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Performance Analysis of Wind-Solar Based Hybrid Renewable Energy Sources

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Abstract: *Completion of a loss of electricity and reap sensible electricity for all by means of 2030 is trouble round the arena for mankind. 1.3 billion human beings without energy get to and a huge community of zero.8 billion humans take advantage of a strong gas isn't always practical for cooking and heating trouble around the world to turn human and economic network occasions. sustainable sources become a famous non-obligatory voltage supply wherein the age of energy in traditional manners are not all the way down to earth. inside the beyond no longer a few years of photovoltaic and improved age elective fundamental vitality. about $ 1 trillion of enterprise expected in the Sustainable electricity for All (SE4ALL) situation to achieve get admission to to the overall power of 2030. approximately 60% of the hypothesis occurring uninterrupted off-grid and smaller than expected skeletal framework with goals that follow to replicate useful resource sustained in a aggregate of power. get admission to to the development of sustainable useful resource skew in off-grid will gain the establishment of the destiny. This painting explores the dedication divulge in Hybrid Renewable energy systems (HRES) and the attitude of the income related hobbies wanted within the separated-matrix and smaller than predicted skeletal framework. presently, the actual configuration of framework more often than not decided by means of monetary attainability examination charge focused vitality and profitability level. concerning herbal viewpoint, the useful effects of sustainable resources are sometimes considered as a measure. the entrance to the herbal device for dynamic unique coordination, monetary and ecological attitude will be returned citizens from HRES. There are research which have no longer been found open doors for HRES in multi-disciplinary topical vicinity. The investigation progress within the structural framework for Hybrid Renewable strength structures (HRES) have the potential for tissue examination outstanding line up with patterns to mix the price chain and inspire imaginative motion plans and practical energy of the market. similarly research on practical plans of movement and empower the executive systems and the important preparations. Sharing their discoveries and make bigger the main database with more traits will help plan the sample on sustainable useful resource use in the formation of off-community the equal way that distinguishes them undiscovered openings studies and development of future capability to assist the chain well worth complete HRES. Right here I propose solar / wind energy systems disbursed a working result model of software software superior in MATLAB / Simulink.*

Keywords: Hybrid Renewable Energy System, Photo Voltaic, Maximum power point tracking

I. INTRODUCTION

T. Salmi et al. [1] discussed about MATLAB/SIMULINK model of a photovoltaic cell. This model is based on mathematical equations and is described through an equivalent circuit including a photocurrent source, a diode, a series resistor and a shunt resistor. The developed model allows the prediction of PV cell behavior under different physical and environmental parameters. The model can also be used to extract the physical parameters for a given solar PV cell as a function of temperature and solar radiation. In addition, this study outlines the working principle of PV module as well as PV array. In order to validate the developed model, an experimental test bench was built and the obtained results exhibited a good agreement with the simulation ones. S. Meenakshi et al. [2] discussed about the modelling and power flow analysis of a stand-alone hybrid generating system (SAHGS) comprising of wind and photovoltaic systems. The wind driven self-excited induction generator (SEIG), photovoltaic array and other network components are

