POWER TRANSMISSION AND DISTRIBUTION

PROJECT REPORT

MODELING AND SIMULATION OF TRANSMISSION LINE

SUBMITTED TO:

PROF. RACHNA GARG

SUBMITTED BY:

CHETAN PRAKASH (2K18/EE/057)

DEEPAK KUMAR (2K18/EE/060)

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CERTIFICATE

This is to certify that this SIMULATION BASED PROJECT titled "**Modeling and Simulation of Transmission Line**" is the record of work performed by CHETAN PRAKASH and DEEPAK KUMAR, Electrical Engineering student of B.Tech, Delhi Technological University as a part of their Innovative project for the 5th semester. This Simulation based project was carried out under my supervision.

Prof. Rachna Garg

Department of Electrical Engineering

Delhi Technological University

ACKNOWLEDGEMENT

We would like to express our deep sense of respect and gratitude to our project mentor Prof. Rachna Garg, Department of Electrical Engineering, Delhi Technological University for providing the opportunity of carrying out this project and being the guiding force behind this work. We are deeply indebted for the support, advice and encouragement she provided without which this project could not have been a success.

Abstract

With the modernization in technology, demand for power has increased considerably that needs efficient analysis and control of the power system through the help of various modern grid applications like simulation based approach.

Modern grid technology makes installation and utilization of renewable resources efficiently. Now a days solar and wind energy micro plants are being installed near the consumer sites in order to reduce or eliminate the power loss and use of renewable energy in lesser cost.

Introduction

In this project we will be focusing on modeling a real time power transmission model and perform various tasks as per the customer usage and their activities and we will performing following tasks:

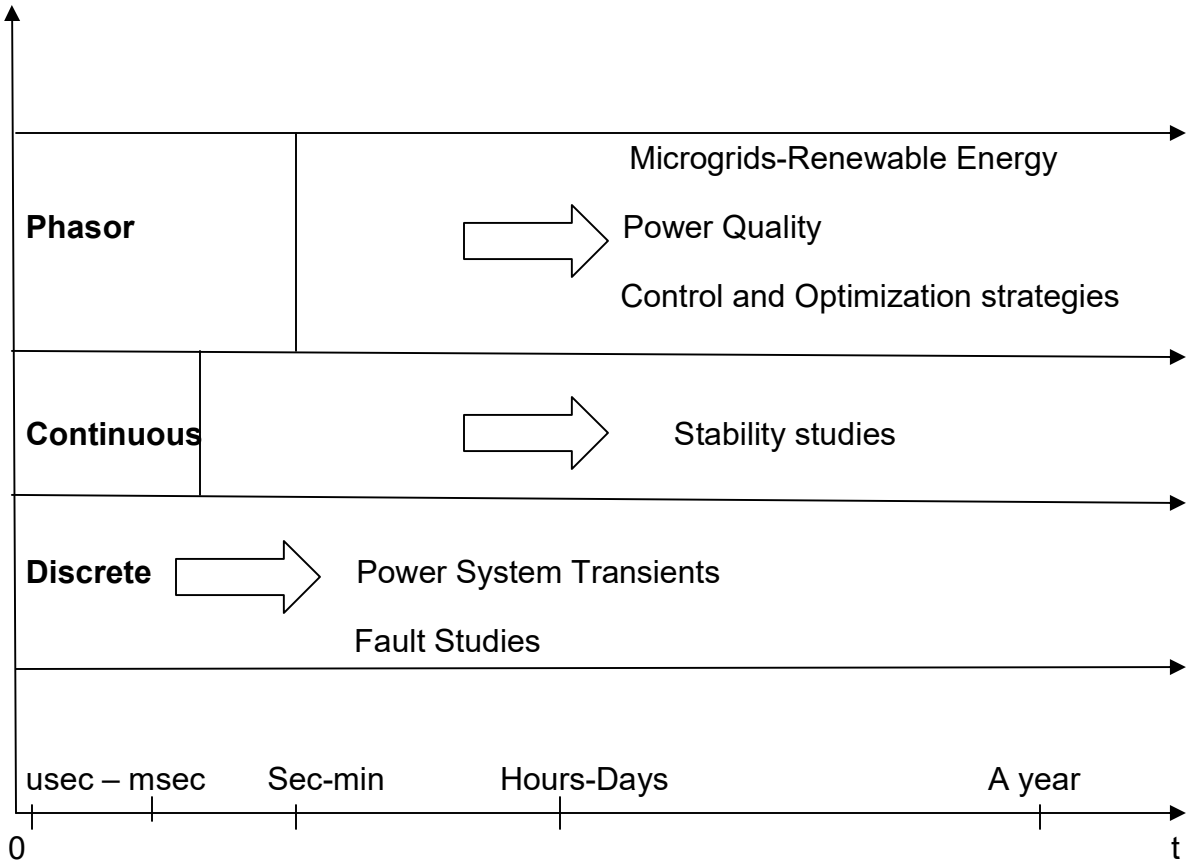
- Modeling of simulation model for varying time-periods.
- Developing Customized Simulation Components.
- Replaying recorded data through a simulation model.
- Monitoring the various activities that leads to demand fluctuation.
- Providing smart approach for efficient fault analysis.
- Analyzing large amount of simulation data.

