Optimal Power Flow Management And Control Of Renewable Energy Source With Grid

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Abstract-*One of the biggest issues in today's era is excessive use of Electricity for various application. In order to get an uninterrupted power supply, It needs to utilize generation in an optimum way [1]. To achieve this, we need to seek for the new resource other than conventional resources. Renewable Energy Sources are the better option for recent trade. India has the large potential for the renewable energy sources like Solar and Wind. The study has been made on the Hybrid System with the grid which can be used as a Stand-alone in the future. This paper significantly highlights the ability of consumer side generation and shows the possibility of the Hybrid System with the grid for higher demand. This project aims to Integrate Grid Tied system and encouraging the consumer to be a prosumer and design a control circuitry, which enables us to control and synchronize the hybrid system with Infinite bus bar system. Focuses are also made on inverters and phenomenon of synchronization. The project has wind and PV cell module which going to generate clean energy. These sources act as a primary generator and grid will be the secondary for the consumer.*

Keywords-Renewable Energy Sources (RES), Hybrid system, Synchronization, Demand side management.

I. INTRODUCTION

At the present time, the world is facing lot of crises in availability of conventional energy sources. They are decaying day by day. Electricity is essential part of present industry and rural areas development. Traditionally we use conventional energy sources to achieve this. If we look towards the characteristics like limited storage, uneconomical, dependency on other nations, environmental pollution make us wise to seek for new sources and one of the answers for this is RES. It creates big issue for the fulfillment of gap between supply and demand side management. To mitigate these problems the project is looking for one of the solutions that is Renewable Energy Source, so the project having hybrid renewable source that helps to satisfy consumer reliability.

RES is available in many different types, out of which focus is made on solar and wind, due to their abundant presence as compared to other RES. Use of hybrid technologies to achieve the demand has been steadily increases for the last few years. Hybrid renewable system makes combination of two or more RES with conventional system, in order to meet the demand of the zone [6]. The drawback associated with the use of RES are overcome by Hybrid system. Consumer is to be as prosumer, generating the electricity with consumption of energy. Hybrid system comfort the use electricity with ability of making consumer as prosumer. In which they produce sufficient amount of energy for satisfying the demand and reduce the dependency on the conventional system. This project like to focus on concept of smart grid system. In this the simulations of wind turbines and solar PV cells are likely to be done.

II. METHODOLOGY

[I] CONVENTIONAL METHOD

1. Stand Alone System:

Stand alone is the off-grid system in which another system other than grid is the main source of generating electricity presently various standalone system are available,

1) Wind turbine
2) Geothermal
3) Photovoltaic
4) Micro hydro system
5) Diesel generation

This system is where the absence of grid power.

2. Grid Integration

In AC infinite bus bar system, Voltage and frequency are the constant parameter. Those buses are helps to keep the all generator at same voltage and frequency. Tie the all generating station generators with a common frequency and voltage and keep the all connected generator in the synchronism is call as 'Grid Integration'. Practical it is difficult to maintain these parameter at all time because of load variation. Load duration curve shows the requirement of consumer with respect to time of day/month/year [5].

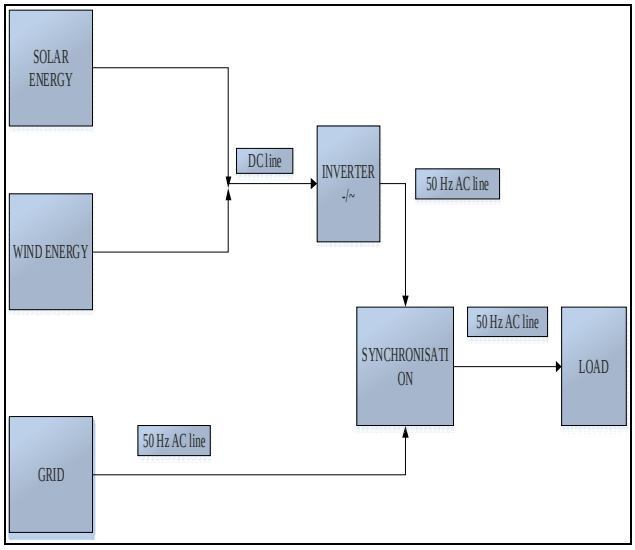


Figure 2.2.[1]: Block Diagram of Hybrid Power Generation

[II] HYBRID POWER GENERATION SYSTEM:

Two or more resources are used to generate the electricity is known as 'Hybrid Power Generation'. In this model, two renewable resources are used such as wind and solar [3]. Grid is stand alone for this system. Due to large variation in the non-conventional resources DC generation is variable [7]. This block diagram explained the project idea. In this, generated solar and wind generated is directly given to consumer by opening the circuit breaker of grid side with all-time closing C.B.1, when the consumer requirement of power is satisfied by Hybrid power generation [8]. On peak load demand, circuit breaker of grid will closed and synchronization of grid and hybrid model is done [4]. Above concept is explained more clearly by single line diagram.