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modelled and simulated using MATLAB/SIMULINK. The variable voltage and frequency of a generator is first rectified and controlled by a DC/DC converter before being fed to a common DC bus. The variable output voltage of the photovoltaic module is also controlled by a DC/DC converter. The DC bus collects the total power from the wind and photovoltaic systems and uses it partly to supply the required load demand and partly to charge the battery bank. The individual systems are simulated for varying wind velocities and solar intensities respectively and the results are used to identify the operating modes. A neuro controller is designed to adjust the duty ratios of the choppers and the firing angle of the converter at which the maximum power generation occurs. Nabil A. Ahmed et al. [3] discussed about hybrid energy system combing solar photovoltaic and wind turbine as a small-scale alternative source of electrical energy where conventional generation is not practical. A simple and cost effective control technique has been proposed for maximum power point tracking from the photovoltaic array and wind turbine under varying climatic conditions without measuring the irradiance of the photovoltaic or the wind speed. The proposed system is attractive owing to its simplicity, ease of control and low cost. A complete description of the proposed hybrid system along with detailed simulation results which ascertain its feasibility are given to demonstrate the availability of the proposed system in this paper. Simulation of the hybrid system under investigation was carried out using PSIM software. Marcelo Gradella Villalva et al. [4] discussed about an easy and accurate method of modeling photovoltaic arrays. The method is used to obtain the parameters of the array model using information from the datasheet. The photovoltaic array model can be simulated with any circuit simulator. The equations of the model are presented in details and the model is validated with experimental data. Finally, simulation examples are presented. This paper is useful for power electronics designers and researchers who need an effective and straightforward way to model and simulate photovoltaic arrays. Hiren Patel et al. [5] discussed about performance of a photovoltaic (PV) array is affected by temperature, solar insolation, shading, and array configuration. Often, the PV arrays get shadowed, completely or partially, by the passing clouds, neighboring buildings and towers, trees, and utility and telephone poles. The situation is of particular interest in case of large PV installations such as those used in distributed power generation schemes. Under partially shaded conditions, the PV characteristics get more complex with multiple peaks. Yet, it is very important to understand and predict them in order to extract the maximum possible power. This paper presents a MATLAB-based modeling and simulation scheme suitable for studying the I-V and P-V characteristics of a PV array under a nonuniform insolation due to partial shading. It can also be used for developing and evaluating new maximum power point tracking techniques, especially for partially shaded conditions. The proposed models conveniently interface with the models of power electronic converters, which is a very useful feature. It can also be used as a tool to study the effects of shading patterns on PV panels having different configurations. It is observed that, for a given number of PV modules, the array configuration (how many modules in series and how many in parallel) significantly affects the maximum available power under partially shaded conditions. Mohammed Abdulazeez et al. [7] discussed about Partial shading of photovoltaic modules is a widespread phenomenon in all kinds of Photovoltaic (PV) systems. In many cases the PV arrays get shadowed, completely or partially, by the passing clouds, neighboring buildings and towers, trees or the shadow of one solar array on the other, etc. This further leads to nonlinearities in characteristics. In this study, the simulation and experimental results of uniform and partial shading of PV modules are presented. Different shading pattern have been investigated on series and parallel connected photovoltaic module to find a configuration that is comparatively less susceptible to electrical mismatches due shadow problems. Siyu Guo et al. [8] discussed about in most cases, solar cells within a PV module are connected in series in order to generate a high voltage. The series-connection is a limiting factor if a PV module is partially shaded, for example by nearby buildings, passing clouds or wildlife. In a string of cells connected in series, the cell that generates the smallest current limits the current of the whole string. Additionally, shaded cells operate in reverse bias and may, for example, show “hot spots” in case they are locally shunted. Bypass diodes are usually introduced to reduce such effects. The bypass diode will ensure the operation of the module with partially or fully shaded cells, at the price of a reduced voltage. However, the number of bypass diodes in a module is typically limited, so that shading of one single cell will still affect a significant percentage of the cells in the module. In this paper, distributed circuit simulations of a PV module under partial shading conditions are presented. The circuit is modeled from one-diode elements and implemented in LTspice IV. The influence of different grades of shading on the current-voltage characteristics and the output power of the module are investigated. Also, different possible configurations of bypass diodes are evaluated. Finally, a time-dependent model of a PV module is constructed to

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simulate the modules' behavior if a shadow moves across it. The shadow's moving direction is also taken into consideration. It is observed that the choice of bypass diode configuration has a strong influence on the performance of a PV module under partial shading conditions.

II. SIMULATION MODEL AND RESULT

Simulation Model: MATLAB/SIMULINK is used for performance analysis of Hybrid Renewable Energy sources in varying environmental conditions. All the results are observed in varying environmental condition. The model is divided into 4 important parts: a diesel generator working as a grid, a PV farm, a wind farm ,to produce renewable energy, the load of the grid.

