

Optimum Use of Renewable Energy Generating Sources in Micro-Grid

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Abstract: This paper gives a manager of a micro-grid at isolated vicinity the energy is generated by the use of wind and sun based natural energy resources. The main tool that is used for wind energy conversion is doubly fed induction generator (DFIG) and separate battery financial institution is connected to a commonplace DC bus of them. A sun photovoltaic (PV) array is used to convert sun energy that is evacuated at the common DC bus of DFIG the usage of a DC-DC boost converter in a cost effective way.

Keywords: DFIG, PV, MPPT, BES.

INTRODUCTION

There are a few far flung locations in the world, where main power supply do not reach. There also are a few places which might be connected to the grid, however, they do not receive power for a maximum of 10-12 hours a day and therefore, and the human beings suffer. Some such locations are good places of renewable power resources (RE) which includes wind, sun and biomass. Linking within the self reliant nursing generation system using RE accessible domestic sources will greatly reduce dependence at the grid's based energy resources. The resources of wind and solar strength, which can be desired over the system primarily based mostly on biomass, are later affected by chain problems. However, wind and sun are situation to high tiers of electricity conversion, the hassle of the use of low ability blended with unpredictable properties. As a end result of these factors, total energy cannot be related to the self sufficient device. Meanwhile, battery strength storage (BES) is very beneficial in reducing electricity fluctuations and increasing overlooked conclusions, the trouble is exaggerated by operating all strength substances for the motive. finest operation. The optimal point in operation is also referred to as most chasing output (MPPT), it is important to regulate the purpose of the wind electricity generator and PV (Photovoltaic) array is to regulate speed and voltage to extract maximum power, most cutting-edge from the input source. MPPT is completed by management based totally in most cases on physical science (PE)..A hybrid electricity device of two or more types of strength assets is in a position to reduce the power cuts. Wind energy and sun are natural resources which can be trapped to increase the total power . Each source is complementary to each alternative in furthering the annual conduct pattern. Recognizing the blessing of this hubrid technique some authors have endowed self sustaining solar-based hybrid systems. The leading preferred for small wind applications is a magnet synchronous generator. It is possible to gain an pointless configuration with PMSG, however, it needs a 100% rated tool to supplement the more high-priced device. Some authors have used an additional megastar wind hybrid device with cage induction (SCIG), although SCIG has an industrial benefit with admire to system value, however, the situation does not have the specified speed law.

A smart grid would play an important role in integration of renewable sources to the grid. Devices like wind turbines, plug-in hybrid electrical vehicles and star arrays don't seem to be a section of the good Grid. Rather, the good Grid encompasses the technology that allows to integrate, to interface with and to regulate showing intelligence these innovations. There's a general thought that good grid is usually a complicated metering infrastructure (AMI). However, this is often not the case. AMI is simply a section of a wise grid. An ideal definition of a wise grid isn't viable; instead, a wise grid may well be outlined consistent with the wants of the network. In numerous countries the necessity for good grids needs different technology integration. As an example, in USA the transmission grid reaches to ninety nine you look after its population. As compared to it in a very developing country like Bharat the transmission grid reaches solely to eighty you look after its population. In countries like Bharat wherever power thefts are common, the good grid should focus in the main on energy security.

