Latest Scenario of World Energy Demand, Electricity Consumption and Their Development Trend

Shantanu Virnave*[1], Dr. Sanjay Jain[2]

*[1] M. Tech Student, Electrical Engineering Department, RKDF University, Bhopal, M.P.
virnaveshantanu@gmail.com[1]
[2] Professor& HOD, Electrical Engineering Department, RKDF University, Bhopal, M.P.
jain.san12@gmail.com[2]

* Corresponding Author: Shantanu Virnave

ABSTRACT

World energy consumption has been on the rise worldwide as developing nations begin to industrialize and as consumers in developed nations buy more energy consuming appliances to make life more comfortable. Energy used to power our lives can be divided into two types: Renewable and Non-renewable. Energy is essential to everyone's life no matter when and where they are. Rural areas are also in the same pace. Due to geographical location and low demand compared to the urban area, rural areas are mainly suitable for renewable energy off grid applications. Wind energy based grid connected stand alone system can supply large amount of power but its presence is highly unpredictable. Similarly, solar energy is present throughout the day but the solar irradiation level varies due to sun intensity and unpredictable shadows casting by clouds, trees etc. The intermittent nature of the wind and photovoltaic systems makes them unreliable, which is its major drawback. The combined utilization of these two renewable energy sources, the power transfer efficiency and reliability of the system can be improved significantly. The difficulty to generate the quantities of electricity is one of the major disadvantages that are as large as those produced by traditional fossil-fuel generators. So it's necessary to reduce using the amount of energy or simply find an alternate source of energy. Using different power sources is the best solution to balance our energy problem. In this chapter, an overview is given on the world energy demand, electricity consumption and their development trend in the near future.

Keywords:

1. INTRODUCTION

The main components of hybrid systems are: the power sources, the storage devices, the power management center, and monitor and control devices (Skoglund et al., 2010). A stand-alone power system, which operates "off-grid", is a good solution for supplying power to rural area where it is hard to be connected to the main grid. There are two types of standalone photovoltaic power systems: direct-coupled system and standalone system. In direct-coupled system, there are no storage devices and the solar panel is connected to a dc load. In standalone photovoltaic system, there are storage devices because the demand from the load does not always equal to the capacity of the solar panel

(Evans et al., 2009). This thesis proposes a modification of a hybrid solar power system called the SAPS system in which the flow of energy from different sources is monitored and controlled. In addition to solar panels and wind turbines, a diesel engine is used to provide power only in the event of a power outage. There are two main advantages of the proposed system in this study compared to others. First, the power of the proposed system is used efficiently and effectively by monitoring the load capacity and renewable energy available to determine the amount of power required and selecting the best available source. Second, additional batteries are used as a disposable load in the proposed system, which can be used in the event of a shortage of renewable energy sources to reduce diesel engine use. In addition a hybrid energy storage system is also designed with battery-ultra capacitor to increase the storage of power. The output of the Hybrid HRES system is further fed inverter to varying load.

1.1 ENERGY MANAGEMENT SYSTEM TO SELECT BEST OPTIMAL POWER FLOW

Under the current global trend towards market liberation, the overall approach to operating and controlling power units is critical to the survival of any electrical appliances (Misak et al., 2014). The main objective of the Hybrid Power System is to meet the demands of electricity at the same time and to increase the use of renewable energy sources while improving the performance of the bank of batteries and conventional generators. The supervisor control determines the operation mode of each generation subsystem for optimized operation. Fundamentally, these operation modes are determined by the energy balance between the total demand (load and battery bank) and the total generation (wind, solar, and grid). To design the supervisory controller, the wind and PV subsystem work as the main generator role; the complementary roles are in charge of battery and ultra capacitor. Diesel generator is not taken into account as the source because of the nature of the fuel (Habib et al., 1999). When appropriately applied, plant instrumentation and control frameworks can build plant working effectiveness, operability and mobility, strength and unwavering quality, just as plant accessibility, in this way adding to hold down fuel, activity, and support costs, which represent the vast majority of the costs in a force plant (Hojabri et al., 2012). Along these lines, there is direness to create compelling plant-wide robotization frameworks, and therefore the related in general unit control frameworks and methodologies, to keepthem runningproductively. Likewise, it ought to be noticedthat the concentrated utilization of PC based instrumentation andcontrol frameworks, with regular progressively dependable and amazing broadly useful data handling advanced gadgets, permits framework architects to concentrate more on the execution of programming applications to react to the previously mentioned difficulties..

2. BATTERY EQUIVALENT CIRCUIT AND MATHEMATICAL MODEL

The battery equivalent circuit model helps in getting a clear understanding regarding cells response to different circumstances, which are required for solar PV application design.