Component	Description
DieselGenerator	15MW,2pole,25KV,60Hz
Windfarm	4.5MW,15m/smaxwindspeed,13.5m/snominalwindspeed
PVfarm	8MW,area8000m^2,efficiency10%
Load	12MW0.95pf,0.16MVAsquirrelcageasynchronousmotor

Fig. Description of model component parameter

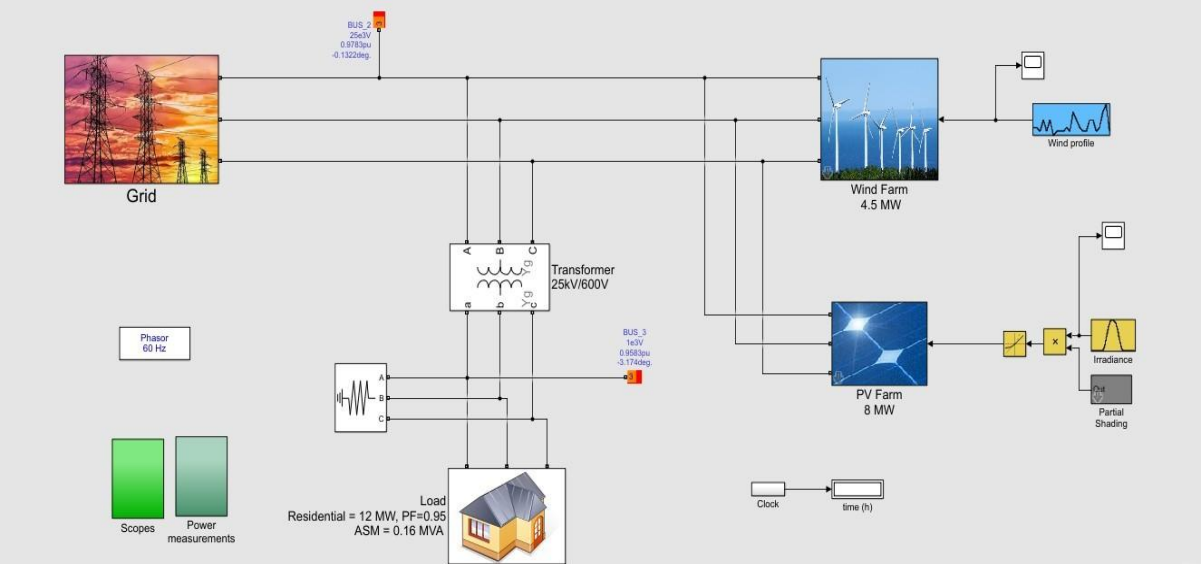

Fig. MATLAB/SIMULINK Model

The simulation lasts 24 hours. The solar intensity follows a normal distribution where the highest intensity is reached at midday. The wind varies greatly during the day and has multiple peaks and lows. The residential load follows a typical pattern similar to a normal household consumption. The consumption is low during the day and increases to a peak during the evening, and slowly decreases during the night.

Four events will affect the grid frequency during the day:

1. The kick-off of the asynchronous machine early at the third hour
2. A partial shading at noon affecting the production of solar power
3. A wind farm trip at 22h when the wind exceeds the maximum wind power allowed

We first plot the irradiance and varying wind speed curves along with their power generation curves of all three sources and second we discuss the combined curve of the power generation and load. Last we discuss the frequency deviation of the grid during normal condition and fault condition.

Irradiance and wind speed curves

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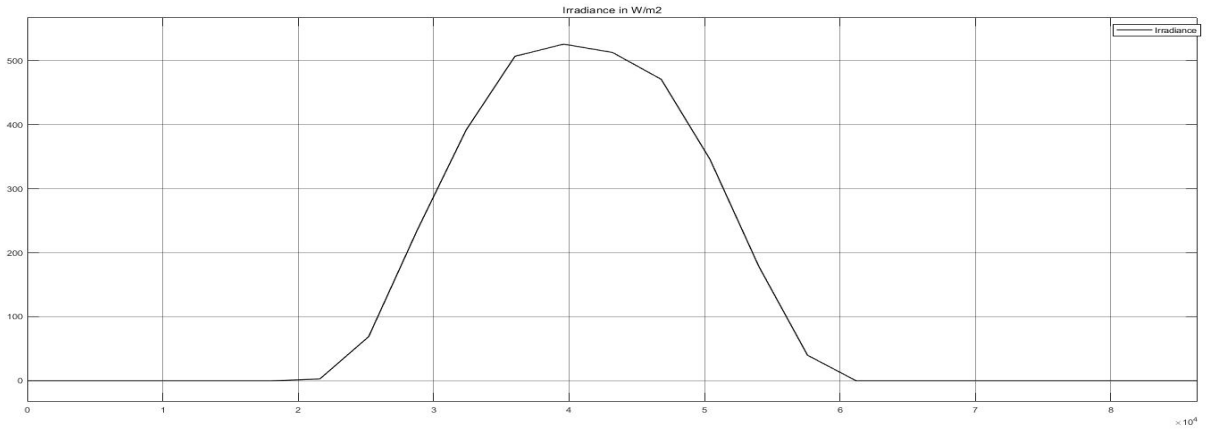