NEED OF HYBRID SYSTEM

In these days, hybrid technology has developed and upgraded its role in renewable energy sources whereas the benefits it produces for autonomous power production are unquestionable. These days several homes in rural and concrete areas use hybrid systems. many isolated islands attempt to adopt this kind of technology as a result of the benefits which can be received as compared with one renewable system. It has been antecedent explained that this technique utilized in my project depends upon a wind ducted rotary engine and PV panels, it's perform is analogous to the image below. This specific hybrid system presents many edges. Tons of specifically for a wind/solar hybrid system the assessment is targeting the wind and solar potential of the region. Therefore it should be operated throughout the day victimization the energy from the sun and once the sun has set it'll apply the potential wind energy to continue its performing. For this reason, wind and solar systems work well on throughout a hybrid system which they provide tons of consistent year-round output than either wind-only or PV-only systems. what is more with the utilization of the appropriate auxiliary systems like batteries you'll store energy which might be useful in compensating electrical demands used by the building for periods where there's no sun or wind. Finally, it's economically sound and advantageous to use non finite resources, i.e. solar and wind (hybrid). The investment financially and environmentally in trendy technologies will win through the generations to come among the fight for energy efficiency and effectiveness. Wind and solar energy sources, are more favourite than bio-mass based system as latter is susceptible to supply chain issue. However, wind and solar energies suffer from high level of power variability, low capacity utilization factor combined with unpredictable nature. As a result of these factors, firm power cannot be guaranteed for autonomous system. While the battery energy storage (BES) can be helpful of lowering power fluctuation and increasing predictability, utilisation factor can be increased by operating each energy source at optimum operating point. The optimum operating point also called as maximum power point tracking (MPPT), requires regulation of the operating point of wind energy generator and solar PV (Photovoltaic) array in term of speed and voltage to extract maximum electrical energy from input resource. Controlling and redesigning of a renewable energy based micro grid connected system. Extracting of more power from REGS and provision of quality power to the consumers Give the appropriate protection to the whole micro-grid system for a risk free and smooth operation of system. The performance of the system has been presented for change in input conditions for different type of load profiles

LITERATURE REVIEW

Now under this section I will mention few names of some researchers who have previously done or carried on some work related to this topic. The research paper entitled "Hybrid Renewable Energy Based Micro Grid" describes the result of fossil fuels on the world warming. The paper defines the importance of micro-grid associate degree could be a conception that integrates the DER (Distributed Energy Resources) to develop a freelance electrical infrastructure. [1]) the research paper entitled "Design and control of Micro-Grid fed by Renewable Energy Generating Sources" describe the management of a micro-grid at an isolated location fed from wind and solar based mostly hybrid energy sources [2]) the research paper entitled "Grid Integration and Power Quality Issues of Wind and Solar Energy System: A Review" presents review on grid integration and power quality problems related to the mixing of renewable energy systems into grid and role of power electronic devices and versatile AC Transmission Systems associated with these problems. During this paper, recent trends in power physics for the mixing of wind and photo voltaic (PV) power generators are conferred [6.]) the research paper entitled "Smart and micro grid model for renewable energy based power system" describes that this energy crisis has oil-fired analysis in renewable energy. It's accepted that renewable sources of energy would facilitate in assuaging our dependence on destructible energy sources. A transmission and distribution network that would with efficiency deliver the ability generated from renewable energy to the load would more liberalize the globe from fossil fuels. Full potential of renewable energy sources will be exploited by a sensible grid, resulting in very property electricity provide system. The objective of this paper is to stress the importance of good grid and small grid model for power systems connected with renewable energy resources. [9]) the research paper entitled "Renewable energy based micro grid system sizing and energy management for green buildings" presents the hybrid facility model for building with economically optimum. The system is sculpturesque and therefore the optimum system configuration is calculable with the assistance of hybrid optimisation model for electrical renewable (HOMER). The logic is illustrated with a case study supported the sensible information of a building settled in southern Bharat [10]. the research paper entitled "Research on Design and Control of Micro grid System" describes the recognition of micro-grid across the world in recent years. The optimum configuration issue of micro-grid system is represented shortly, so the watching system of micro-grid system is mentioned in details. Completely different management strategies of micro-grid system and their blessings and shortcomings are analysed later. The comparative analysis of various management strategies is distributed. Finally, a laboratory-scale micro-grid system is projected as AN example to verify

the micro-grid management strategy [17]. the research paper entitled “Design and Implementation of an Integrated Micro-Grid System” describes the Micro-grid throughly with its impacts on massive facility of distributed applications. During this paper, AN integrated micro-grid system with versatile structure and reliable multi-micro-grids system structure is projected that contains a spread of distributed generations and energy storage systems. The little micro-grids will operate severally or within the kind of one massive micro-grid. And this technique, victimisation master-slave management strategy, will switch flexibly between grid-connected operation mode and freelance operation mode [19].) the research paper entitled “Research on Control of Micro Grid” describes the micro-grid for future power systems. This paper proposes a hybrid management methodology for the complete small grid and a scientific control method style of micro-sources in grid-connected mode and isolated mode are analysed [20].