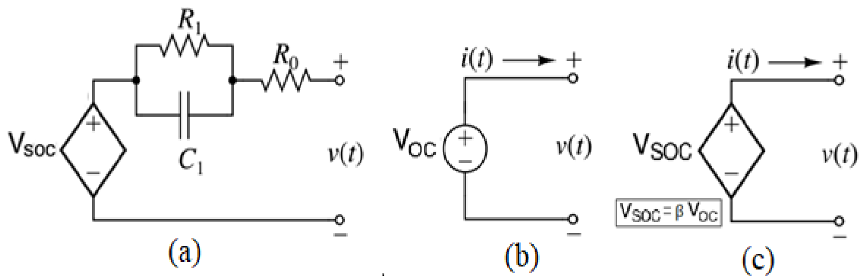

Figure 1: Battery Equivalent Circuit

2.1 EQUIVALENT SERIES RESISTANCE

When the load is applied to a battery, it is observed that the cell's voltage drops. This effect of load on cell voltage can be realized by introducing a resistance R_0 in sequence with the ideal voltage basis as exposed in figure 1.2 (a) and expressed by the following voltage equation,

$$v(t) = V_{SOC} - i(t) \cdot R_0$$

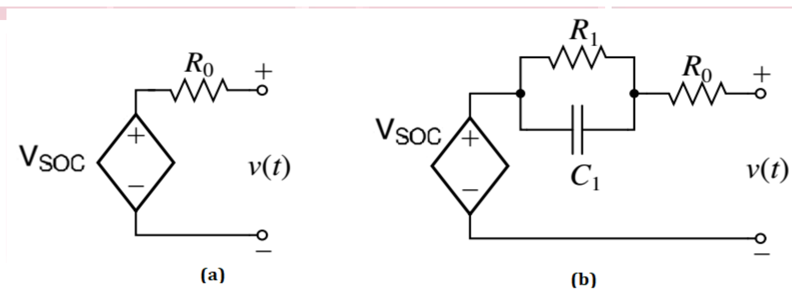

Figure 2 : Battery equivalent circuit incorporating (a) battery loss (b) diffusion voltages

The energy is dissipated in the resistor R_0as heat, and therefore the energy efficiency of the battery cell has imperfection associated with it.

2.2 DIFFUSION VOLTAGES

The battery terminal voltage experiences a reduction in its open circuit value when being loaded, this reduction is referred to as polarization. The $i(t) \times R_0$is an example of polarization, modelling an instantaneous response to a change in input current. A non-instantaneous, dynamic response is also observed to a step change in current. When the cell is allowed to rest, its voltage does not immediately return to V_{OC}, but decays slowly (taking considerable time to reach V_{OC}) as shown in Figure 1.3.

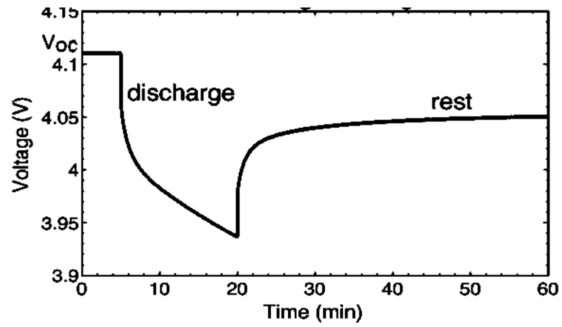

Figure 3 : Polarization during discharge and rest

3. CHARGE AND DISCHARGE CHARACTERISTICS

Here is provision to modify the battery parameters pertaining to equivalent circuit of the battery so as to represent a particular type of battery, founded on its discharge characteristics. A typical discharge curve is a plot between Battery SOC and Ah which is composed of three sections i.e., Discharge curve, Nominal area and Exponential Nominal, as shown in the Figure1.4.

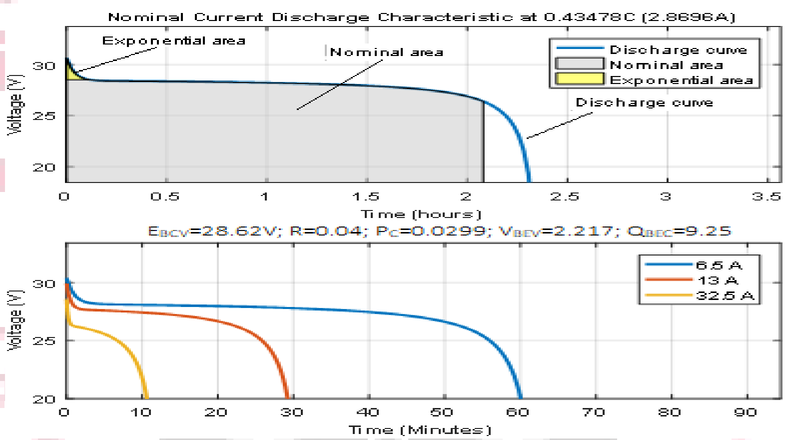

Figure 4: Battery Discharge Characteristics

4. RESULTS

The results obtained from the simulation work, show the effectiveness of the proposed system and their control system. Figure 1.5 shows the simulation effects of voltage V, load current I and voltage waveform before the filter unit. Different loads of L1 = 4KW; L2 = 8KW; L3 = 12KW; L4 = 15KW is used for a simulation time of 0.1 sec., 0.2 sec., 0.3 sec. respectively. The loads increase in sequence as can be seen by the current waveform which rises every time the load is changed. The controller maintains a constant voltage across the entire 200V load.

