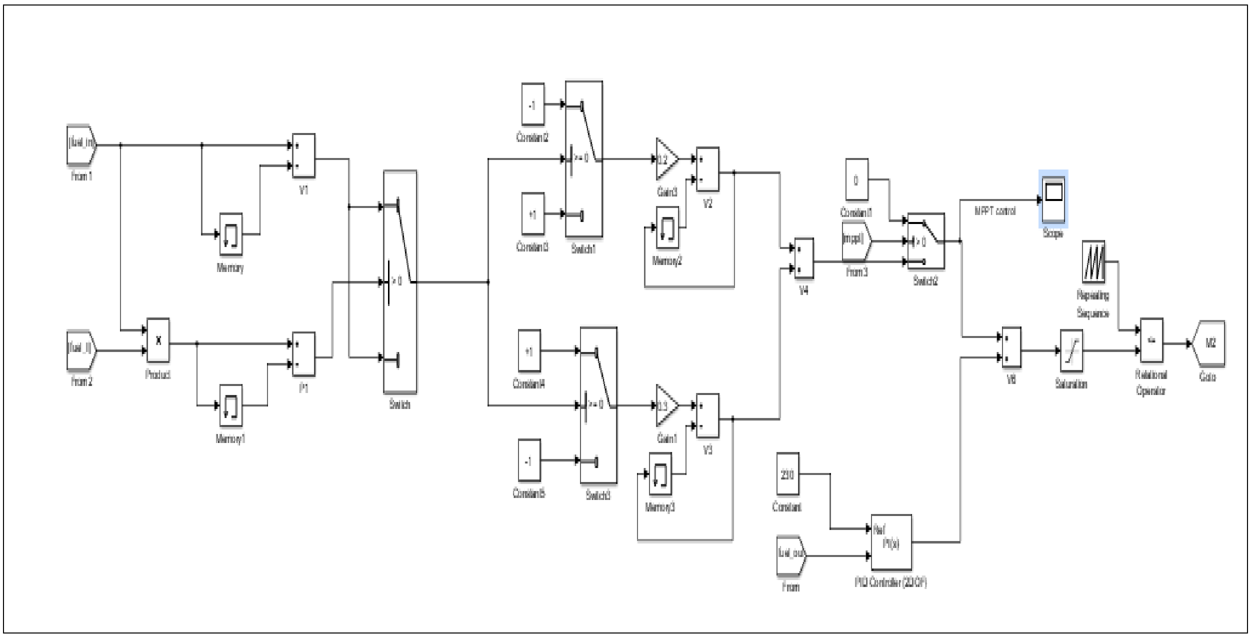

Fig.4 MPPT for solar panel

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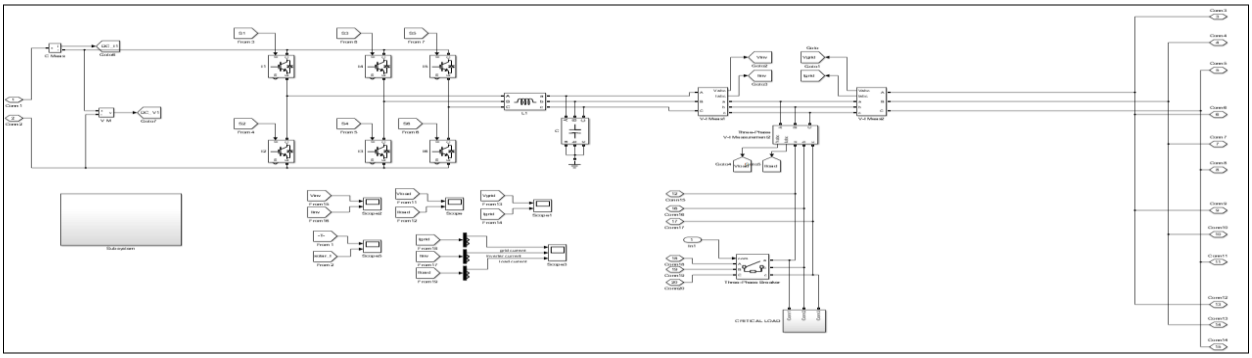

