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Power Production Strategy by Renewable Energy Resources in a Hospital of Multan with Techno-Economic Aspects

Anum Shafqat *, M. Siddique, Nawaz Joiya, Owais Manzoor, M. Kamran Liaquat Bhatti and Safdar Raza

Electrical Engineering Department, NFC IET Multan, Multan, 66000, Pakistan
Corresponding author: Anum Shafqat (anum.shafqat766@gmail.com).

***Abstract*- With increasing trend and interest in renewable and sustainable forms of energy, the energy generation from renewable sources is increasing rapidly. There are many ways of getting energy from renewable sources. Power generation through solar is one of the emerging techniques. One of the major advantages of the solar power station is to production of electricity from free and unlimited reservoir of heat resources. This research deals with the implementation of the solar system at the roofs of hospitals to generates its own free and clean energy. By utilization of this idea, we can generate extra power from solar radiations to meet energy demand and able to mitigate energy crises. This research also deals with the production of energy with the help of biomedical wastes in major hospitals of Multan. By using medical wastes through the Rankine cycle, we can meet our energy demand.**

***Index Terms*—Solar, Medical wastes, Energy demand, Rankine cycle, Reservoir**

I. INTRODUCTION

Power crises have large lasting effects on socio-economic developments of our country. Pakistan is facing energy crisis due to increasing the electricity demand day by day [1]. To meet the energy crises, GOP builds powerhouses in different regions of Pakistan. These power plants are running with renewable and nonrenewable energy resources [2-5]. The nonrenewable energy resources based traditional power plant caused by the high carbon emission, environmental pollution as well as global warming. This is the primary cause in attention to sustainable energy resource assets across the globe.

Pakistan is one of the nations in the world which have enormous energy resources in all area such as solar. So, by implementing the solar we can generate electricity and provide this electricity to different units of the hospital. In this research work for implementation of the solar system, we are considering the area of the roofs of Nishtar Hospital Multan. The total area of Nishtar teaching hospital is approximately equal to 112 acres. But we can use only 35 acres roofs area of Nishtar hospital for installation of solar. There are many types of solar plates has been existing in markets but the efficiency of concentrator collector is better than other plates. These plates can be connected in series as well as parallel as per system requirements. The Systematic voltage of single solar plate is 12 volts. If we required the 12-volt solar system then we conned our solar plates in parallel with each other. But if we required a 24-volt solar system then these plates must be connected in series with each other [6-10]. This research paper also deals with the production of electricity through biomedical wastes of Nishtar medical complex [11-17]. As we know that proper arrangements and land must be required for dumping the medical wastes. So, if we used this medical waste for energy production, we can easily save our fertile land. Biomedical wastes are classified into two groups that can be depicted in Fig. 1.

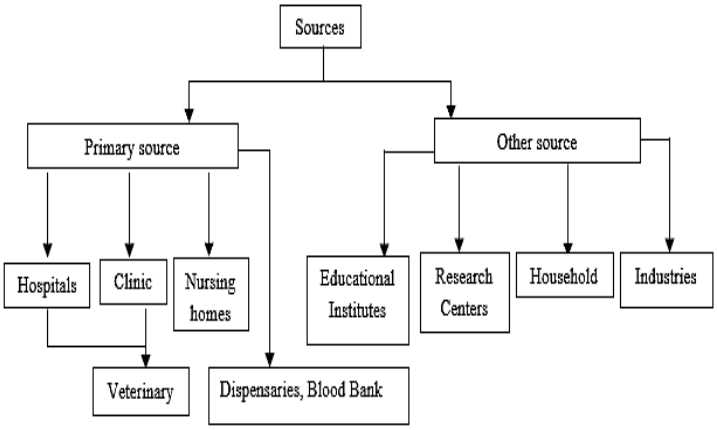

FIGURE 1. Sources of biomedical wastes.[3]

The main contribution in this research paper is to implement the combine solar and biomass (include biomedical waste) power station and analyzed its technical and economic aspects.