In this project we will put light on various modern day methods and improvements in power grid operations to make the energy generation, transmission and consumption smart and more economic and efficient as compared to traditional power grid.

Objective:

- The objective of this simulation it to demonstrate power system capabilities to simulate an electric circuit in “phasor mode” for a whole year period in few minutes.
- It also illustrate concepts related to energy storage system by showing how to use solar cell and data time series and how to create typical load profile.
- **The model is divided into four major components**:
    1. The Electrical generation and distribution system- This component contain a diesel generator that is responsible for generation of power.
    2. The dynamic load model that represents residential load- This component implements a three phase, three wire load on load profile and shows the active power (P) and reactive power (Q) absorbed on a daily load profile on hourly basis.
    3. The typical solar cell block feeding power signal to PV farm model and a wind farm Model- This component contains meteorological year data system that converts solar irradiance data to power, this power is then fed to power system model PV Farm that converts power signal to current and wind mills that generate electrical energy through kinetic energy of the wind.
    4. The vehicle charging model- This component contains a model to charge the car of the consumers.
- This electric grid represent a typical Indian Energy grid in which transmission is carried out at 25 kV and distribution is carried out at 600 V. Hence all houses will receive power at 600V supply through the feeders. One these feeders supply electricity to a community that owns a PV farm and energy storage system.
- Here we don’t need to solve complex differential equations resulting from R, L and C elements to analyze the transient response, here we use a special control block that is designed to control fault breaker for given period of time. This block allows simulation model of power system to capture the transient response up to milliseconds accuracy.
- Here the significance of introducing renewable energy sources it to meet the demands of consumers at the peak load conditions when there is more demand at consumer end side and sometimes generator is not able to produce this much energy while under base load condition energy supplied through the generator is sufficient.

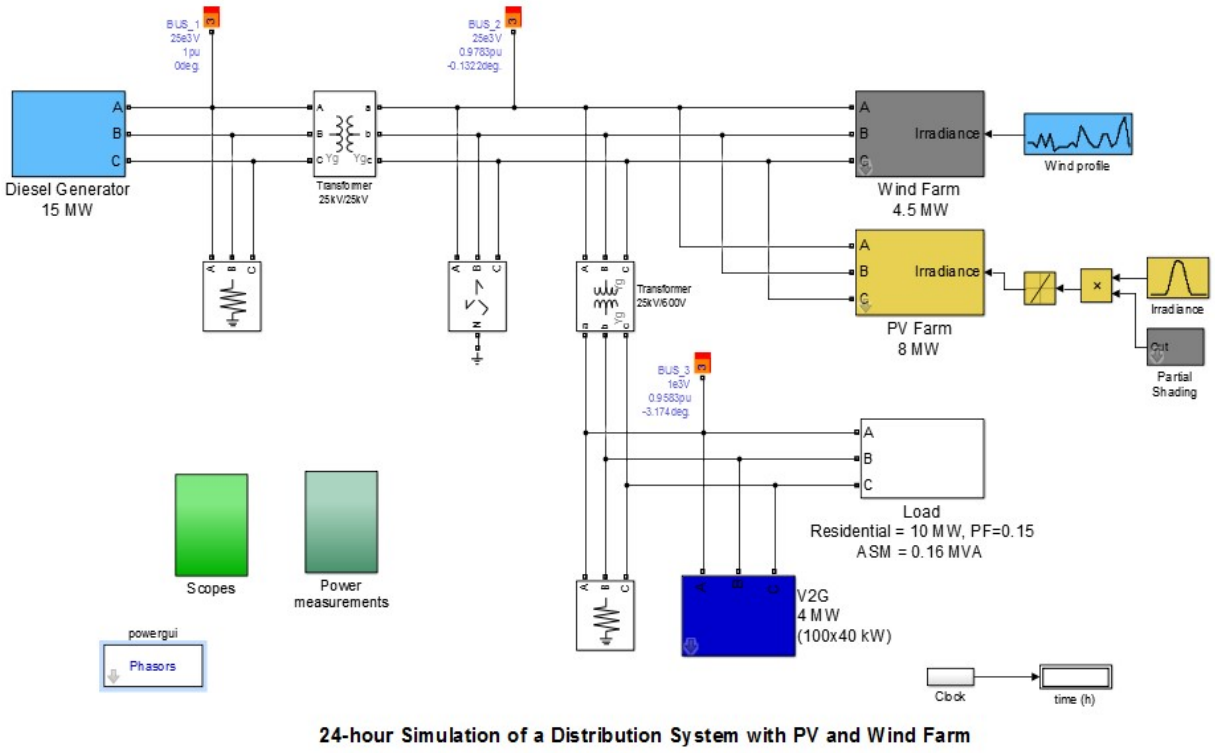
Developing Simulation Models Suitable for Various Time-Periods



This chart shows the use of various time-domain approaches I order to measure various aspects of power generation.

- In this project through the help of SIMULINK the power will be generated and then it will be Step up for transmission and then power will be transmitted through the feeder and then after reaching consumer ends power will be step down and distributed to the consumers.
- The main problem occurs when there is fluctuation in power usage at consumer ends that causes unsymmetricities at the load end and here smart technology comes into picture where various automation and optimization techniques are used to overcome such issues.
- We will be analyzing the power consumption for the running the simulation model for the whole year to analyze the load curves so that power can be generated according to the consumer demands and it can be transmitted efficiently. In this way we can reduce the wastage of power because storing electrical power is not economic in nature.