Fig.5A.C. Bus

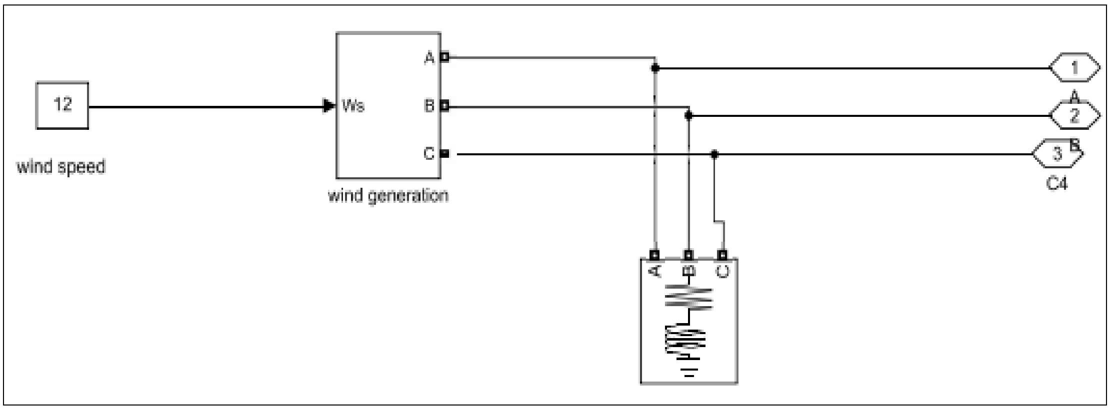

Figure 6 Wind Simulink Model

An electric wind system is made up of a wind turbine mounted on a tower to better access stronger winds. In addition to the turbine and tower, small wind electric systems also require balance-of-system components.

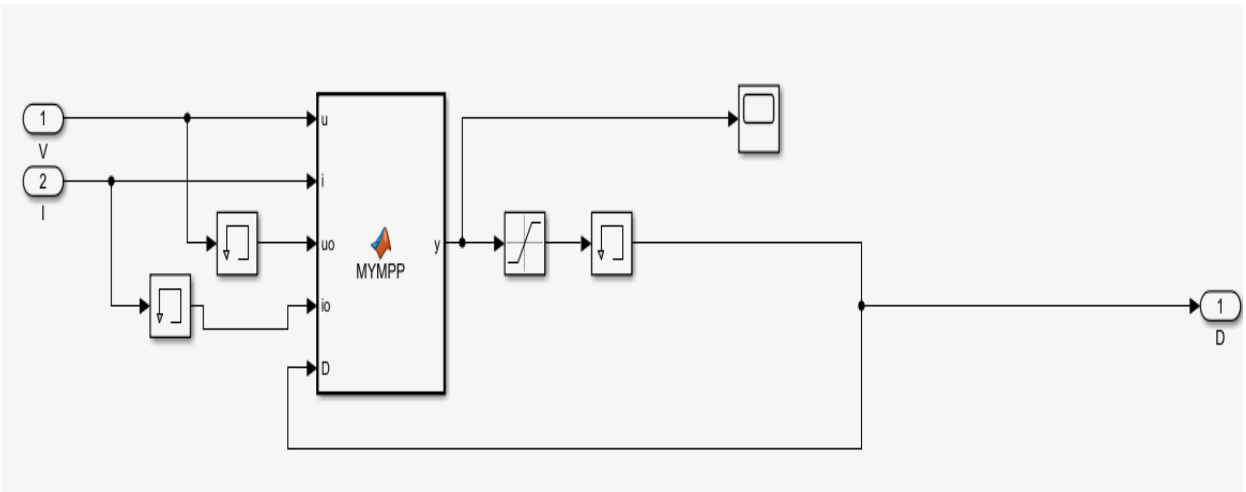

Figure 7 : Sepic Converter Model

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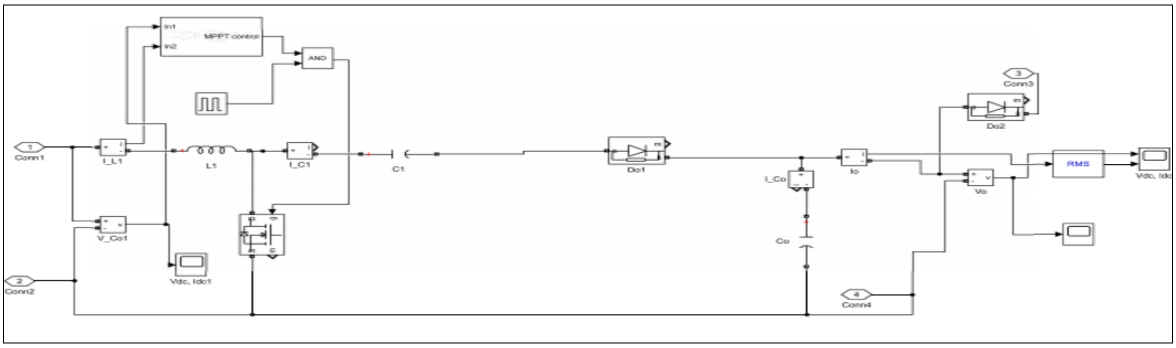