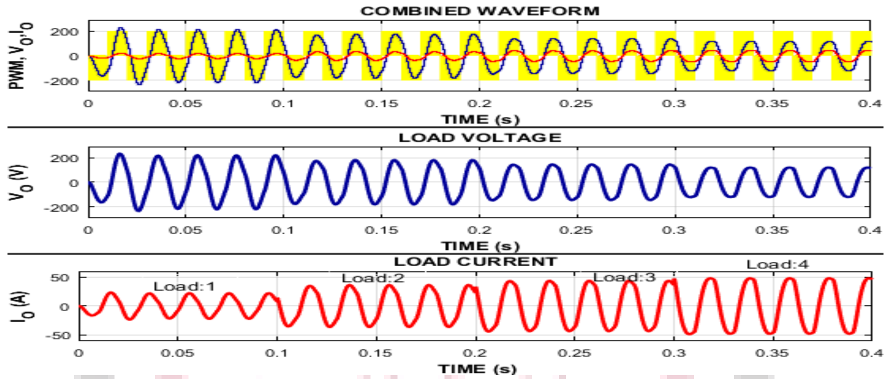

Figure 5: production voltage and current waveforms lacking manage exploit

In Figure 1.5 the top section shows the current waveforms of Pulse, Load and Load waves where no controlled feedback is used. The middle and bottom part of the figure represent the Load Voltage and the Current Load respectively. It is evident from the load voltage and current waves that with increasing load, the load capacity of the load decreases with its magnitude. In order to maintain a constant voltage under a wide range of requirements to change the load use of the feed-back control system. Loads are applied to 0, 0.1, 0.2, 0.3, and 0.4 seconds. the controller is able to keep the load voltage unchanged as in Figure 6

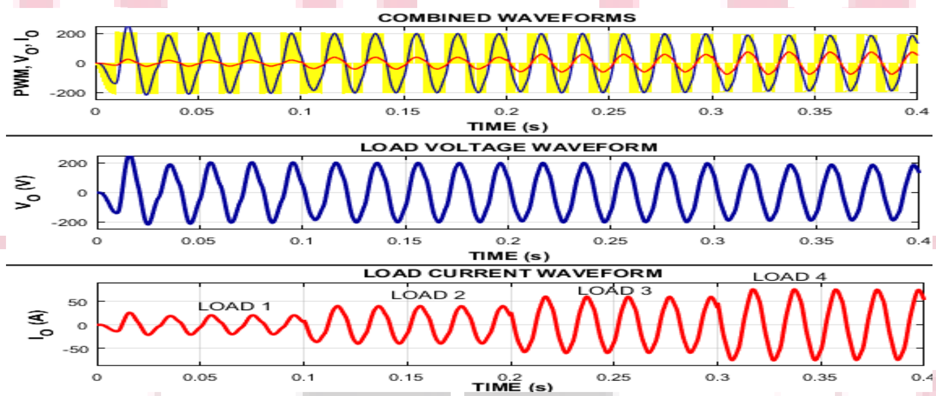

Figure 6: production voltage and current waveforms through manage exploit

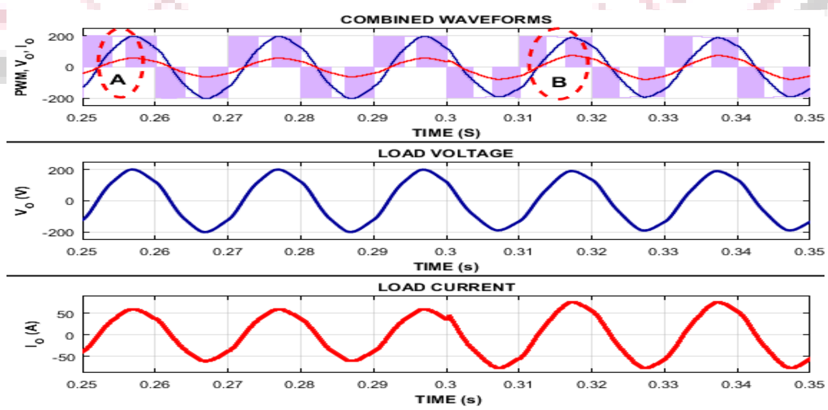

Figure 7. Experiential modify in Pulse Width with modify in weight.