Theory:

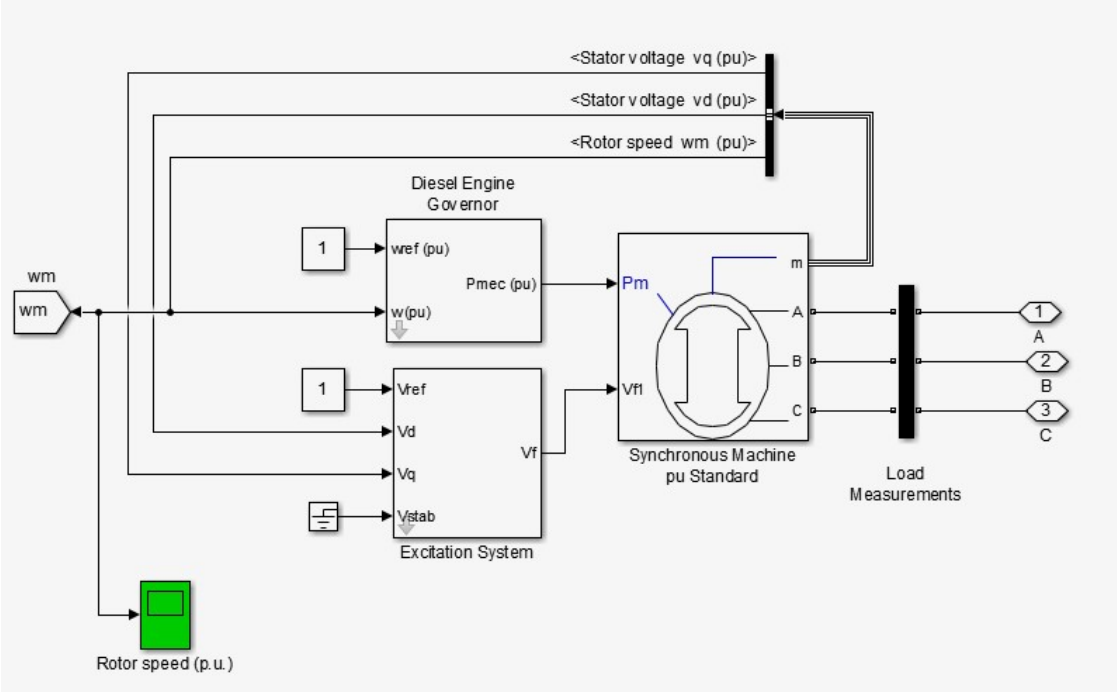


24-hour Simulation of a Distribution System with PV and Wind Farm

The microgrid is divided into four major parts: A diesel generator working as base power generator; A PV farm to supply renewable energy, a vehicle to grid system that is put at the residential load end. This microgrid consists of a community of around 1000 houses. There are 100 electric vehicles within the base model which suggests that there's a 1:10 quantitative relation between the cars and the houses of community. This can be situation during coming future.

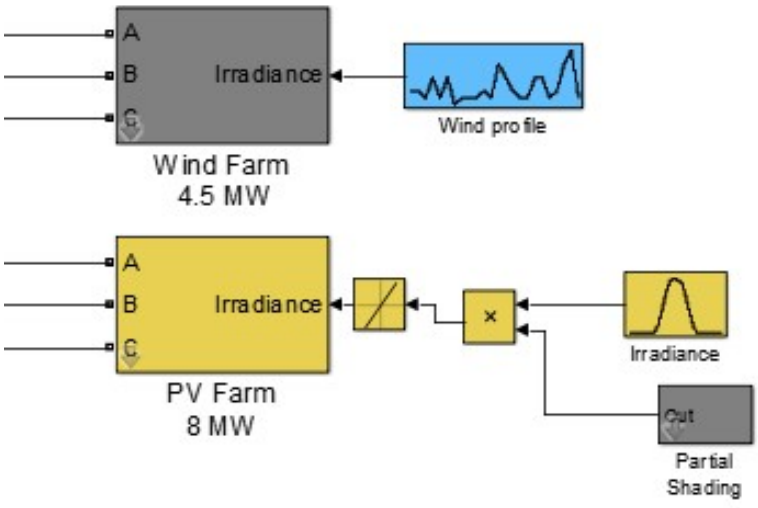
Diesel Generator

The role of diesel generator in this transmission system is to balance the power consumed and the power generated. Frequency deviation of the grid is determined by observing the rotor speed of the synchronous machine.



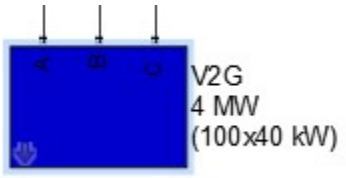
Wind and Solar energy

In This system we are using two sources of renewable energy in the microgrid. First is PV farm that produces energy which is proportional to three factors: the dimensions of the area enclosed by the PV farm, the efficiency of the star panels and the irradiance data. Second is a simplified model of a wind farm that produces electric power following a linear relationship with the wind. When the wind reaches a nominal value, the power station produces the nominal power. The wind farm is disconnected from the grid whenever the speed exceeds the maximum value, until the speed comes back to its nominal value.