Figure 8: Incremental MPPT for wind system

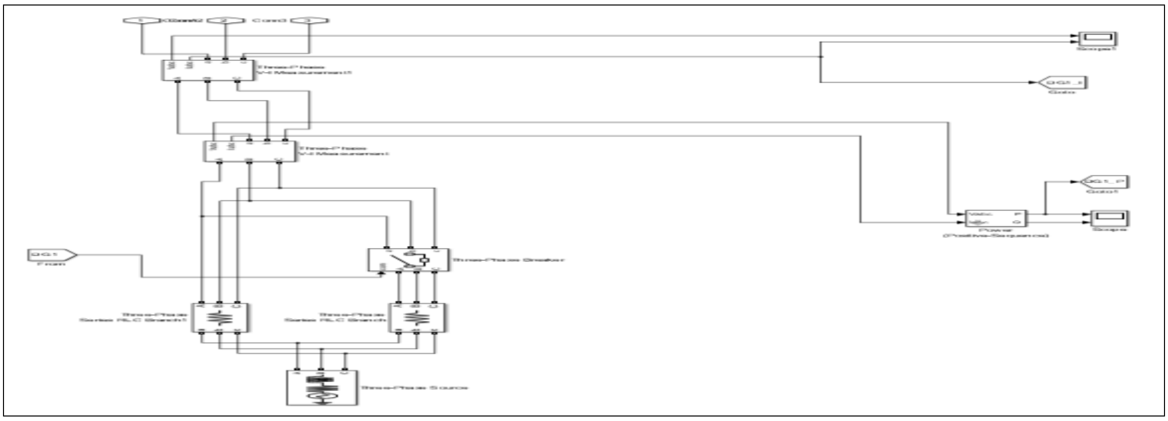

Fig 9 D.G. system

DIESEL GENERATOR- The DG set (element containing the diesel engine and the governor) is an element that converts the diesel engine (diesel) into mechanical energy from the diesel engine and then converts it into electrical energy by the governor mechanics. The governor can be defined as a mechanical or electromechanical device used to automatically control the engine's speed through the input of associated fuel [10].