Figure 7 is a close-up view of mathematics. 6 for the purpose of a clear analysis of the performance of the converter. In the regions around A and B in the figure, it can be noted that with load changes the controller controls the pulse width to maintain a constant voltage at the loading terminals.

REFERENCES

1. Y. Bo, L.Wuhua, Z. Yi, and H. Xiangning, "Design and analysis of a grid connected photovoltaic power system," IEEE Transaction on Power Electronics, vol. 25, no. 4, pp. 992–1000, Apr. 2010.

2. W. Tsai-Fu, C. Chih-Hao, L. Li-Chiun, and K. Chia-Ling, "Power loss comparison of single- and two-stage grid-connected photovoltaic systems," IEEE Transaction on Energy Conversion, vol. 26, no. 2, pp. 707–715, Jun.2011.

3. S. B. Kjaer, J. K. Pedersen, and F. Blaabjerg, "A review of single-phase grid-connected inverters for photovoltaic modules," IEEE Trans. Ind. Appl., vol. 41, no. 5, pp. 1292–1306, Sep.–Oct. 2005.

4. G. Petrone, G. Spagnuolo, and M. Vitelli, "A multivariable perturb and observe maximum power point tracking technique applied to a single-stage photovoltaic inverter," IEEE Trans. Ind. Electron., vol. 58, no. 1, pp. 76–84, Jan. 2011.

5. E. Villanueva, P. Correa, J. Rodriguez, and M. Pacas, "Control of a single phase cascaded H-bridge multilevel inverter for grid-connected photovoltaic systems," IEEE Trans. Ind. Electron., vol. 56, no. 11, pp. 4399–4406, Nov. 2009.

6. C. Cecati, F. Ciancetta, and P. Siano, "A multilevel inverter for photovoltaic systems with fuzzy logic control," IEEE Trans. Ind. Electron., vol. 57,no. 12, pp. 4115–4125, Dec. 2010.

7. S. Busquets-Monge, J. Rocabert, P. Rodriguez, S. Alepuz, and J. Bordonau, "Multilevel diode-clamped converter for photovoltaic generators with independent voltage control of each solar array," IEEE Trans. Ind. Electron., vol. 55, no. 7, pp. 2713–2723, Jul. 2008.

8. N. A. Rahim, K. Chaniago, and J. Selvaraj, "Single-phase seven-level grid connected inverter for photovoltaic system," IEEE Trans. Ind. Electron., vol. 58, no. 6, pp. 2435–2443, Jun. 2011.

9. B. Sahan, S. V. Ara´ujo, C. N¨oding, and P. Zacharias, "Comparative evaluation of three-phase current source inverters for grid interfacing of distributed and renewable energy systems," IEEE Trans. Power Electron., vol. 26, no. 8, pp. 2304–2318, Aug. 2011.

10. B. Sahan, A.N. Vergara, N. Henze,A. Engler and P. Zacharias, "A single stage PV module integrated power converter based on a low power current source inverter", IEEE Transaction on Industrial electronics, vol.55 no.7,pp 2602-2609,Jul-2008.

11. P. P. Dash and M.Kazerani, "Dynamic modeling and performance analysis of a grid-connected current-source inverter-based photovoltaic system, "IEEE Trans. Sustainable Energy, vol. 2, no. 4, pp. 443–450, Oct. 2011.

12. S. Jain and V. Agarwal, "A single-stage grid connected inverter topology for solar PV systems with maximum power point tracking," IEEE Trans. Power Electron., vol. 22, no. 5, pp. 1928–1940, Sep. 2007.

13. A. Darwish, A. K. Abdelsalam, A. M. Massoud, and S. Ahmed, "Single phase grid connected curent source inverter: Mitigation of oscillating power effect on the grid current," in Proc. IET Conf. Renewable Power Generation, Sep. 2011, pp. 1–7.

14. R. T. H. Li, H. S.-H. Chung, and T. K. M. Chan, "An active modulation technique for single-phase grid-connected CSI," IEEE Trans. Power Electron., vol. 22, no. 4, pp. 1373–1382, Jul. 2007.

15. Katsuya Hirachi and Yasuharu Tomokuni, "A novel control strategy on single-phase PWM current source inverter incorporating pulse area modulation," Proceedings of Power Conversion Conf., vol. 1, pp. 289–294, Aug. 1997.

16. S. Nonaka, "A suitable single-phase PWM current source inverter for utility connected residential PV system," Sol. Energy Mater. Sol. Cells, vol. 35, pp. 437–444, Sep. 1994.