METHODOLOG

This work can adopt a research methodology that mixes the idea model with empirical analysis and refinement of the planned theme on MATLAB simulation tool. MATLAB could be helpful high-level development surroundings for systems that need mathematical modeling, numerical computations, information analysis, and improvement ways. A single line diagram of the proposed renewable energy generation system (REGS) fed micro-grid is shown in following figure.. As shown in a schematic diagram, the wind energy source is isolated using a 3-pole breaker from the network in case of insufficient wind speed. The DC side of both RSC and LSC along with HV side of solar converter is connected at the battery bank. RSC helps the wind energy system to run at the optimum rotation speed as required by W-MPPT algorithm.

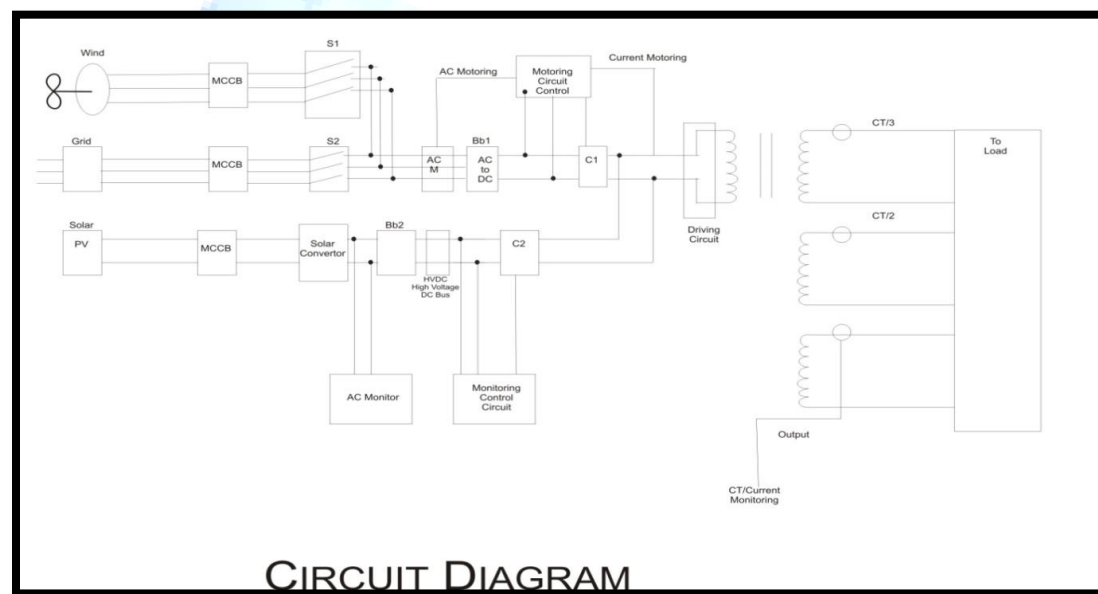
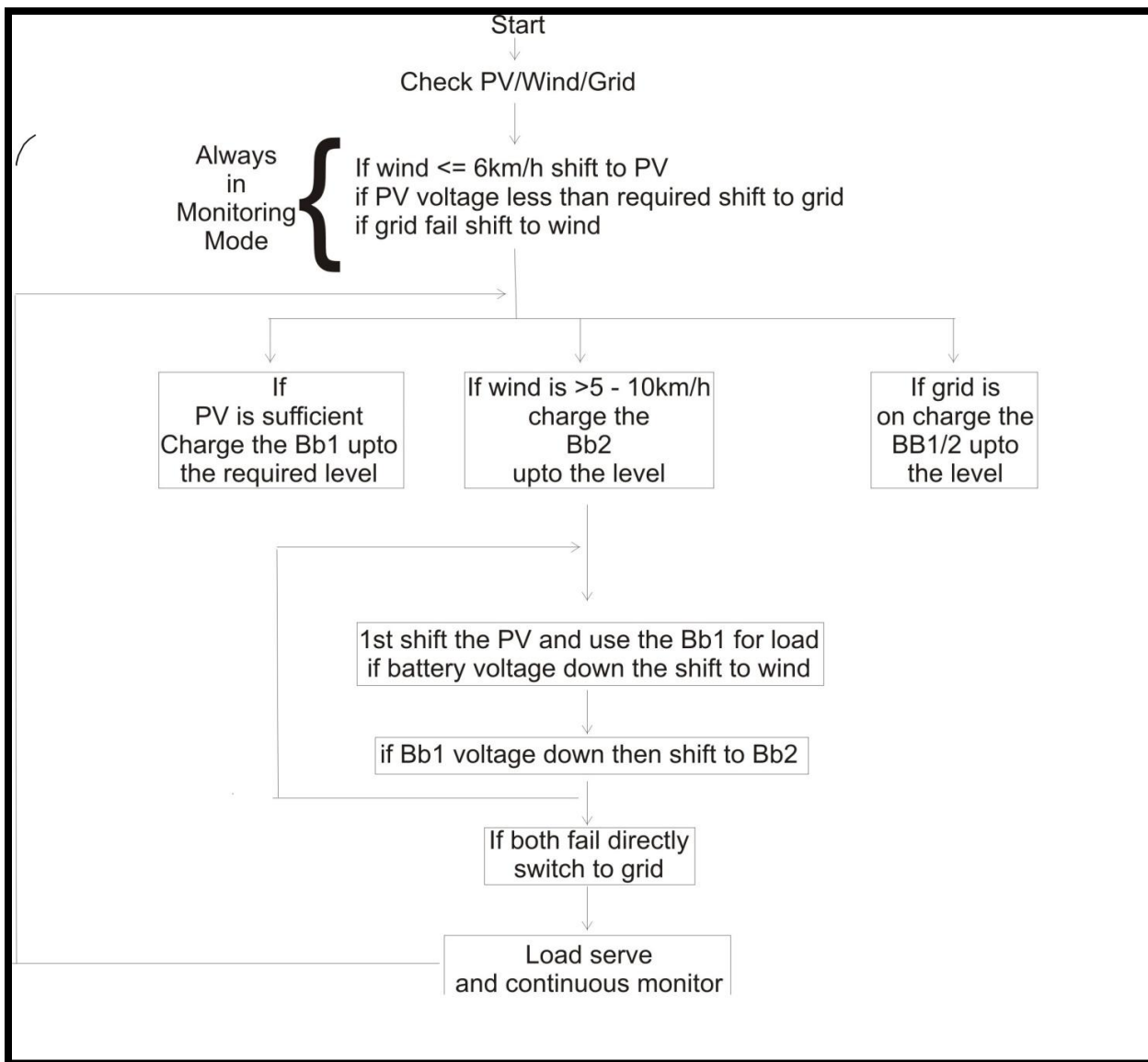