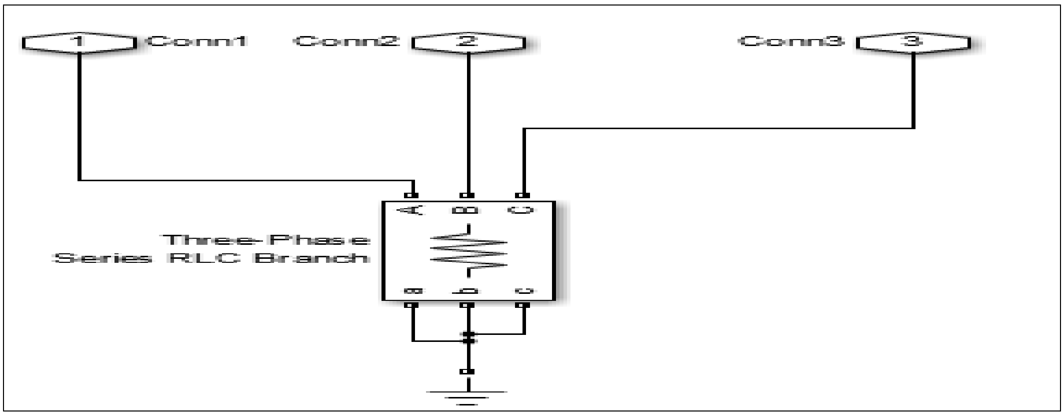

Fig.10 Non Critical Load

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III. SIMAULTION RESULT

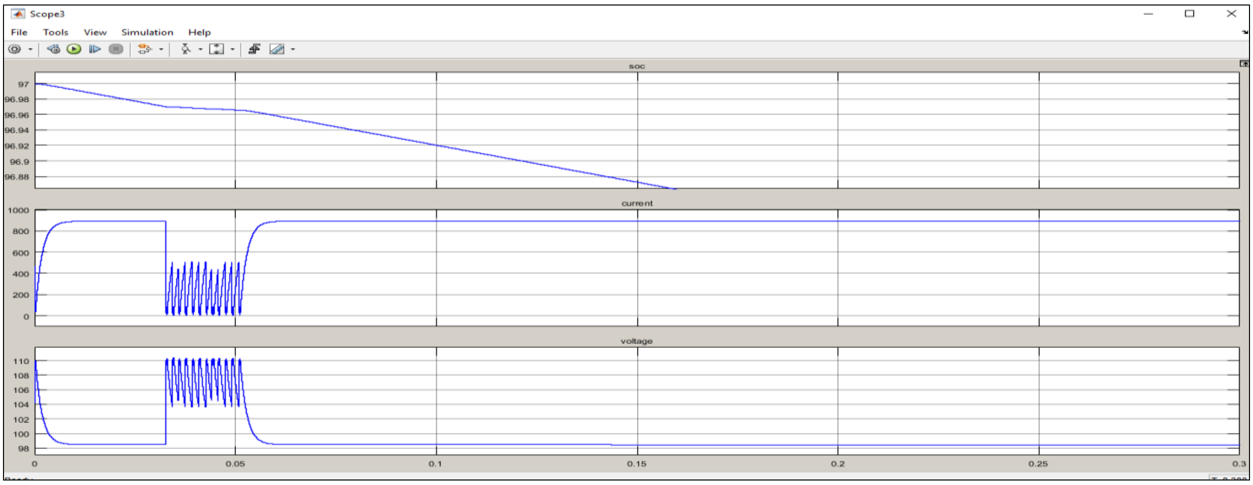

Fig 11 Battery Output

The system has variable energy source such as PVs, hence it is interesting to show the active power control of the hybrid Microgrid system fig 11 show the battery ,current ,voltage and charging time

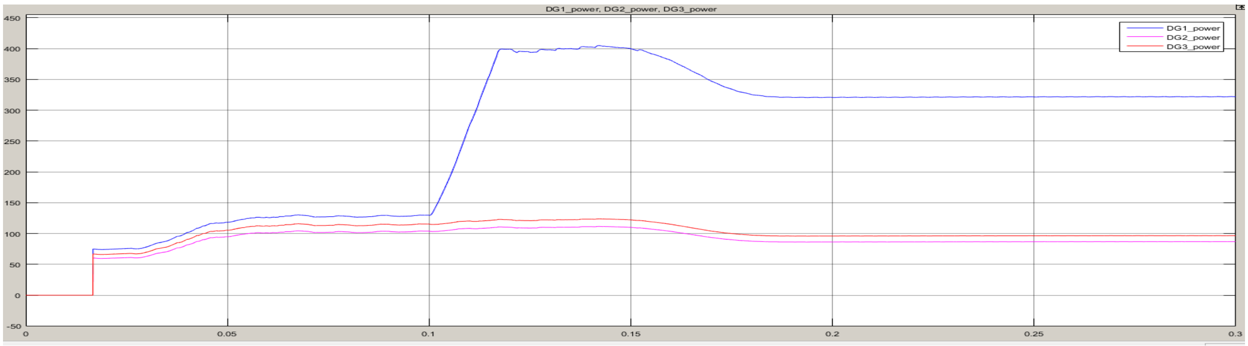

Fig. 12 DG 1,DG2,DG3 power output

The output powers of DGs are changed from initial values to new values as agents require getting more power from all DGs,DG1 = 400kW, DG2 = 1110kW and DG3 = 120kW).in fig 4.10 showing DG 1,DG2,DG3 power output.