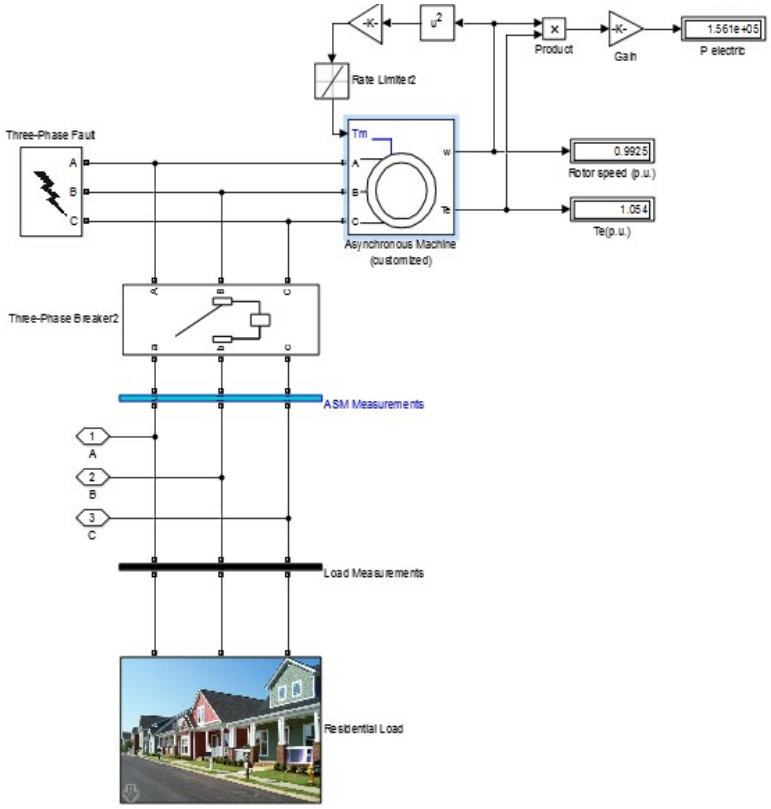
Electrical Vehicle

Vehicle to Grid has two functions: First is to control the batteries charging of the vehicle that is attached to the grid and consume the power available to control the grid when an event happens throughout the day. The role of this block is to run five different car-user scenarios the plug and the state of charge operation lookup tables of every profile. We will set the number of vehicles following every type of profile. The rated capacity, the rated power and efficiency of the power convertor can also be determined by the user.



Consumer Load

The consumer load is depicting small industries and houses. It consists of residential load associated with induction motor that represents the effect of industrial load. The induction motor is controlled by the square relation between the rotor speed and the torque.