Fig Irradiance curve for the whole day

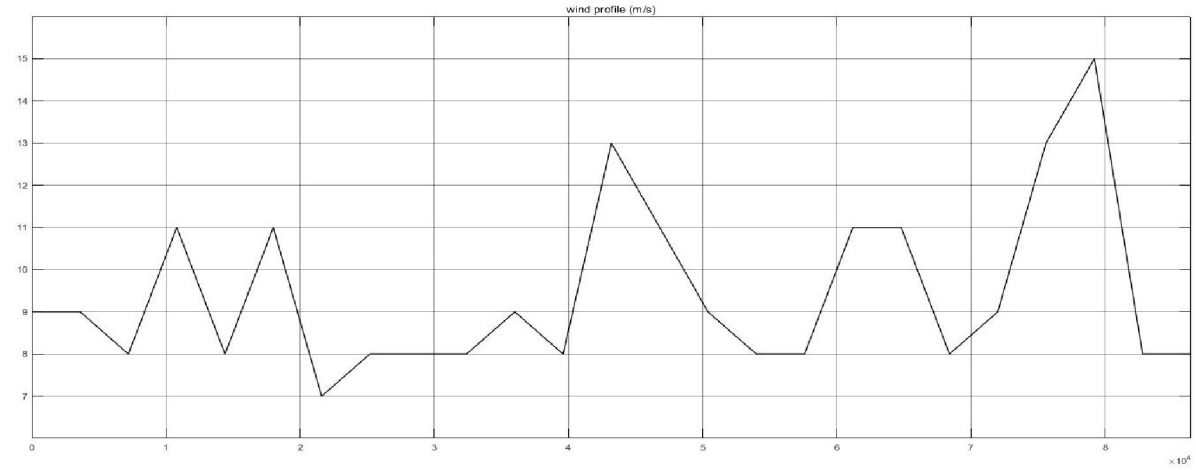

Fig. Wind profile for the whole day

Power generated by Different sources

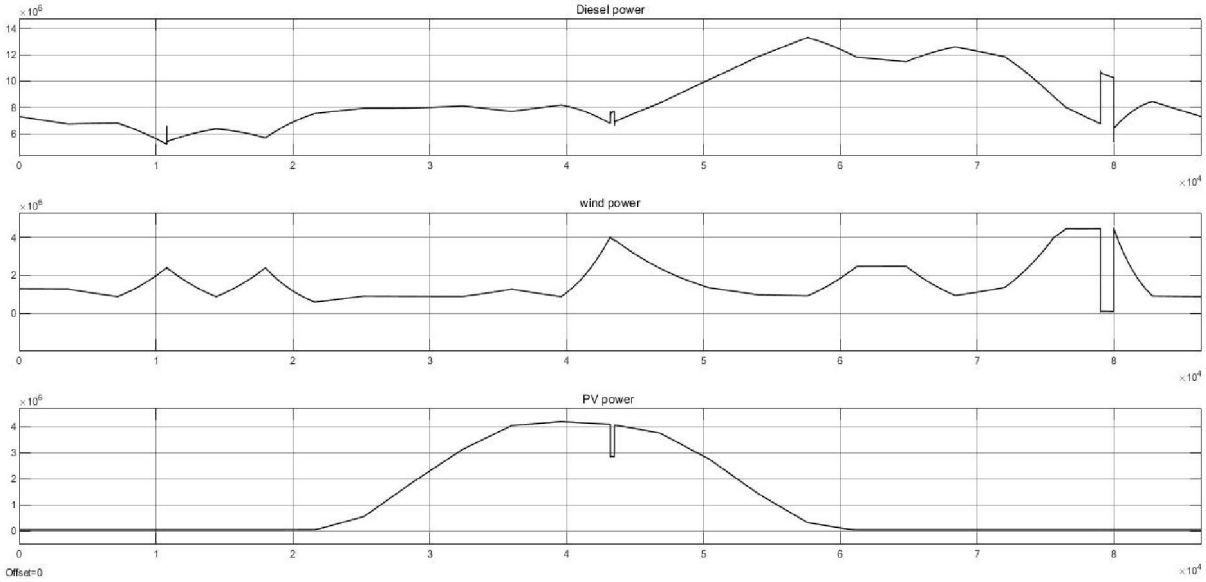

Fig. Power output of Diesel generator, Wind farm, PV farm

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In the above figure we can observe that during all the transient state the grid (DG) will compensate for the reduced power in noon and at early hours, because of the wind power is available at that time it will compensate less and burden on the grid is reduced.