II. METHODOLOGY

A. IMPLEMENTATION OF SOLAR SYSTEM

The method which has been used in our research work for the generation of electricity is depicted in Fig. 2. In this system the radiations from the sun fall on the Solar panel, as a result, the current is generated. The voltage generated from the solar panel varies concerning a time scale that results in random energy production. Therefore, the consistency and stability of the system are the fundamental requirements. So, to regulate the DC voltage from the panel, a voltage regulator has been used in this system. Voltage regulator consists of a power transistor and it worked as boost and buck converter. This current is reserved in the battery via a charge controller and after that with the help of an inverter, we can convert into AC voltage. For getting the maximum efficiency from solar we used a tracking system. This tracking system is consisting of motor, LDR sensor as well as gear-box. With the help of the tracking system, we changed the direction of plates w.r.t solar direction.

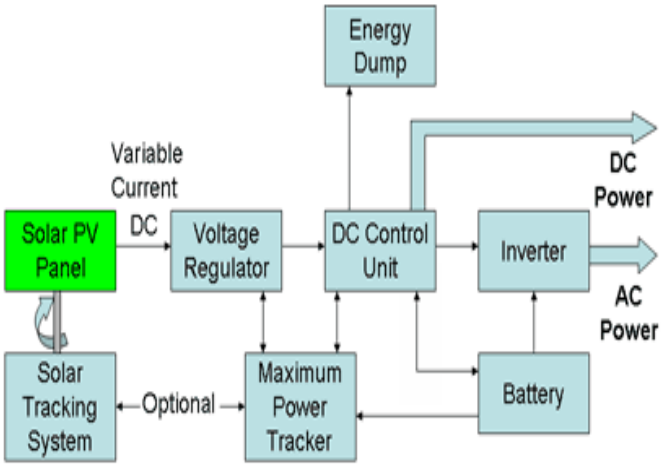

FIGURE 2. Block diagram of solar system.

B. IMPLEMENTATION OF BIO-MEDICAL WASTES POWER PLANT

In this research work, the technique which has employed to generate electricity is based on the Rankine cycle. The block diagram of the implemented scheme is shown in Figure 3. From Fig. 3 it has been analyzed that, medical wastes have been used as a fuel of this power station. This fuel is burned in the furnace for production of heat. After that two different gasifiers have been used to convert the materials into different gases i.e. CO_2 and O_2. So, by using the heat energy we warm up the water and make useful steam. After that with the help of a turbine, we generate electricity. In this research work, supercritical technology has been implemented to reduce GHG emissions.

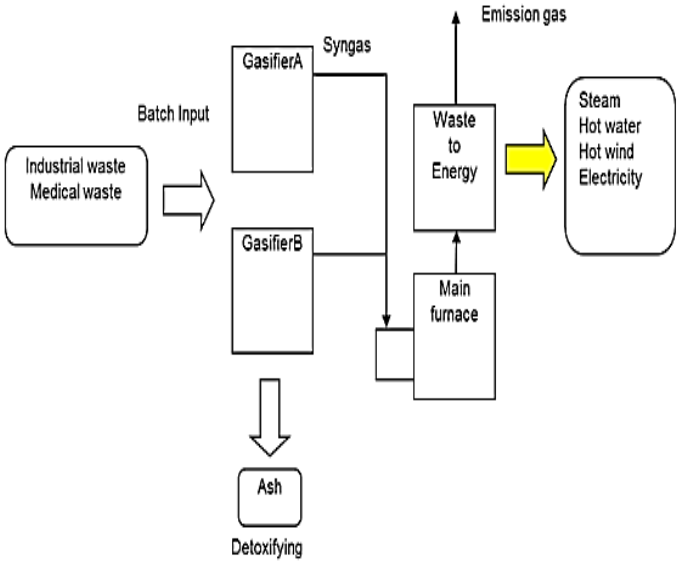

FIGURE 3. Block diagram of energy production through medical wastes.

III. RESULTS AND DISCUSSION

The model is simulated in MATLAB and analyzed the characteristics of the system in the normal condition.

A. SIMULATION OF SOLAR SYSTEM

The Simulink model of the solar system has been designed in MATLAB with two solar panels as shown in Fig. 4. The system has been tested with different radiations of the sunlight. The converter that is simulated in this model is based on the timer. With the help of a timer, we generate the PWM pulses and set the frequency of pulses.

