Volume : 3 | Issue : 5 | May 2014 • ISSN No 2277 - 8179

Research Paper

A Review on Hybrid Energy System and A Model Simulation

Engineering

KEYWORDS : HES, Economic, Transients, Grid

Ritesh Dash	Ajya Binya Institue of Technology ,Cuttack
Chinmaya Behera	School Of Electrical & Electronics Engg.Kiit University
Pratik Ranjan Behera	School Of Electrical & Electronics Engg.Kiit University
Manas Ranjan Sarangi	School Of Electrical & Electronics Engg.Kiit University
Kunjan Kumar Mohapatra	School Of Electrical & Electronics Engg.Kiit University

ABSTRACT

In order to meet the global energy demand the hybrid energy system acts as a best solution. The hybrid system generally integrate the solar , wind , micro hydro generation , geothermal to that of the existing transmission distribution system. This increases the power system efficiency, stability and hence leads to meet the global energy demand. This paper describes the hybrid energy system and its economic analysis with a model. Solar photovoltaic system can act as a best solution to meet the power demand in the remotely grid connected villages. The economic analysis at the end of the paper describes about the feasibility of the hybrid system to that of the existing grid connected system.

I. INTRODUCTION

With the rapid growth in the population level worldwide the demand for energy i.e. electrical energy is also increasing. The power engineers now thinking for some alternative source of energy to meet the global demand. The major part of the electrical energy is form the fossils only. Harvesting the energy from the fossils fuel leads to global pollution and hence affects the Scio economic sustainability. Instead of all possible action still we are not able to meet the global energy demand. Specially in summer season to give supply to the big consumer we have to go for power cut. For last five decades engineers and scientist have devoted their time for the development of renewable source of energy. renewable energy are basically regarded as abundant sources of energy. But with such technology we can meet a fraction of total energy demand. Harvesting the renewable energy leads to a sustainable development for future generation and also produces almost negligible amount of green house gases. Most of the renewable energy system works off grid basis that is stand alone system. They can be used to power a small geographical area or a village. However their installation cost is too high as compared to their running cost. So it becomes very difficult to install a personal renewable sources' of energy harvesting device. Hybrid energy system is the solution for the above mention problems. Hybrid energy system integrate the renewable sources of energy with that of the traditional available commercial sources of energy. HES integrates the AC system with that of the DC system though a converter hence increases the system stability. During blackout condition it can mitigate the energy demand a little bit. Here both the energy consumer and that of the supplier becomes benefited as it reduces the loss of transmission and distribution.HES becomes more popular in remote areas where the grid connected is not fissile .

HYBRID SYSTEMS

A hybrid PV system is essentially a system which employs at least one more source of electricity, other than Photovoltaic, to fulfill the electrical power demand. The other source of electricity that is generally used in conjunction with the PV source is diesel generators.

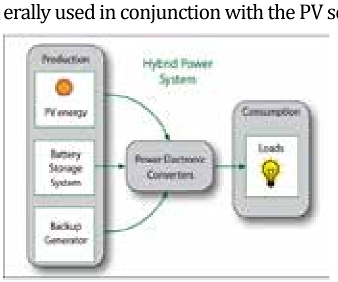

Fig 1.1 Hybrid System

Need of Hybrid System

Photovoltaic is an unreliable source of energy, in a sense that it can supply energy only when the solar radiation is available. In grid connected systems when the sun is not available, the energy demand of the load can met by the grid. However, in the PV based stand-alone applications, without any storage media, such situations may lead to the total shutdown of the load. Even if the sun is available, the intensity of the solar insolation received by PV arrays varies continuously, which affects the load's performance. Such scenario is quite common in the cloudy conditions, where partial shading decreases the power output. Also the change in the shading pattern due to the cloud movements also changes electrical characteristics of the PV array. Under such conditions, to maintain the continuity of energy and to maintain it at a level required by the load, a modified configuration including a source other than PV is a must requirement.