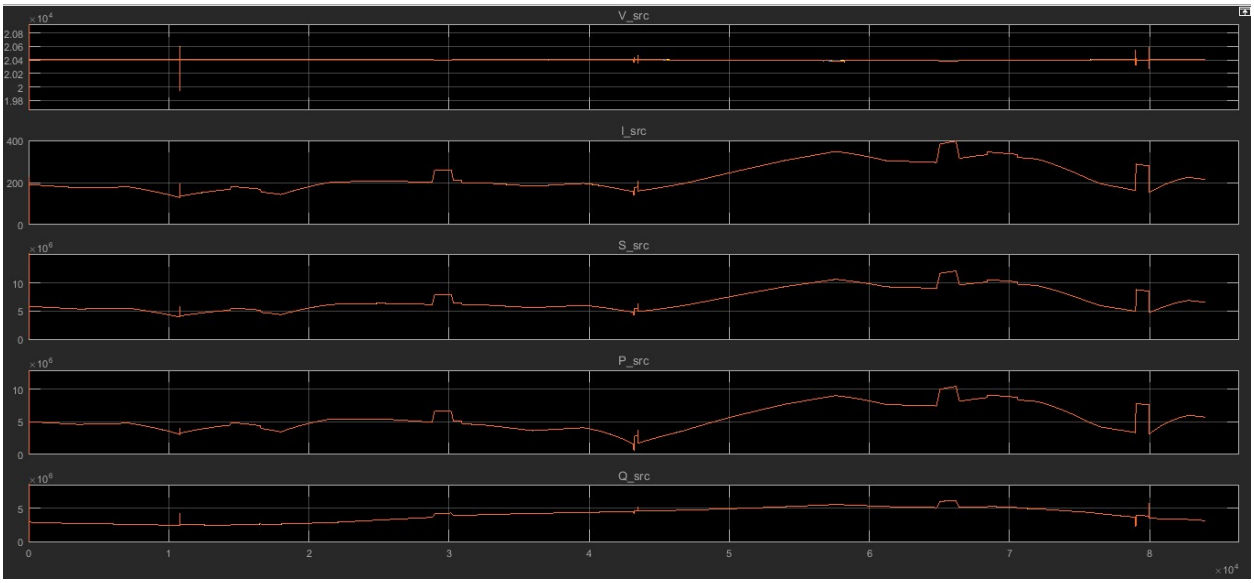


Result

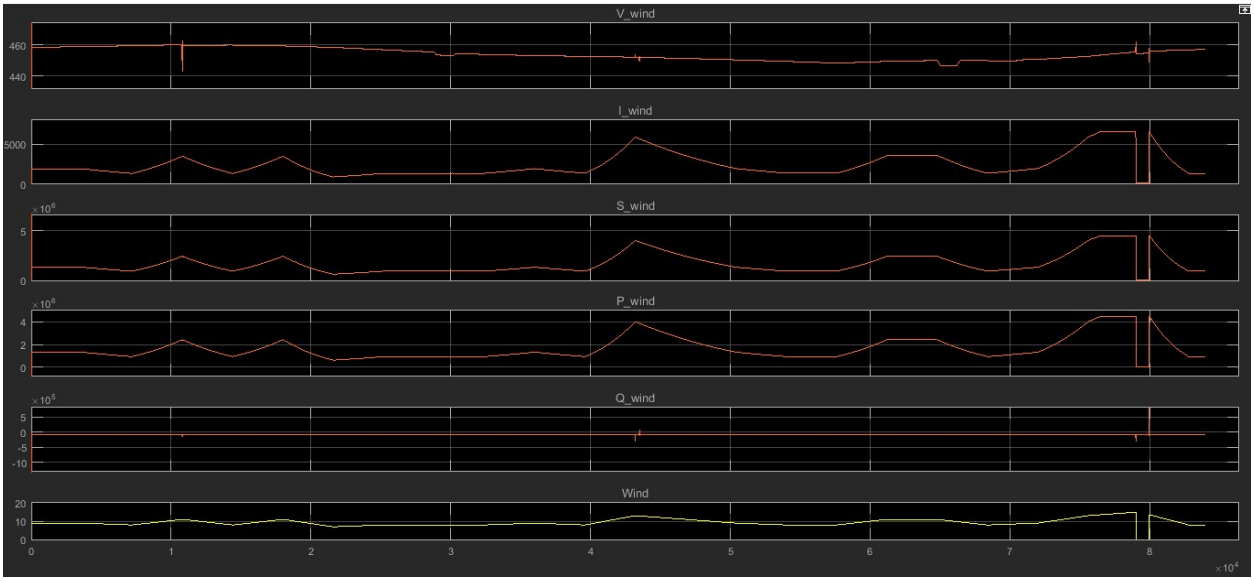
Simulation Run Time = 24 hr (86400s)