Figure: Schematic of isolated micro-grid network fed by renewable energy source using battery storage



RESULTS

The results are very important for research and development work to prove the problem definition practically. In my research I am using MATLAB tool to simulate the results.

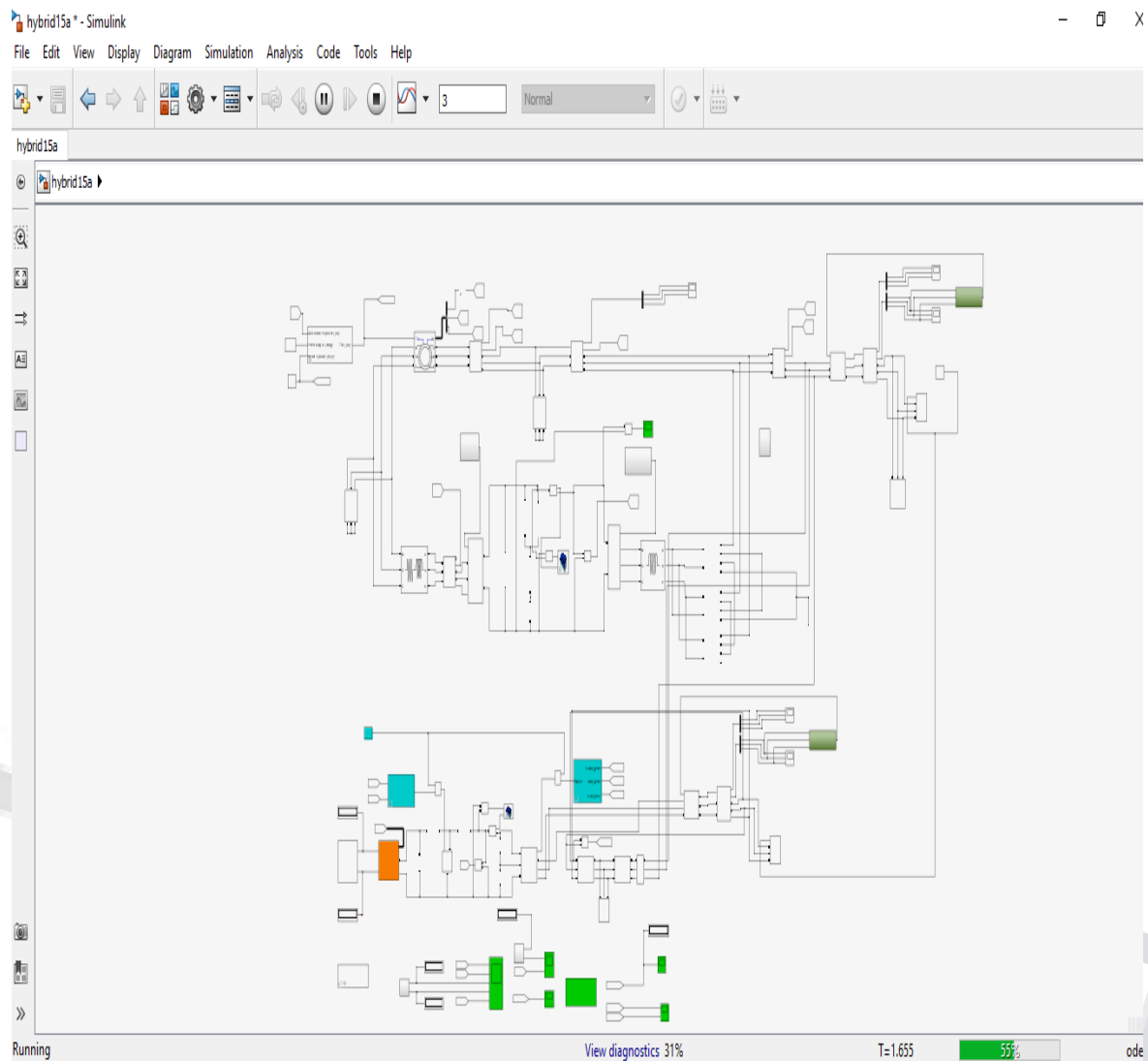


Figure simulation of the circuit

Wind Turbine and Gear

The wind turbine captures the kinetic energy of the wind and provides driving torque for DFIG.

The value of captured mechanical power is given as:-

$$P_m = 0.5 C_p \pi r^2 \rho V^3$$

Power Coefficient, $C_p = 0.4$

$$A = \pi r^2$$

Blade length, $r = 7.8 \text{ m}$

$$A = 7.8 * 7.8 * 3.14 = 191.037$$

Wind speed, $v = 13$ m/sec

Air density, $\rho = 1.23$ kg/m³

$$P_m = 0.5 \cdot 0.4 \cdot 191.037 \cdot 1.23 \cdot 13 \cdot 13 \cdot 13$$

$$P_m = 103248.239 = 103 \text{ KW}$$

Here V_w , and W_r , Velocity/speed of wind and radius of wind turbine respectively. C_p is the coefficient of performance of wind turbine. An external power flow in DFIG is through both stator and rotor. Neglecting losses, at maximum wind speed, the nominal power of DFIG (P_e) is related to rated air gap power (P_{ag}) as,

$$P_e = P_{ag} / (1 + |s_{pmax}|)$$

s_{pmax} is the slip corresponding to the turbine speed, ω_{rm} and its value is -0.267. The speed range of DFIG is the speed corresponding to slip 0.3 to -0.267

Solar PV System

The basic element of a solar PV system is the solar cell, The solar panels are configured such that the open circuit voltage of the solar string remains less than the lowest downstream voltage of solar converter or DC bus voltage, V_{dc} . The cell numbers (N_c) in a string, is a function of its DC voltage and cell open circuit voltage V_{oc} as,

$$N_c = V_{dc} / V_{oc}$$

The value of V_{oc} based on a typical commercially available cell characteristics and its value, is taken as 0.64 V.