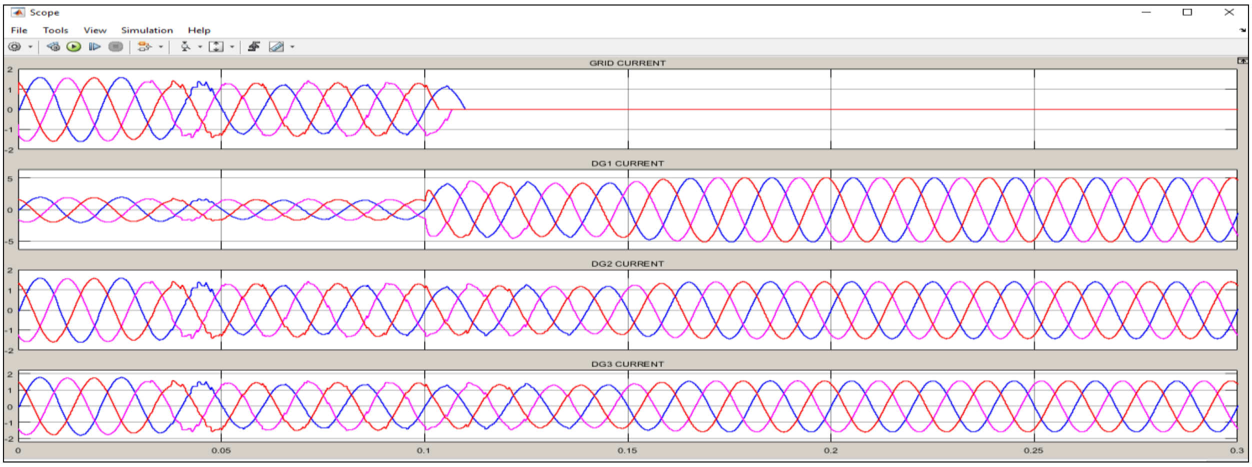

Fig.13 Grid Current, DG1, DG2, DG3 output current

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Fig.13 shows the control actions performed in the system. It can be observed that stability of the Microgrid is not lost due to primary control action of the sources