II. TYPES OF PV-DIESEL HYBRID SYSTEM

Series Hybrid: The fig 1.2 shows the series hybrid system. Here the power generated by the diesel generator is converted to DC and then converted back to AC through an inverter. The inverter which is designed to meet the maximum load, converts the DC into AC and supplies the AC load. The PV source is also connected to the DC bus via a DC-DC converter at which the battery is connected. The DC-DC converter ensures the function of Maximum Power Point Tracker (MPPT) to optimally use the PV array. The Battery is used to store or supply the excess or deficit power and also to help during instances like the starting of the diesel generator or load changes.

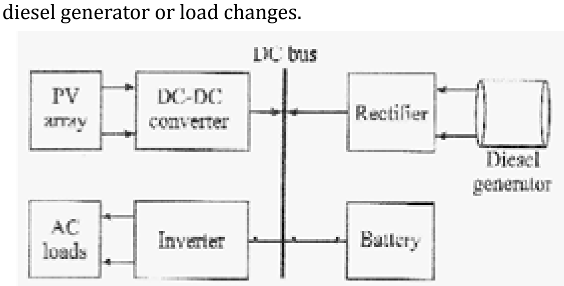

Fig 1.2 Series Hybrid system

Parallel Hybrid: In parallel configuration the generator and inverter are connected in parallel to the AC load. The rating of the inverter is less and efficiency of the system is higher. The power supplying capacity of the parallel configuration is much more which is equal to the sum of the capacity of individual sources.

However proper synchronization is required between output voltage of inverter and diesel generator.

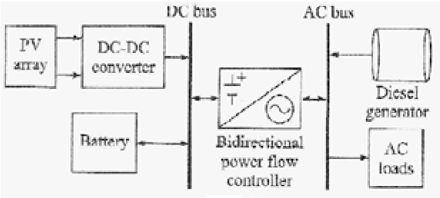

Fig 1.3 Parallel hybrid system

Switched Hybrid: In this type of configuration only one of the sources is connected to the load at a given time. But during switching the power is interrupted. Advantages of this type of configuration are:

- The diesel generator can be directly connected to load, so increase in efficiency
- Synchronization is not needed.

III. BARRIERS IN THE TECHNICAL FEASIBLLITY

Sun is regarded as the primary sources of energy. The solar photovoltaic generation depends upon the intensity of sun light. In an cloudy day it becomes difficult to harvest the energy which is again nature dependent. So while integrating solar photovoltaic system with the grid connected system maximum emphasis must be given to the maximum power extraction under variable loading condition. When a large no of PV system are connected to the grid the individual VI characteristics may not match which leads to mismatching operation of the entire system.

Harvesting the energy in traditional process is also nature dependent and hence in a hybrid energy system instability problem may appears. So unit commitment is a necessary process in the hybrid energy system. In an HES frequency mismatching is a great problem which may leads to collapse the entire operation.

Due to the use of high quality converter between the DC and AC system may produces harmonics in the system which may leads to additional loss in the power transmission and distribution system. To minimise these harmonics additional filters can be employed.

IV. DESIGN CONSTRAINTS

A hybrid system is designed with the homor software to verify the optimization and feasibility of the system. Two types of links are provided i.e .AC and DC link for proper simulation of the system. The two generator each of rating 100Kwatt are connected to the AC link. The interconnection between the AC and DC link is provided by the Converter.

Size (kW)	Capital Cost	Replacement Cost	O&M Cost/Hr.
100.000	6,667	1,333	534.000

Table: Generator Description

Table shows the generator design parameter with its cost for economic point of view. Sizes to consider for the two generator are : 100 kW Lifetime:15,000 hrsMin. load ratio:30% Heat recovery ratio:0% Fuel used: Diesel Fuel curve intercept:0.08 L/hr/kW Fuel curve slope:0.25 L/hr/kW.