Waveform Related to production

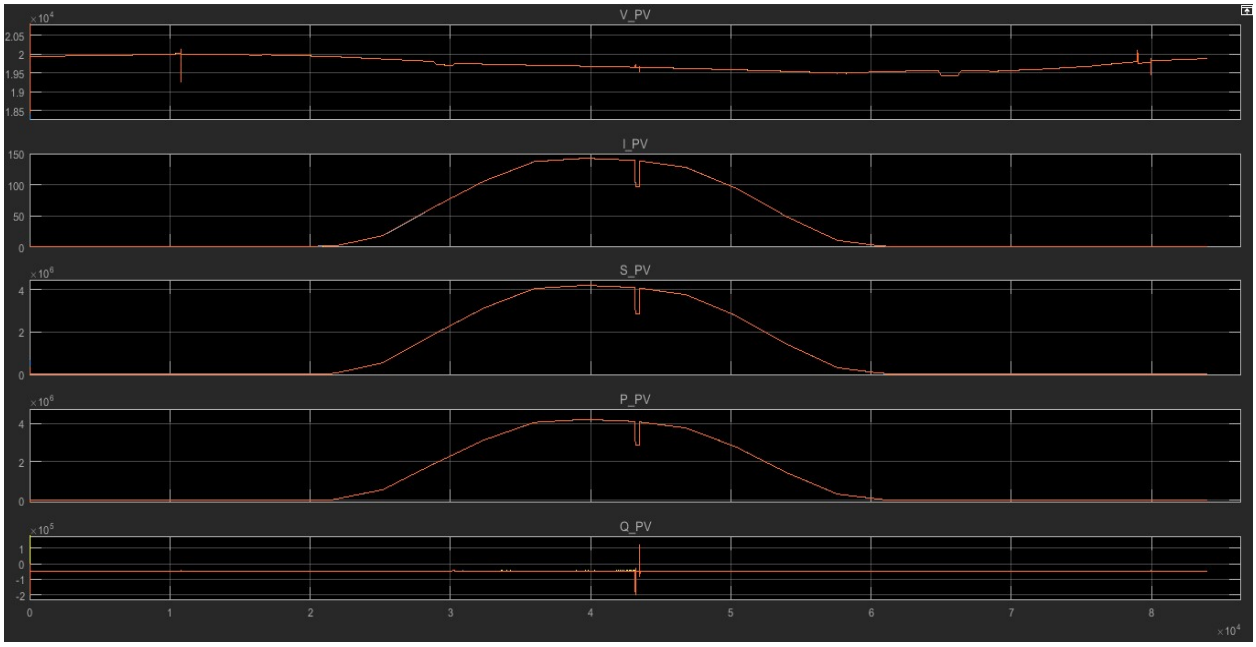
1. Source Generation



2. Wind Farm Production

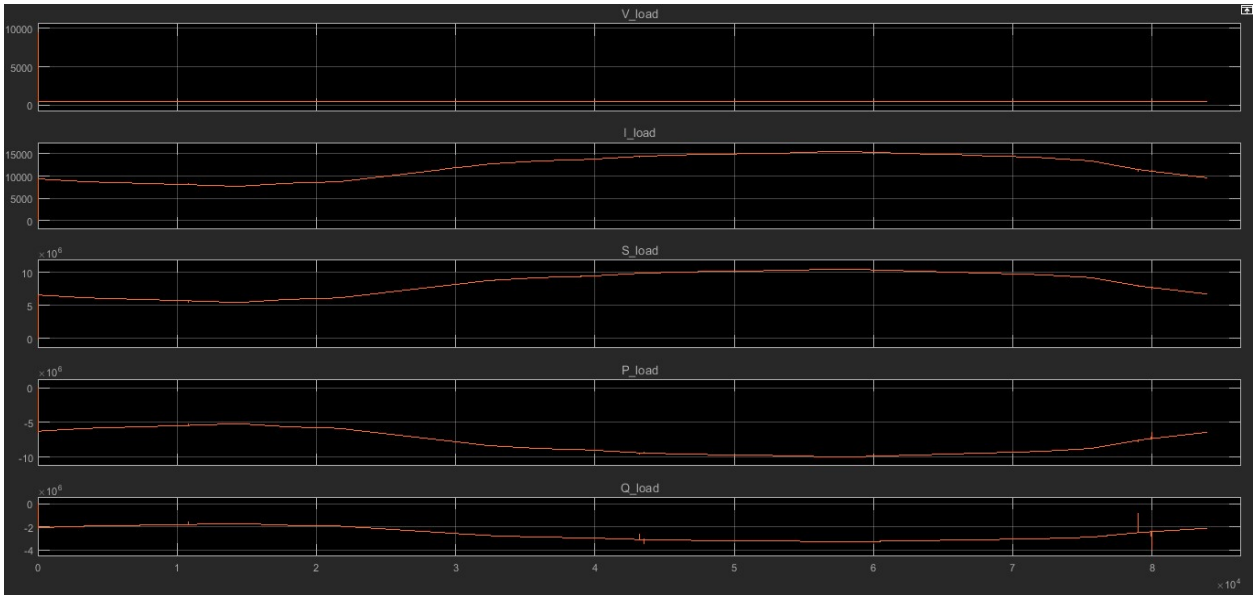


3. PV Farm Production

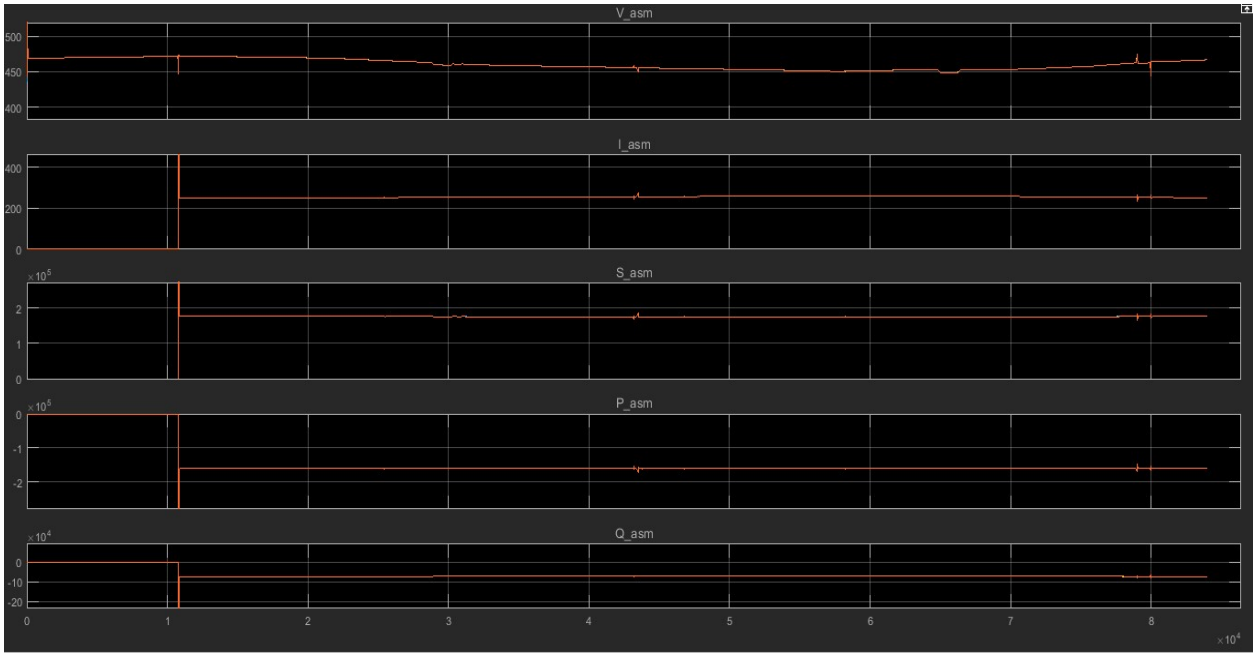


Waveform related to Consumption

1. Residential Load and Vehicle Load Consumption



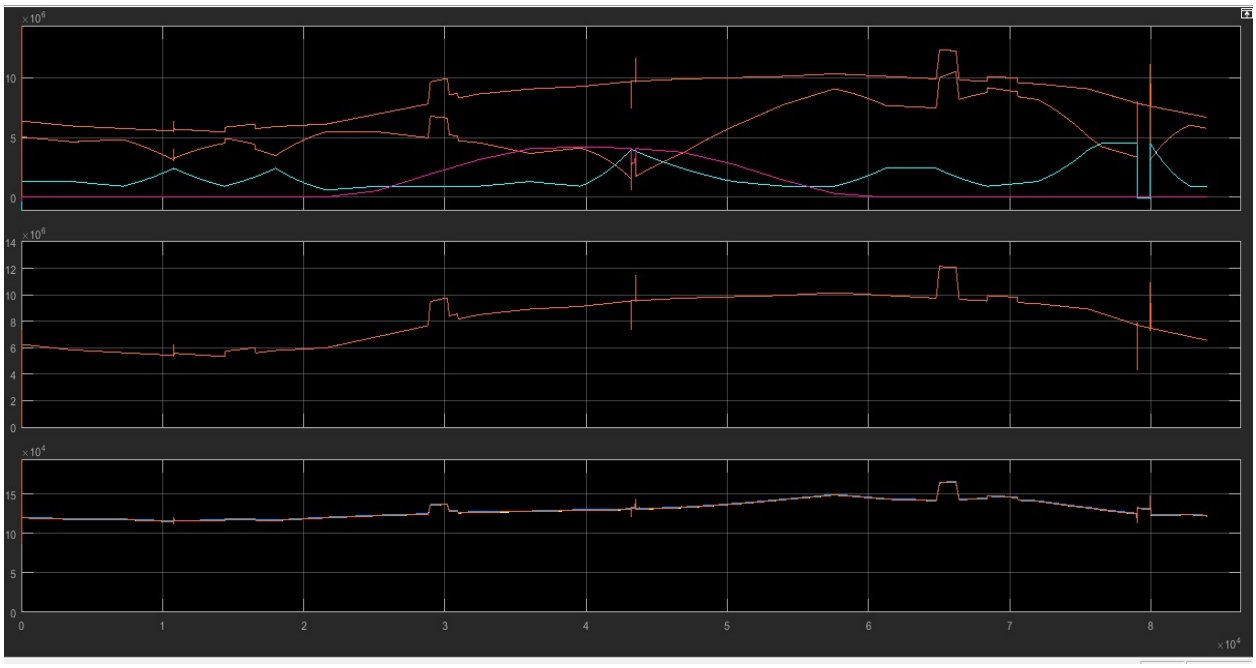