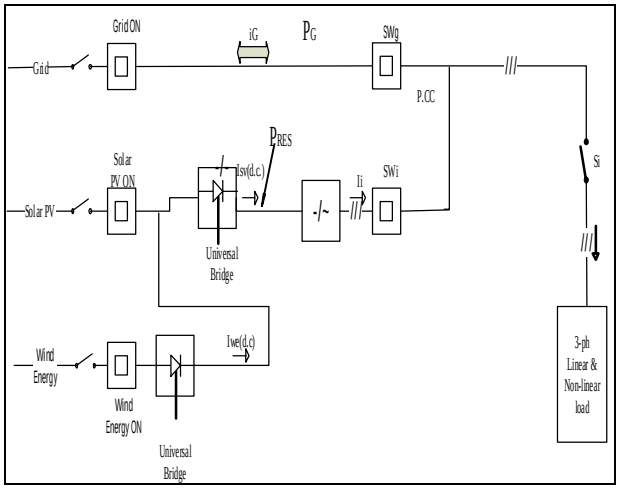
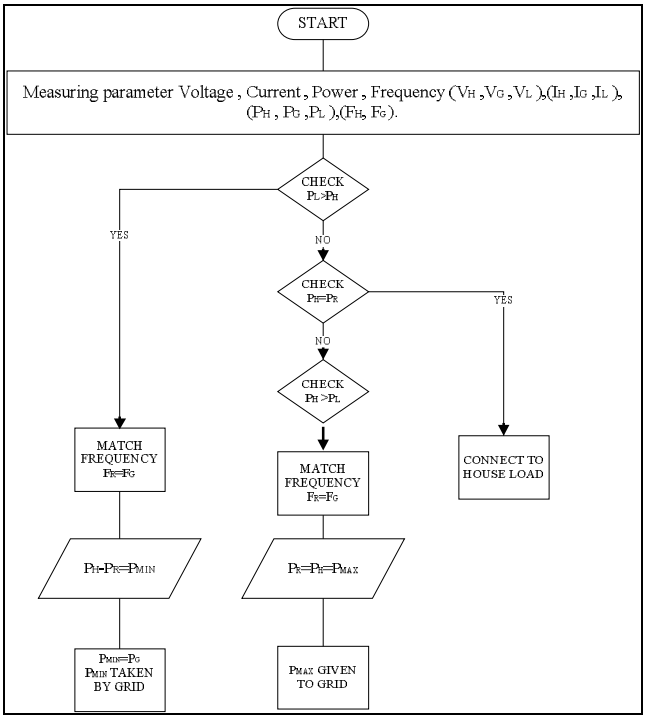


Figure 2.2.[II]: Single Line Diagram of Demand side generation and grid with synchronization.



Flowchart : Conditions for Demand Side Power Transfer System

Consider a system having two generating energy zones one is RES and other is Grid. Residential Load is consider as consumer. Aim of the system is to satisfying consumer need by providing 24*7 power to the Real time load.

Where,

VL=Line Voltage at consumer side or load voltage (Voltage)
VR=Line Voltage at renewable Hybrid plant side (Voltage)
VG=Line Voltage at grid side (Voltage)
IL= Consumed load current (Amperes)
IR= Hybrid Plant current consumed by load (Amperes)
IG=Grid current consumed by Load (Amperes)
FR= Frequency of Hybrid plant (Hertz)
FG=Frequency of Interconnected grid system (Hertz)
PL= Power consumed by Load (Watts)
PH=Power generated by Hybrid Energy generator which is combination of Wind and Solar System (Watts)
PG=Power available at grid (Watts)

Above all parameters are considered to execute following condition:

CONDITION 1:

Power generated by RES is more than the Load requirement. $(P_L < P_H)$

$$\sum P_H - \sum P_L = \sum P_{Extra}$$

This condition shows that the RES generation is more than Load and remaining Power generated by RES is supplied to the grid. But before that the main parameter voltage and frequency of RES should be match with Grid voltage and frequency.