The detailed parameters used for modeling of solar energy block, are given in Table-I

Open Circuit Voltage of PV cell, V_{oc}	0.64 V
Open Circuit Voltage of a module (V_{oc})	23.04 V // 64.2V
Total current of Grid	400A
MPP Voltage of module (V_{mp})	18.83 V // 54.7
Short Circuit Current of module (I_{sc})	8.69 A // 5.96
MPP Current of module (I_{mp})	8.04 A // 5.58
Module Power Rating	151 Wp // 305.226
uI_{sc}	0.04%/°C // 0.061745
uV_{oc}	-0.36%/°C // -0.27269
PV modules in the Solar Block	66 strings each having 5 PV modules
String open Circuit Voltage, u_{soc}	207.36 V // 250V
Capacity of Solar PV System	100 KWp

Table 1: Technical Details of Solar Block

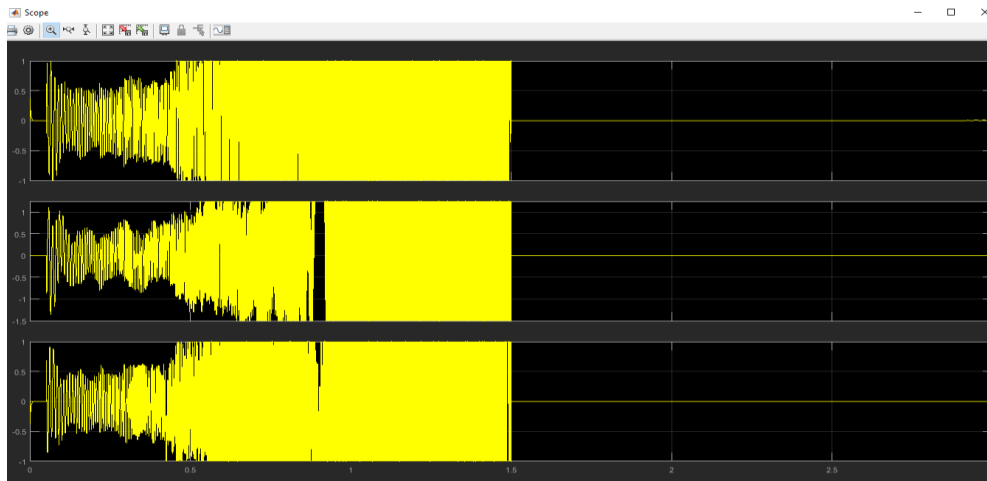


Figure Three Phase output Voltage of Wind Energy Source.



Figure Three Phase Output Current of Wind Energy Source.