Combined Power curves

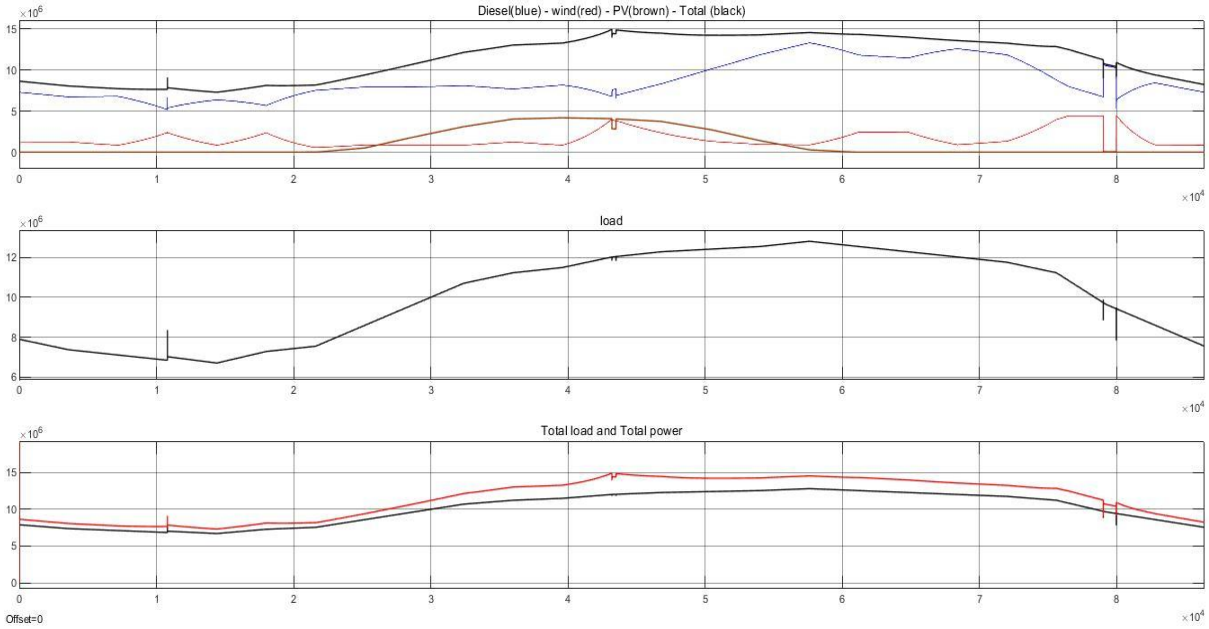

Fig. Complex Power curve

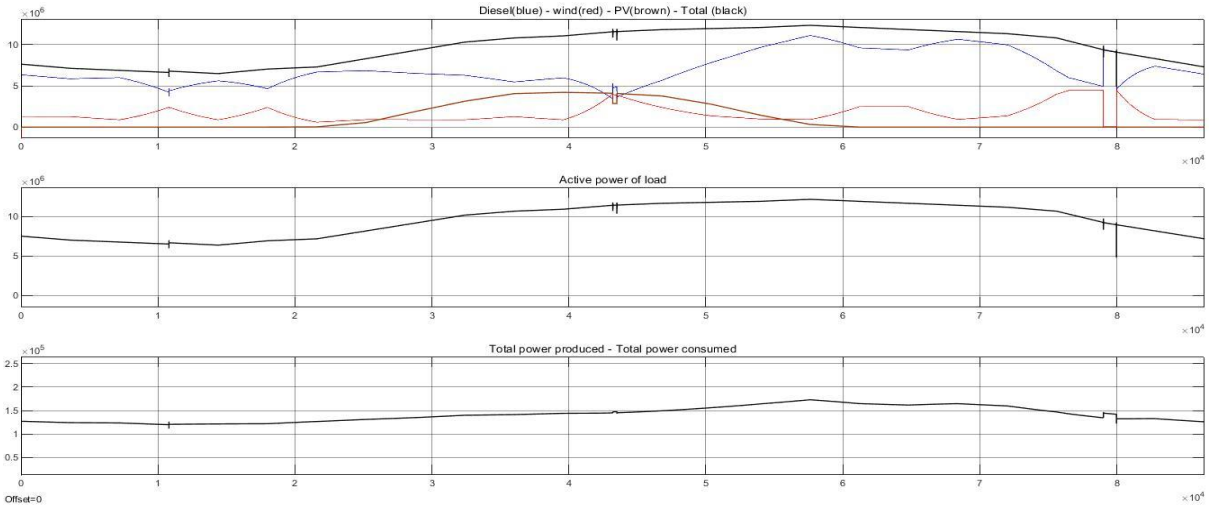