CONDITION 2:

Power generated by RES is less than the Load requirement $(P_L > P_H)$

$$\sum P_L - \sum P_H = \sum P_{need}$$

At this condition load required more power than power generated by the RES. So for satisfying need of load at consumer side remaining power $\sum PNeed$ is taken by grid with closing of circuit breaker C.B.1

CONDITION 3:

Power generated by RES is less equal to the Load requirement. $(P_L = P_H)$

$$\sum PL = \sum PH$$

At this condition Grid is isolated with Load and RES i.e. Circuit breaker C.B.1 is open.

1. Mathematical Generation Model Of Distributed Power:

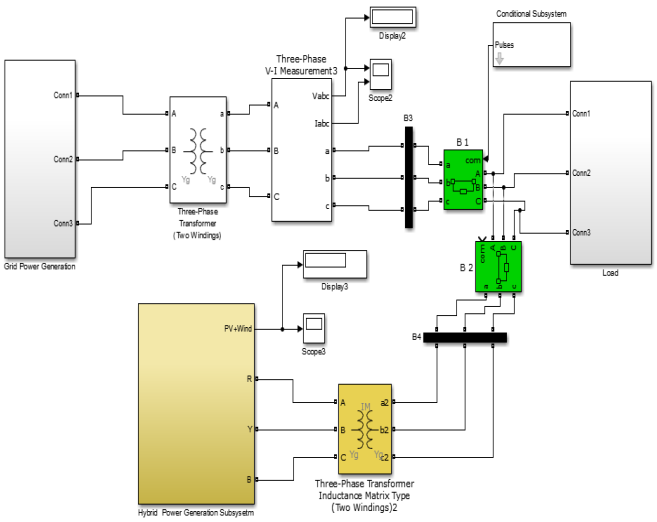
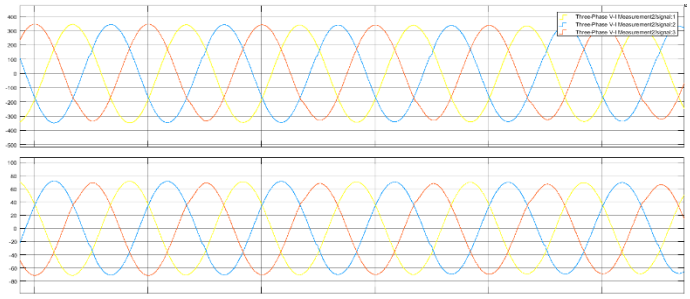


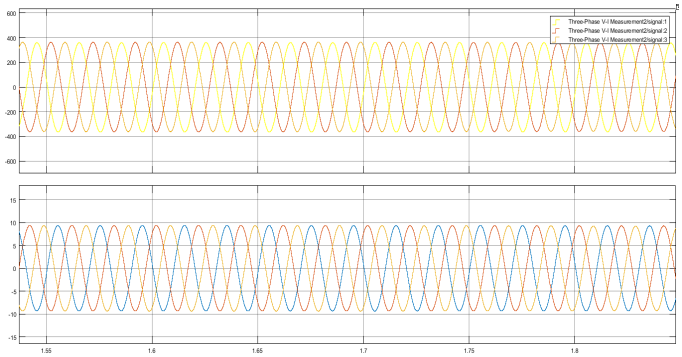
Figure 3.1: Mathematical Model of Renewable and Grid power generation system with Load

2. Simulation Result And Discussion:



Result 4.1: Simulation waveform of grid integration with load of 40Kw

These are the output results of grid integration with hybrid system with the load of 40Kw. First is the voltage waveform showing the peak rms voltage of value 370V .The given waveform enables us to detect 3 phase i.e. R-Y-B phases. Second waveform is load current waveform with magnitude of 70A.



Result 4.2 : Simulation waveform of Hybrid system with load of 5Kw

In result 4.2, 5Kw is consider as off peak hour demand of consumer. At this condition the load is lesser than hybrid generation. So, there is no need to take power from grid. Hence the switch C.B.1 will be open.