2. Rotational (Motor) load Consumption



Waveform Related To Power

1. Active Power (Generation and Consumption)

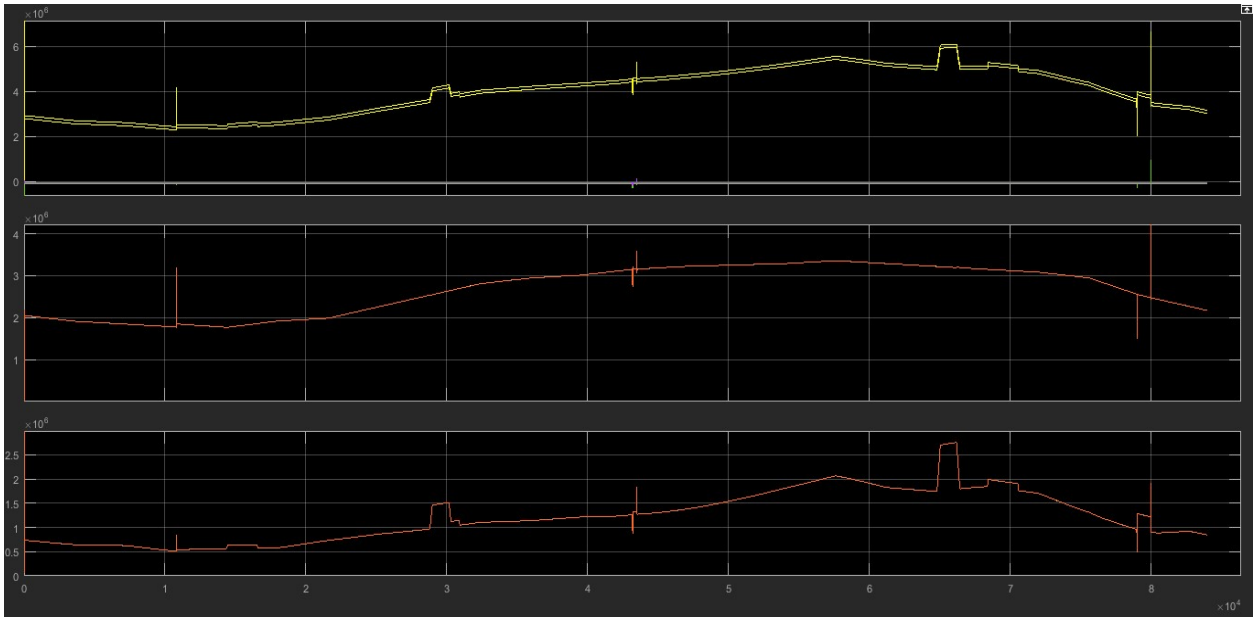
(Magenta = Active Power Generated, Yellow = Active Power generation from Diesel, Orange = Active Power generation from wind, Green = Active Power generation from PV Farm)