Fig. Real power Curves

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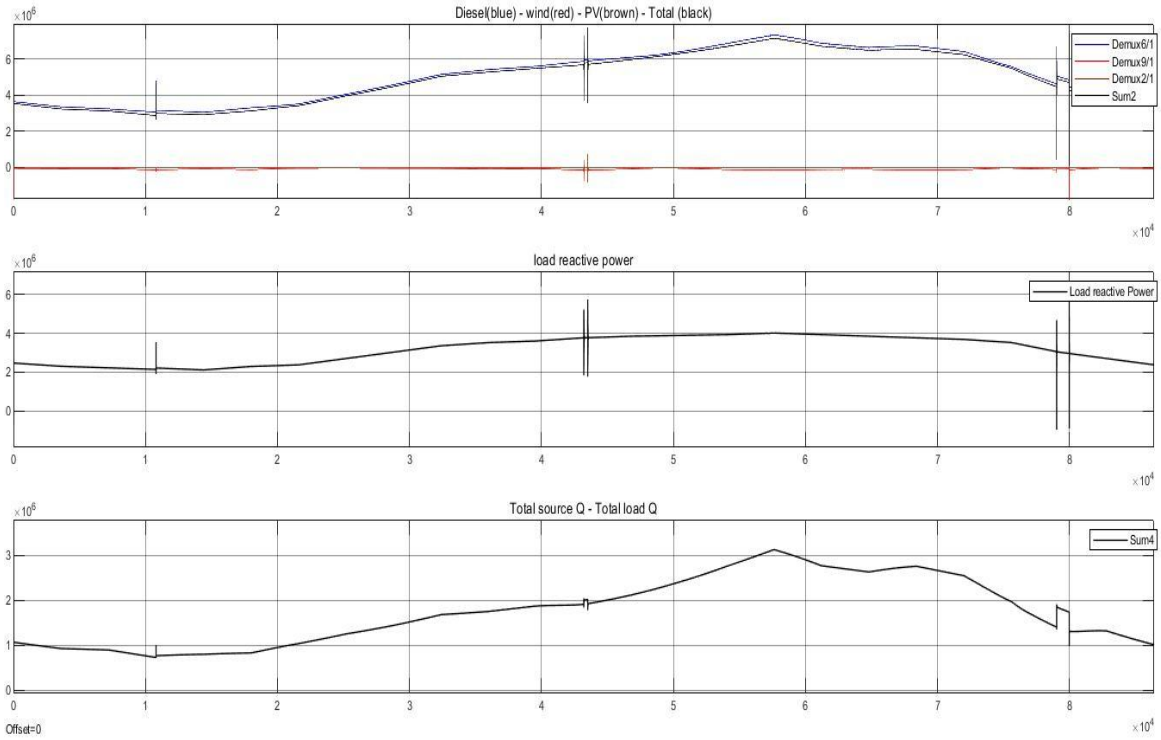