III. PRACTICAL RESULTS

In practical implementation of this system is done in Vadgaon village. In this project two solar panels of 250W are connected in parallel and maximum power output, open circuit voltage and short circuit current of each panel noted down by using power analyzer. Then we installed both panel are connected in parallel, so the resulting current is more.

Solar Specifications: -

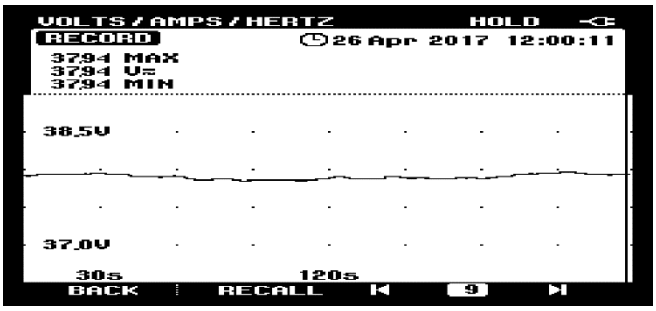
Maximum Power (Pmax)	250w
Open Circuit Voltage (Voc)	42.34v
Short Circuit Current(Isc)	7.70a
Maximum Power Voltage(Vmax)	34.72v
Maximum Power Current(Imax)	7.21a
Maximum System Voltage(Tuv)	1000vdc
Maximum Series Fuse Rating	11a

Maximum Series Diode Rating	20a
Dimension(W*L*Tmm)	1944*982*40
Weight	23kg

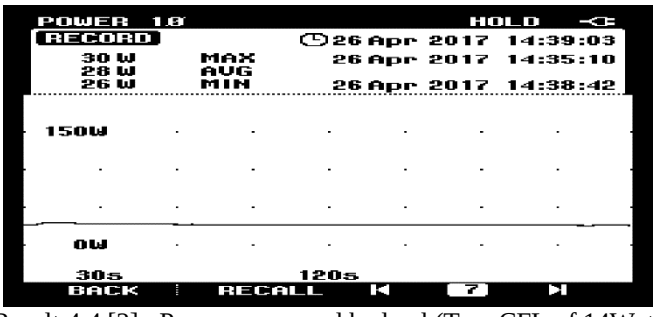
Table 4.3 : Solar Panel Specification for 250 Watt

Power Analyzer Result :

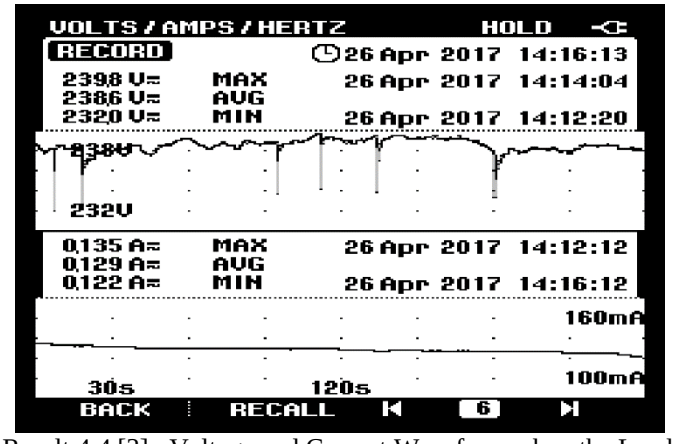
The waveform shows solar panel output for duration of 4 min and 38 Volts is the output at morning 12 O'clock shown in 4.4.[1]. For checking real time effect of load, In this project two CFL are connected through inverter. Variation of load is also observed in result 4.4.[3]. In this load analysis, Voltage and Current variation observed through the power analyzer waveform. Due to variation in solar irradiation the voltage fluctuation are seemed in waveform.



Result 4.4.[1]:Voltage across Solar Panel (250 Watt each connected in Parallel)



Result 4.4.[2] : Power consumed by load (Two CFL of 14Watt each)



Result 4.4.[3] : Voltage and Current Waveform when the Load is connected

IV. CONCLUSION

The field of study introduced in the above paper proposes the solar-wind hybrid system working principle in particular. Here, the solar photovoltaic subsystem and wind energy conversion subsystem are simulated separately. Solar PV module is modelled according to their basic solar equations. Hybrid Generation System has been simulated in this paper and its graphical output proved that Load variations are managed by RES and Grid. The working cost of the hybrid power generation unit is cheaper when installed in proper location as compared to any conventional fuel system.

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