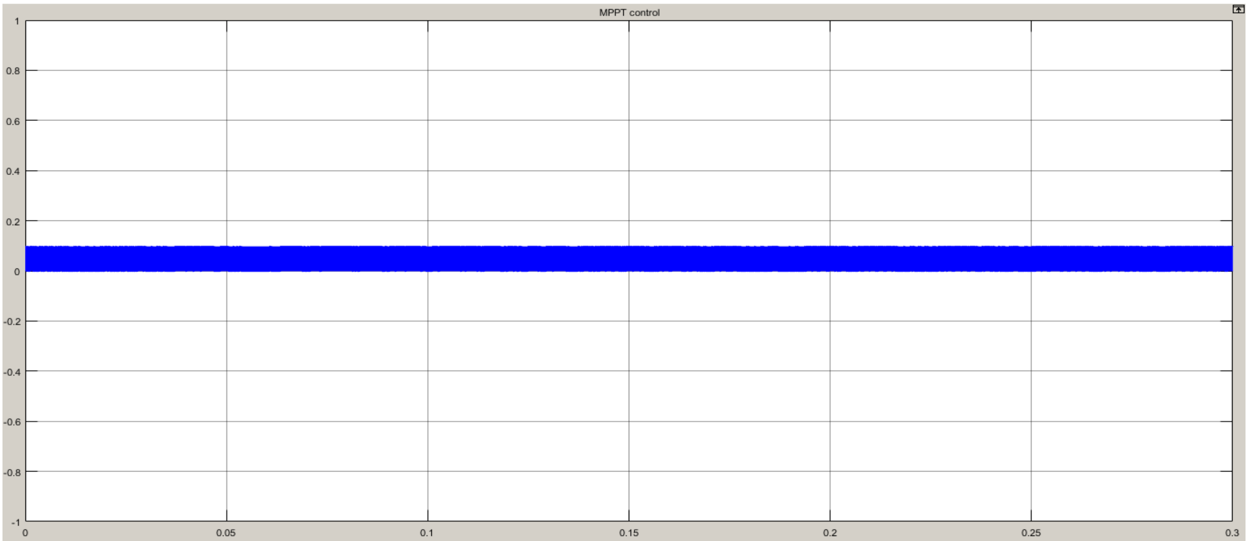

Fig.14 MPPT Control Output

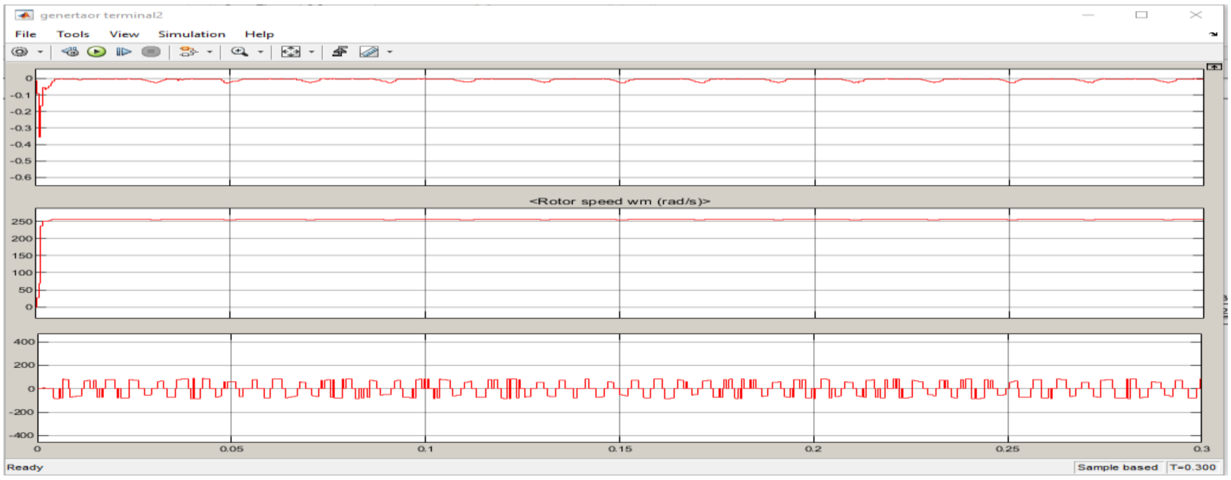

Figure 15 Wind and Rotor Speed

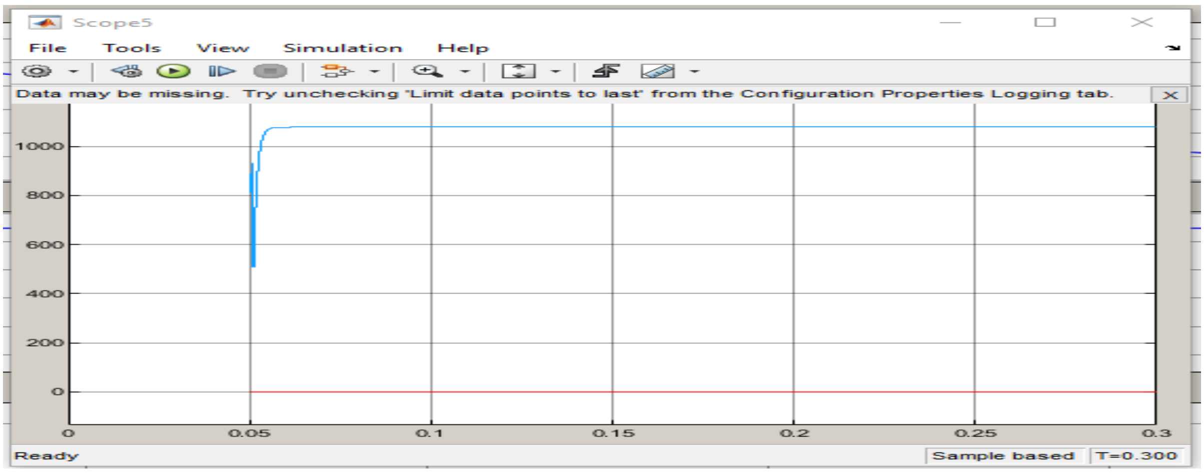

Figure 16 Solar Output

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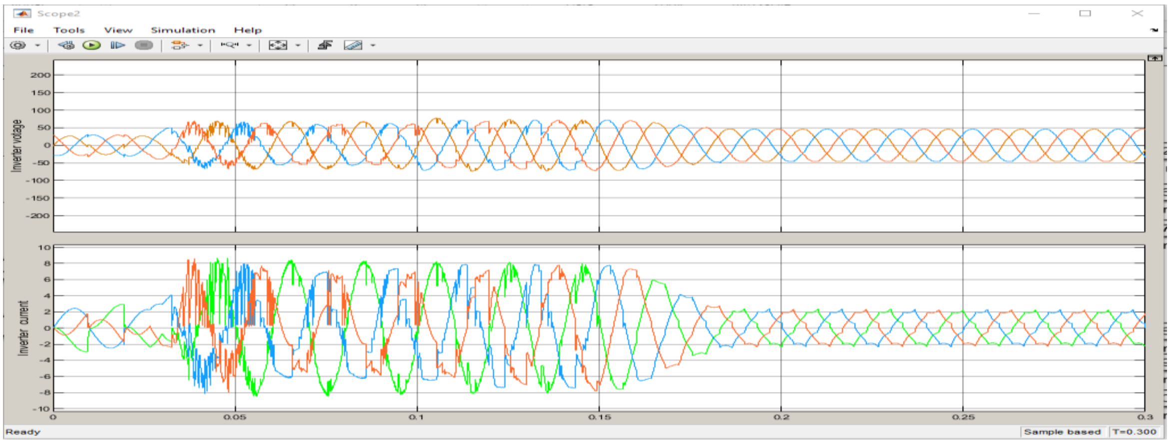