2. Reactive Power (Generation and consumption)

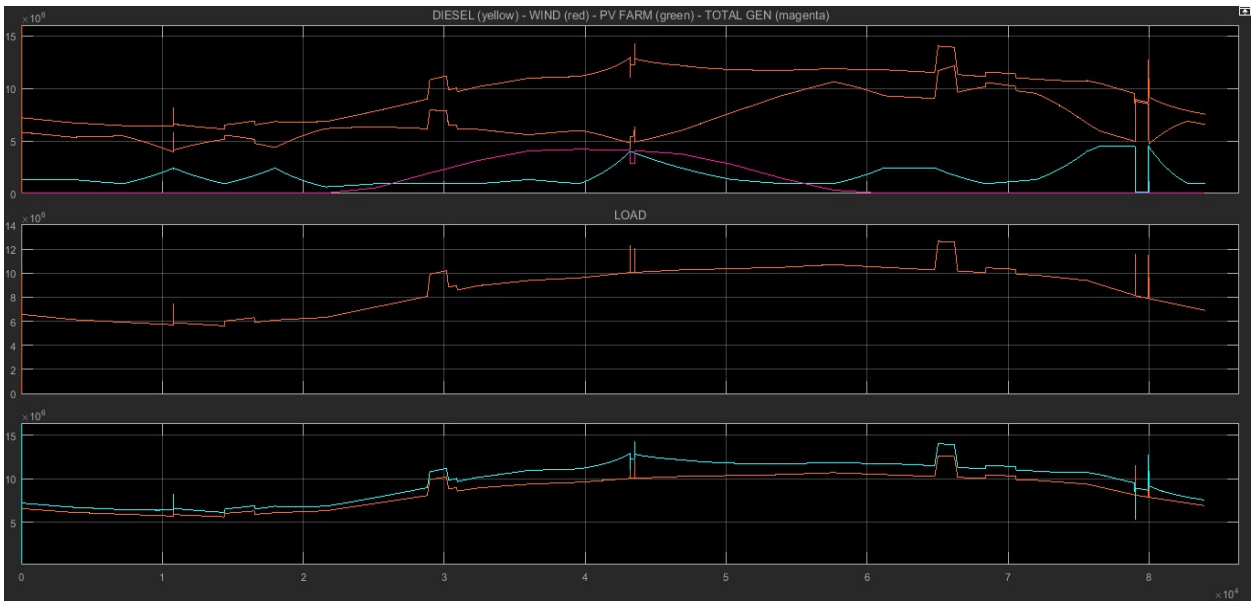
(Yellow = Generated Reactive Power, Red = Reactive Power Consumed,

Orange = Reactive Power Generated Vs Reactive Power Consumed)



3. Total power Generation and Consumption

(Magenta = Total Power Generated, Yellow = Total Power generation from Diesel, Orange = Power generation from wind, Green = Total Power generation from PV Farm)



Conclusion:

Conclusion associated with power generation:

- In wind generation it is concluded that whenever the speed of wind is high there'll be increment in rate of power generation for twenty-four hours. The wind varies generally throughout the day and has multiple peaks and lows.
- In solar energy generation it is concluded that within the simulation that lasts twenty four hour, the solar power intensity follows a standard distribution throughout the day time and the highest intensity is reached at middle of the day. As we will see from the waveform there's a dip in power generation that is cause by presence of clouds in the sky that decreases the solar energy intensity received by solar cells.
- In the diesel power generation it is concluded that the generation is almost constant throughout the day since this power is generated by generators and it does not depend on nature.
- During the whole day simulation, some peaks can be observed which is due to faults in the load that present in residential load.

Conclusion associated with power consumption:

- The consumer load follows a particular fashion the same as a standard unit consumption. The consumption increases as day passes and at peak throughout the evening, and slowly decreases throughout the night because the loads starts turning off.
- Three events effects the frequency of the grid throughout the day: **1.** The kick-off of the asynchronous machine early at the third hour**. 2.** Presence of clouds decreases the intensity of solar energy received by solar cells . **3.** A wind farm is tripped at 22h when the speed of the wind exceeds the maximum permissible wind power.
- The state of charge of every automobile profile is additionally accessible within the system. A negative price of state of charge implies that the automobile is on the road or not blocked in.

References

- Electrical Power and distribution, Author- Electrical4U
- Electric Vehicle load on Power Grids, Author-EEI
- PVPS, IEA. "Evaluation of islanding detection methods for photovoltaic utility-interactive power systems."
- www.mathworks.com
- El-Saadany, E. F., H. H. Zeineldin, and A. H. Al-Badi. "Distributed generation: benefits and challenges." International Conference on Communication, Computer & Power.