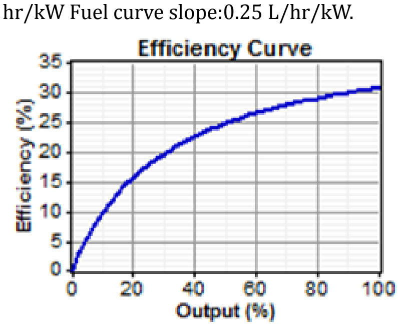

Fig 1.4 :Efficiency curve of the generator 1 and 2

Battery for the design is so chosen that it provides maximum load current under the peak load condition . the batteries are connected in parallel in order to meet the load demand.

Quantity	Capital Cost	Replacement Cost	O&M Cost/Hr.
10	70,000	14,000	10,000.00

Table :1.1 Battery Economical values

Table 1.2 s hows the battery ecumenical values. Here the battery terminal voltage is 6V and having an ampere hour of 360Ah.

Size (kW)	Capital Cost	Replacement Cost	O&M Cost/Hr.
600.000	3,600,000	720,000	25,000

Table :1.2 Converter economics

Table 1.3 shows the economical values of the converter. The converter is employed to convert the DC into AC system. Here the inverter efficiency is assumed to be 90% and that of the rectification efficiency is assumed to be 80%.

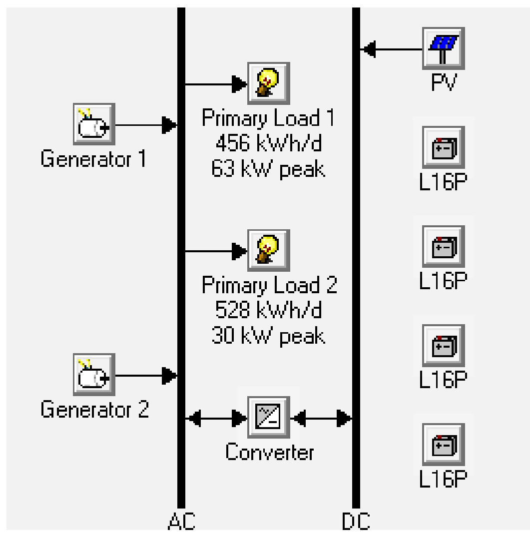

Fig:1.5 Simulation of considered system

Figure 1.5 shows the simulation of hubried system. Two generator are connected to the AC bus. One solar PV system is connected to the DC system. The AC and DC system are connected by the converter. Six no of batteries are connected having 2 cell in each path so the net output voltage becoms 12V. The entire system is designed and simulated for 15 years.

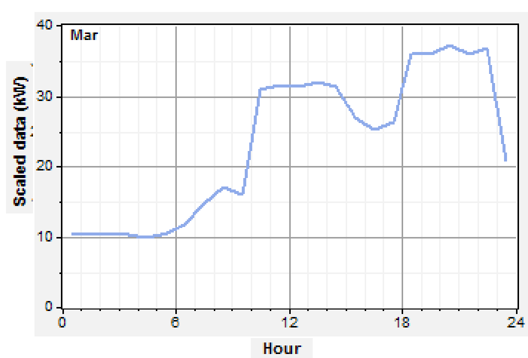

Fig: 1.6 Scaled Data daily profile for the month of March for load 1

Figure 1.6 shows the daily load profile for the month of the march. The load profile can also be plotted for the year basis with an approximation. The load forecasting method can also be carried out to calculate the optimum load on the system.

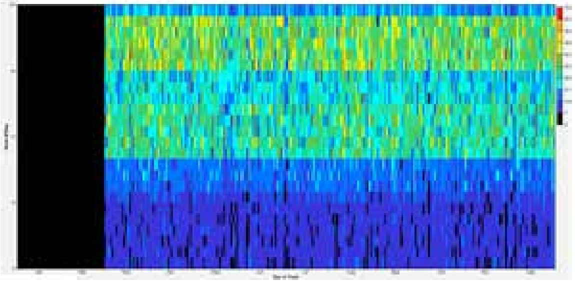

Fig: 1.7 Dmap for the month of March for generator 1

The Dmap or data map shows the annual energy yield or demand of the system by plotting each day of the year at a time. Seasonal pattern can be identified from the figure and hence the system can be designed accordingly.