Figure 17: inverter voltage and current

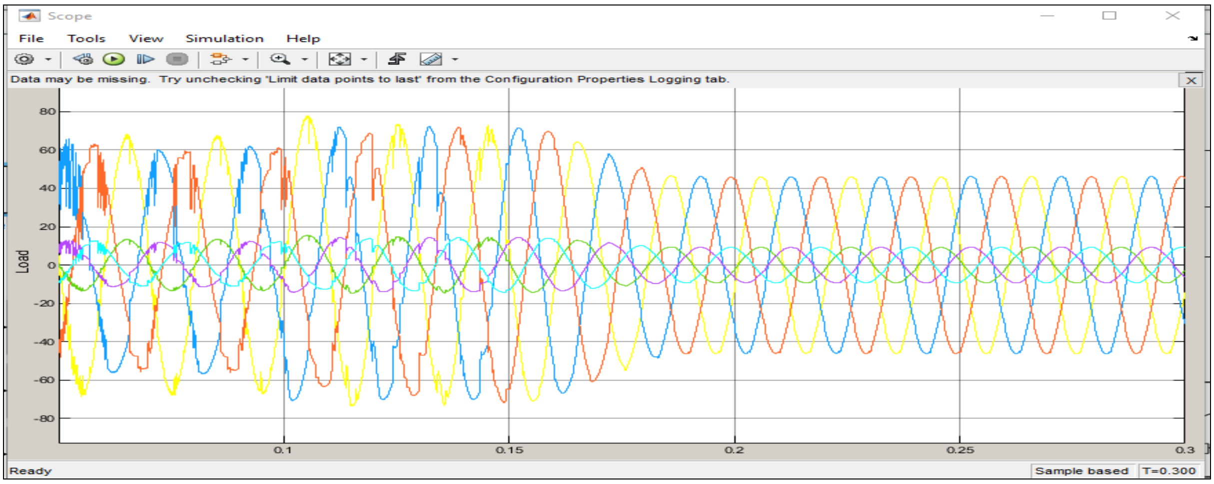

Figure 18: load voltage and current

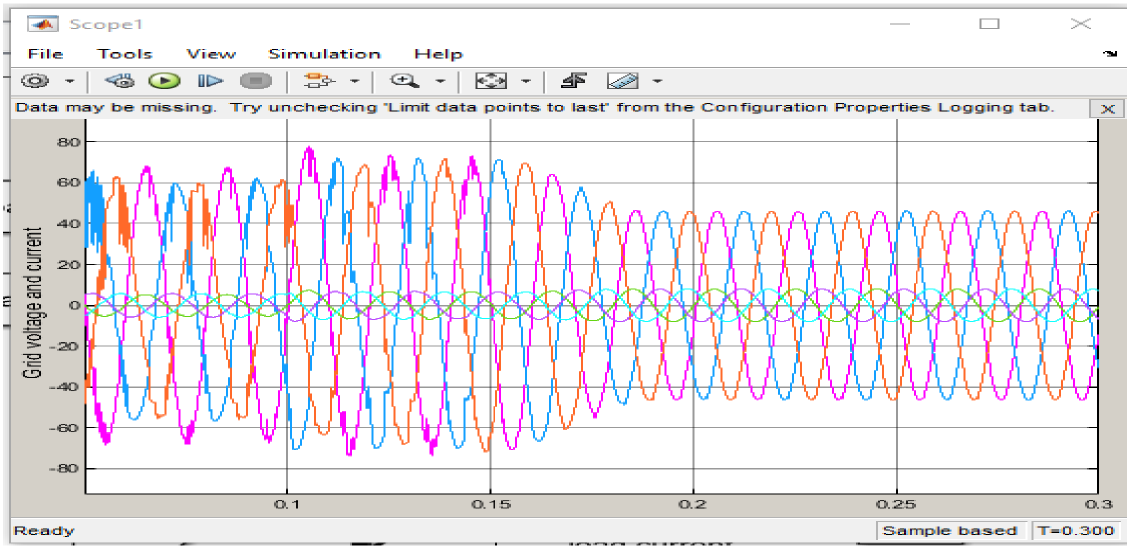

Fig.19 grid voltage and current

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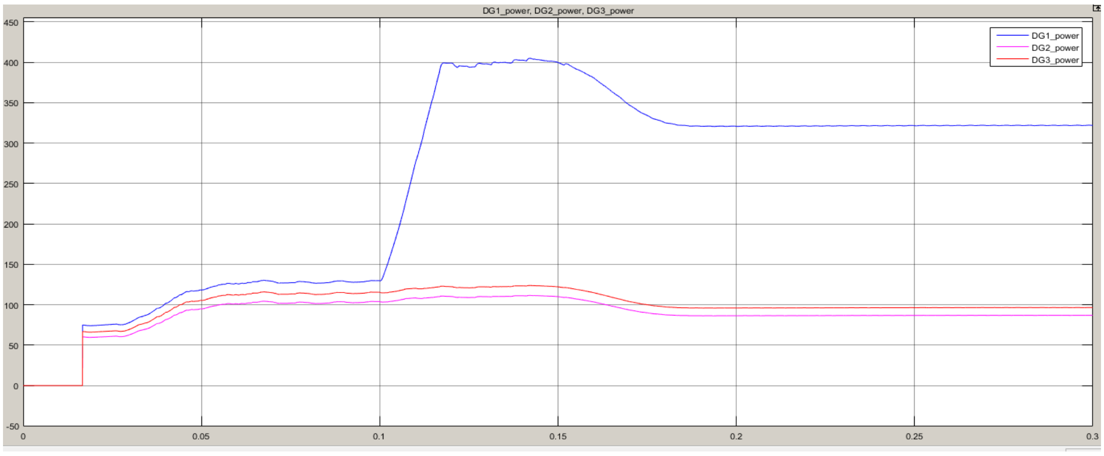