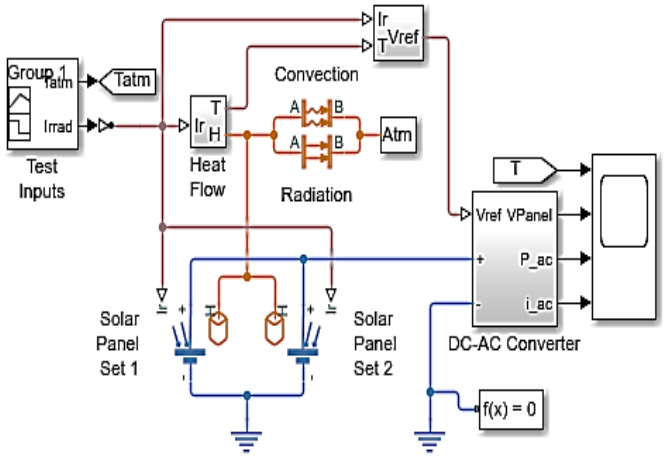

FIGURE 4. Block diagram of solar system.

There are two ways to take the power from the solar, either use directly Photovoltaic (PVs) or concentrated solar power (CSP). In this research work concentrate CSP has been used to generate the voltage.

The output graph of voltage and current w.r.t its different radiations and temperature of the sunlight is shown in Figs. 5 and 6. From the results, it has been analyzed that, when the temperature of sun radiations is increased then the output voltage generated by the solar panel has been increased gradually.

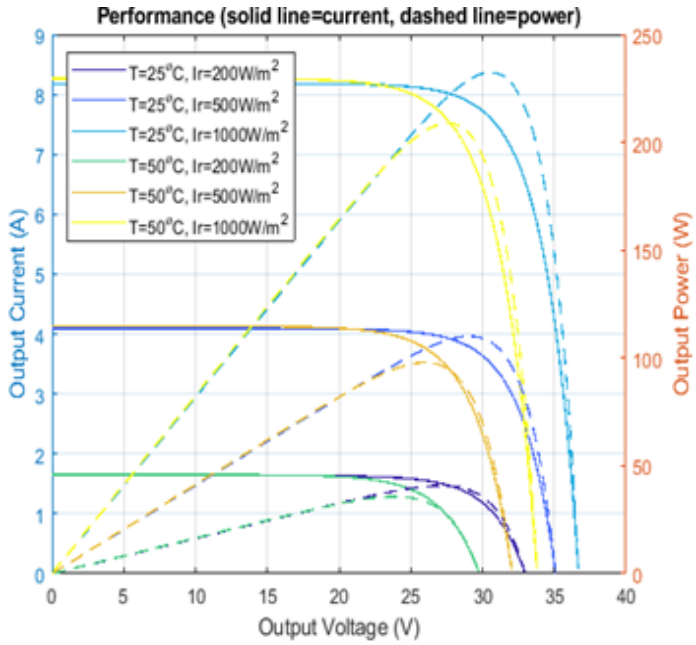

FIGURE 5. Performance of solar system.

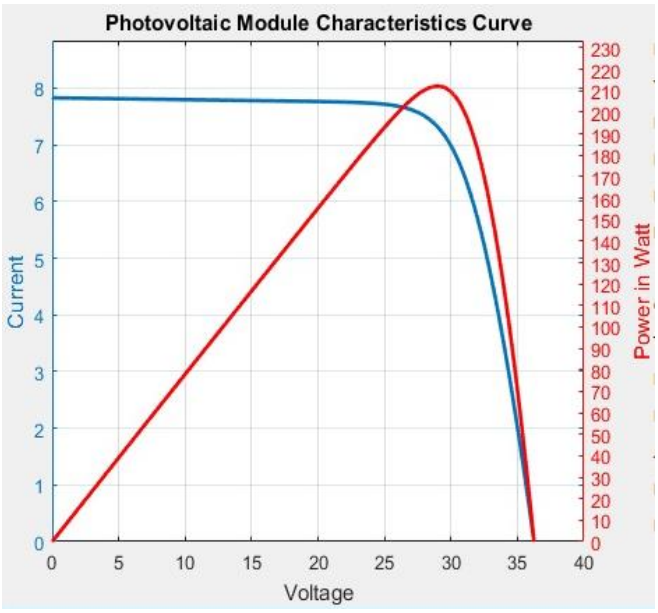

FIGURE 6. PV characteristics system.