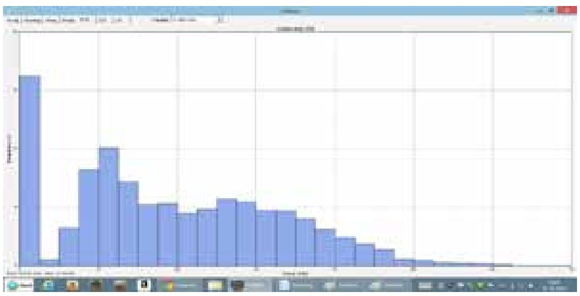

Fig :1.8 Scaled data PDF (Frequency Vs. Kw) for load 1

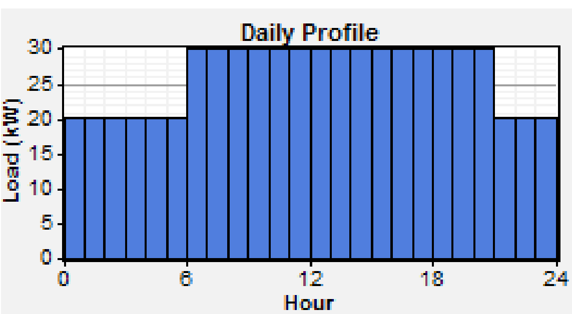

Fig :1.9-Load profile for load 2

Both figure 1.8 and 1.9 shows the scaled data PDF and load profile of the load 2 . Profile shows the load remain constant for some hour in a day. So it becomes very easy to control the system during sudden load thrown off.

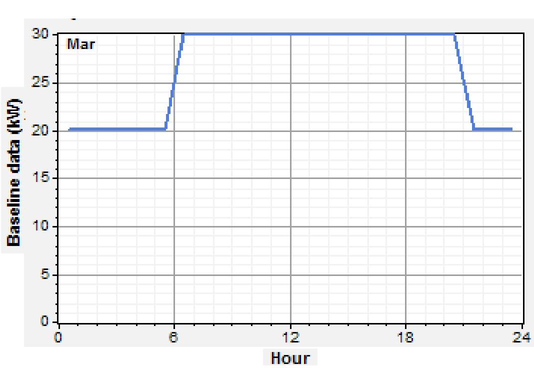

Fig:1.10 Scaled Data daily profile for the month of March for load 2

Figure 1.10 shows the scaled data profile for the load 2 for the month of the march. However annual load profile can also be generated by the forecasting methods.

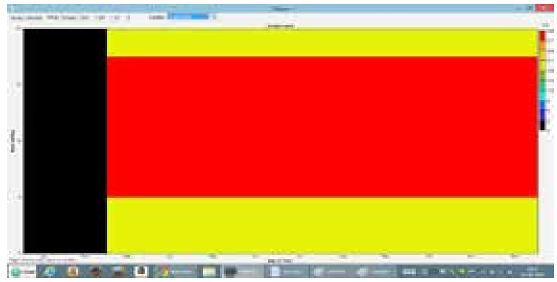

Fig:1.11 Dmap for the month of March for load 2

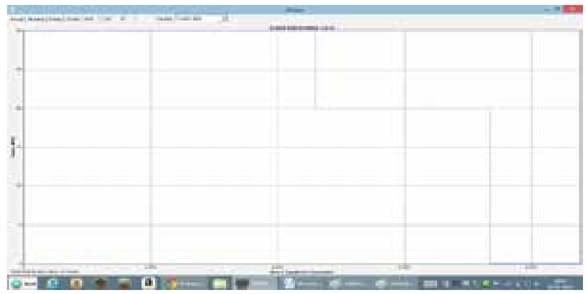

Fig:1.12 Dc level for generator 2

Figure 1.12 shows the Dmap and DC level of the generator 2 under different load condition in a given year.