Figure 20 MPPT Control Output

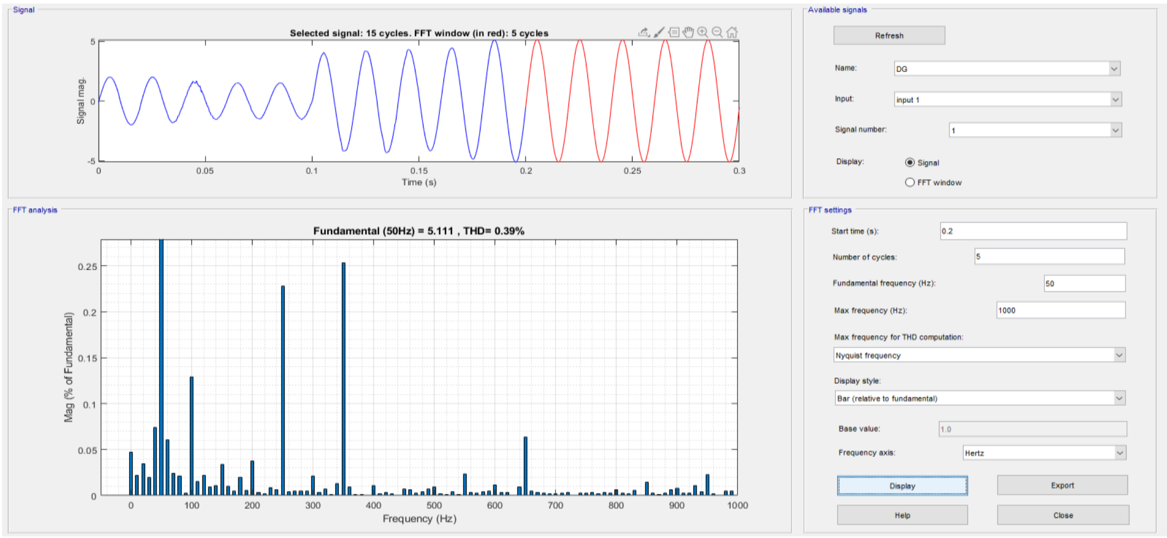

Fig.21 THD performance

IV. Conclusion

Renewable energy is an alternate source of energy for conventional energy resources. Renewable energy sources are the primary energy sources in remote areas where traditional energy cannot be transmitted. The MPPT based solar-wind hybrid energy system with boost converter is studied in this thesis. To increase the conversion efficiency of the hybrid system, an MPPT algorithm is utilized. Perturb and observe algorithm and incremental conductance provide the required duty ratio to control the boost converter with unpredictable weather conditions. A detailed analysis of solar, wind, and PMSG modelling has been done in this work. The simulation results show that the combination of pitch angle controller, generator-side inverter controller, and grid-side inverter controller has good dynamic and static performance. The maximum power can be tracked, and the generator wind turbine can be operated with high efficiency. DC-link voltage is kept at a stable level for decoupling control of active and reactive power. Hence, the output will get the optimum power supply for the grid.And the solar design consists of photovoltaic (PV) panels, wind turbines based on permanent synchronous generators, and batteries as energy storage systems. MPPT uses augmented conductivity technology applied to photovoltaic and wind energy systems. The PV array after MPPT is connected to a DC-DC converter amplifier and connected to a conventional bus network.Generation of power from single source of renewable energy cannot meet the load demands therefore, hybrid PV-Wind model is proposed to compensate the

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effects of environmental factors and climatic variations of the resources affecting the continuous operation of power generation. For efficient tracking of solar energy Perturb and Observe(P&O) AND Incremental Based MPPT technique is used and a boost converter is used to eliminate fluctuations at the Inverter to convert to AC power. Wind energy system with permanent magnet synchronous generator produces sinusoidal AC power. the two energy sources are combined to power the grid to meet the demands

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