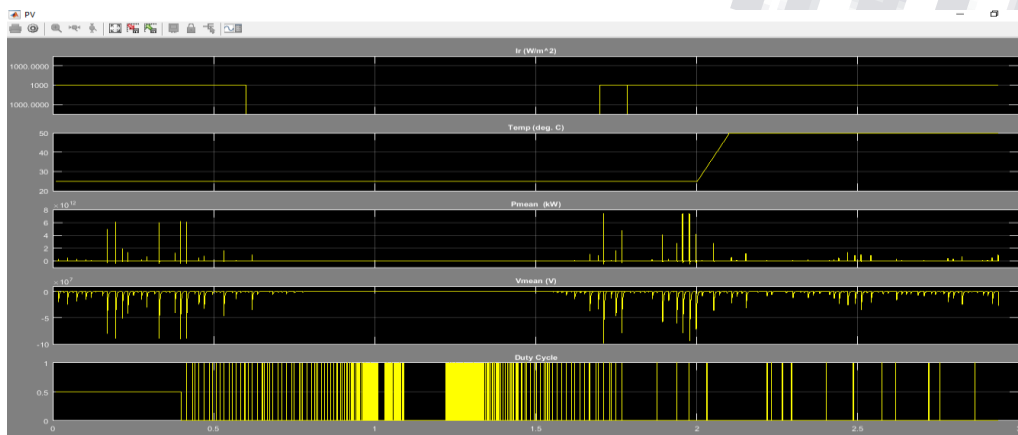


Figure Photovoltaic output Characteristics

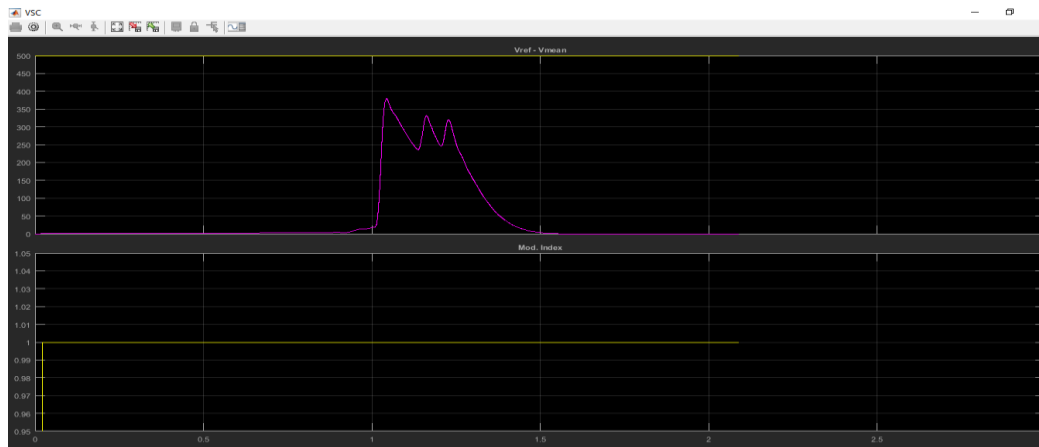


Figure Output Characteristics of voltage source converter (Vsc)

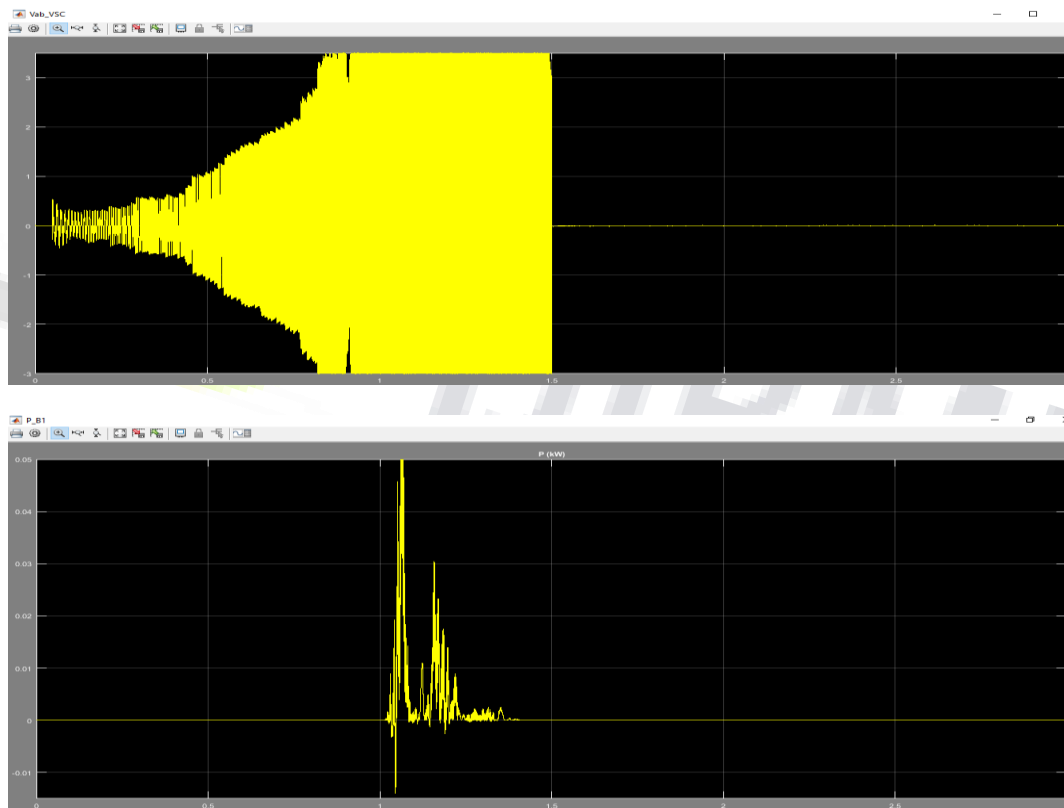


Figure Output Power photo voltaic in Kw (Pkw)