Sl No.	PV (Kw)	Label (Kw)	Label (Kw)	L16P	L16P	L16P	L16P	Converter	Initial capital
1		100		-	-	-	-		6667
2			100	-	-	-	-		6667
3		100	100	-	-	-			13334
4	500	100						600	7606667
5	500		100					600	7606667
6	500	100	100					600	7613334

Table :1.3 Optimization result 1

Sl No.	Operating cost	Total NPC	COE	Ren Fraction.	Diesel (L)	Level (Hr.)	Level (Hr.)	Battery Life
1	4041500	51670596	11254	0	148993	7344		
2	4041500	51670596	11254	0	148993		7344	
3	4043637	51704588	11262	0	149025	7344	4	
4	4110204	60148868	13101	0	149025	7344		
5	4110204	60148868	13101	0	148993		7344	
6	4112342	60182860	13108	0	149025	7344	4	

Table :1.4 Optimization result 2

Sl No.	PV(Kw)	Label (Kw)	Label (Kw)	L16P	L16P	L16P	L16P	Converter	Initial capital
1		100							6667

Table :1.5 sensitivity result 1

Sl No.	Operating cost	Total NPC	COE	Ren Fraction.	Diesel(L)	Level(Hr.)	Level(Hr.)	Battery Life
1	4041500	51670596	11254	0	148993	7344		

Table :1.6 sensitivity result 2

Volume : 3 | Issue : 5 | May 2014 • ISSN No 2277 - 8179

Table 1.1 to 1.6 shows the different simulation values. From the above it can be seen that the hybrid system is economical and beneficial to the grid and to that of the customer from economical point and stability point of view.

V. CONCLUSION

This paper describes the economic analysis of the hybrid system consisting of the two numbers of generators and one PV system. Battery backup is provided to meet the peak load demand. To check the validity of the model Homor based simulation is carried out. An optimal value for the system is presented to check and compare the simulated system result with that of the physical model. The simulation of the system shows that the initial cost of the system is very much higher as compared to the conventional system. But from the result it can be seen that the running and operating cost is much lower in its long term use. So in near future to meet the global demand for the energy, the hybrid system can act like a substitute.

REFERENCE

[1]. Je´re´my Lagorsea,, Marcelo G. Simo˜esb , Abdellatif Miraouia , Philippe Costergc ," Energy cost analysis of a solar-hydrogen hybrid energy system for stand-alone applications" , International Journal Of Hydrogen Energy 33 (2008) 2871– 2879. | [2]. Farshid Mostofi, Hossein Shayeghi ," Feasibility and Optimal Reliable Design of Renewable Hybrid Energy System for Rural Electrification in Iran", International journal of Renewable energy research Vol 2, No 4 2012. | [3]. Jong Hwan Lim," Optimal Combination and Sizing of a New and Renewable Hybrid | Generation System", International Journal of Future Generation Communication and Networking Vol. 5, No. 2, June, 2012 | [4]. Nitin Vania and Vikas Kharea," Rural Electrification System based on Hybrid Energy System Model Optimization using HOMER" ,Canadian Journal of Basic and Applied Sciences", CJBAS Vol. (01) - August - Issue 01 (2013) 19-25 | [5]. Arjun A. K., Athul S., Mohamed Ayub, Neethu Ramesh, and Anith Krishnan," Micro-Hybrid Power Systems – A Feasibility Study , Journal of Clean Energy Technologies, Vol. 1, No. 1, January 2013 | [6]. M. Muralikrishna And V. Lakshminarayana," A 10 Kw Combined Hybrid (Wind And Solar Photovoltaic) Energy Systems For Isolated Generating System" , Arpn Journal Of Engineering And Applied Sciences Vol. 6, No. 6, June 2011 | |