Fig. Reactive power curves

Frequency deviation

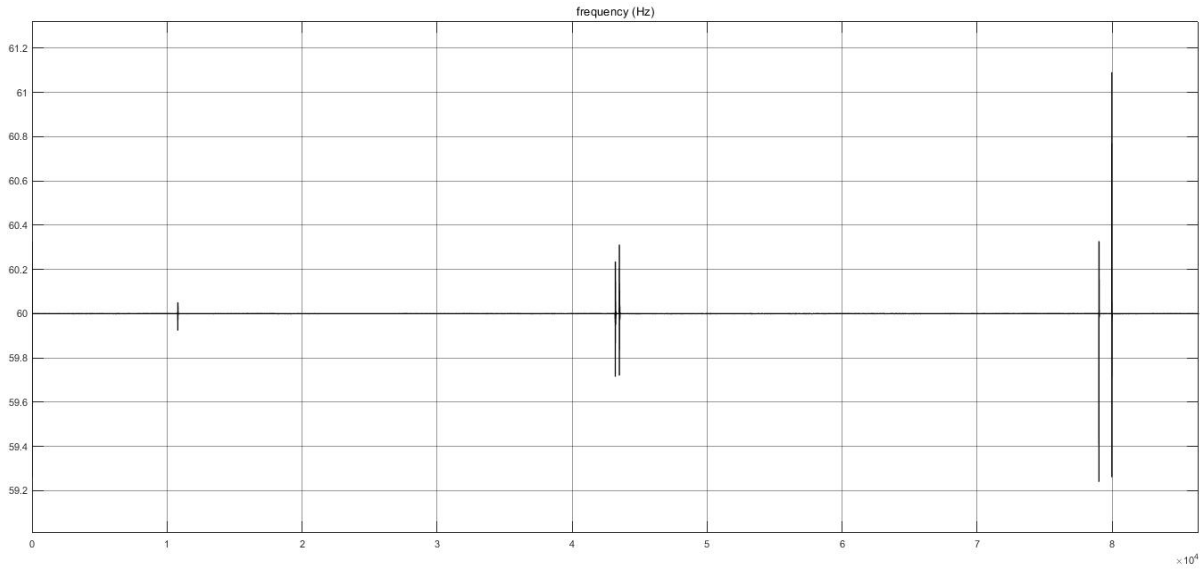

Fig. Frequency deviation curve

These three spikes in the above figure show the frequency deviation during the three condition of the power system.

III. CONCLUSION

In this thesis I have analyse the performance of Hybrid Renewable Energy sources in varying environmental conditions. I have taken three varying condition:

- ASM connection at 3h
- Partial shading at noon
- Wind speed above maximum value at late night.

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When ASM is connected at the early morning the wind farm compensate the additional load demand of the power system, so the system does not disturb as much and the frequency deviation are small. In afternoon during partial shading of the PV farm the power is reduced and decreased power is compensated by the wind farm and the grid but fluctuation at this point is large because at noon maximum load is fed by the PV system. In late night when wind farm goes out of service the system is badly affected and large frequency deviation is occurred because at night no PV farm is delivering power and all the load is fed by the grid system but as the load at night are less and grid will able to compensate the wind farm trip. The frequency deviation will remain in control. Hence the system feed the load during all three abnormal conditions and the power supplied is always in check and remain in synchronization during all the condition. This will shows the diversity in the generation is always helpful. We should use different types of energy sources in the grid rather than depending on the one type of system which will help full in matching the load demand in better way.

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