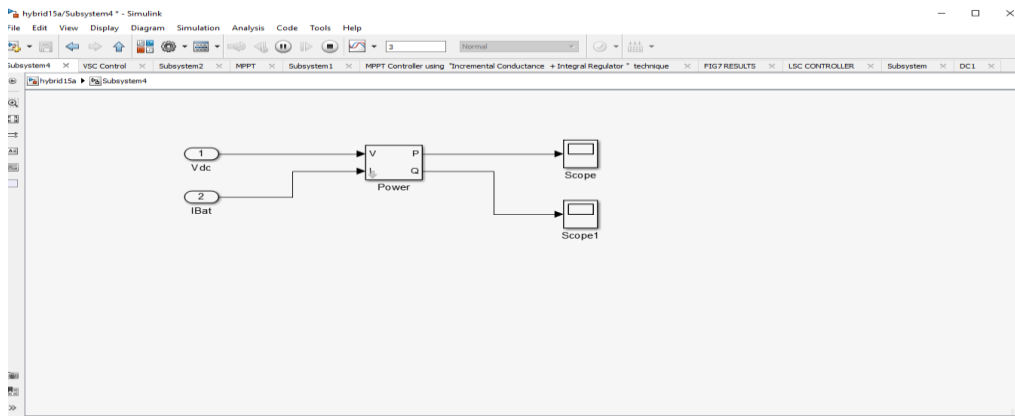


Figure Internal Battery charging circuit.

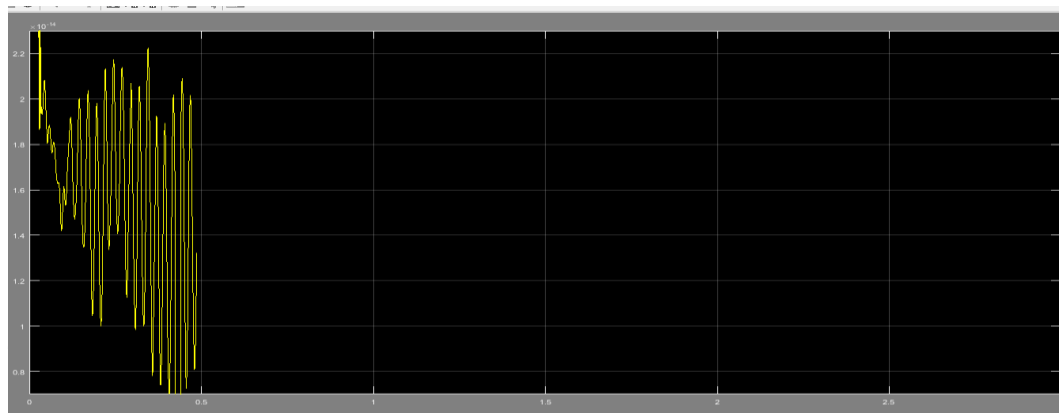


Figure Battery charging

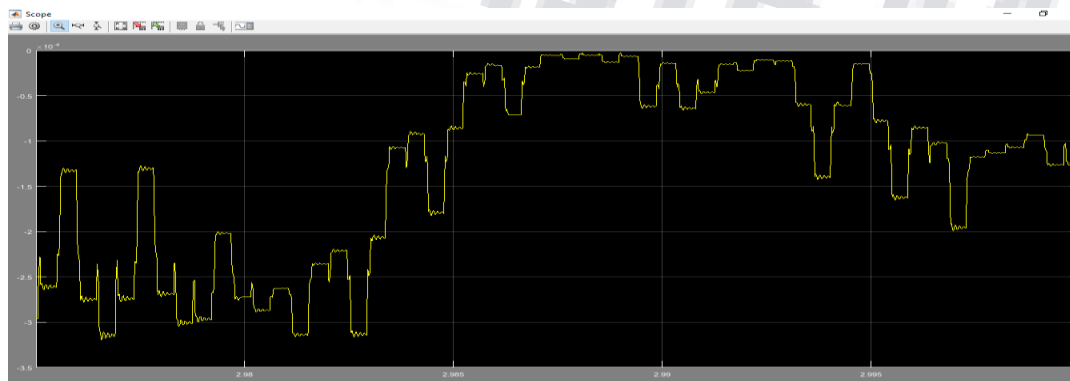


Figure output Voltage of Battery

CONCLUSION

The paper presents Micro-grid fed from REGS and has been found perfect for meeting load requirements of a remote isolated location comprising few households. REGS comprises of wind and solar energy blocks, which are designed to extract the maximum power from the renewable energy sources and at the same time, it provides quality power to the consumers.

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