The shading effect has been added in MATLAB simulation to check the performance of the system as shown in Fig. 7. When the shading occurs in the system it has been analysed that, the voltage of the system has been decreased fastly as the results low energy production, so it is very necessary to prevent the solar system from shading effect.

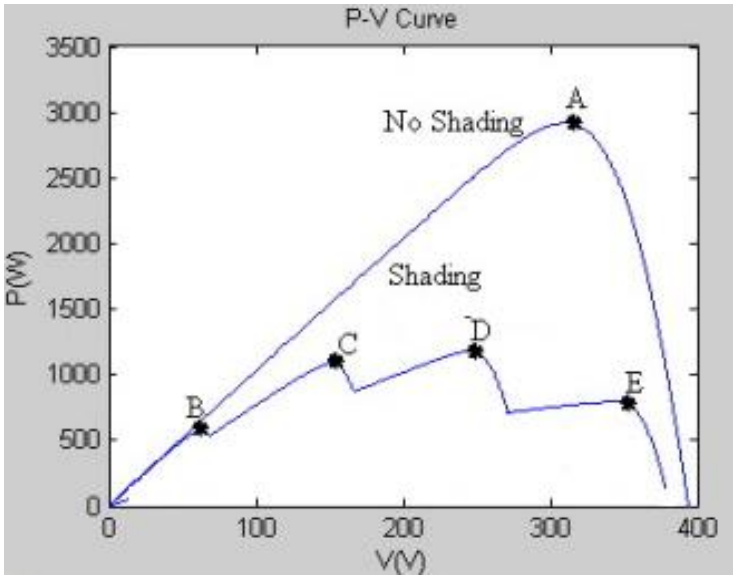

FIGURE 7. VI curve of PV system.

The output graphs of MPPT is depicted in Fig. 8. From the graph, it had been analyzed that, R3 curve is greater than R2 and R1. So, the maximum tracking point has been achieved by using the R3 curve.

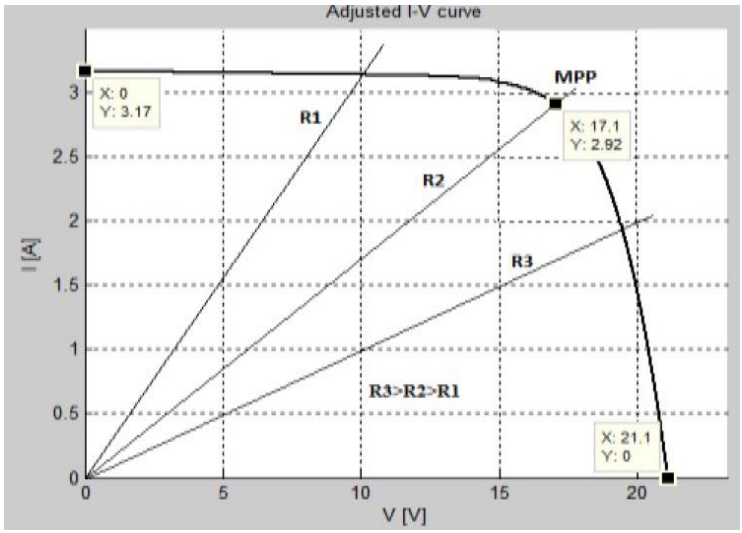

FIGURE 8. MPPT Curve.

The output voltage generated from the PV plates is based on DC voltage. So, we have needed to convert this DC voltage into AC voltage for driving the load.

For this purpose, a single-Phase inverter has been simulated in MATLAB with the help of power transistors. With the help of an inverter, we can alter the DC voltage into AC variable with regulating voltage and frequency.

The simulation results of inverter inputs and outputs are depicted in Figure 9 and 10. From Fig. 9, it has been observed that the input voltage of the inverter is pure in the DC form. This voltage is coming from PV module and further feed into an inverter for the conversion process.

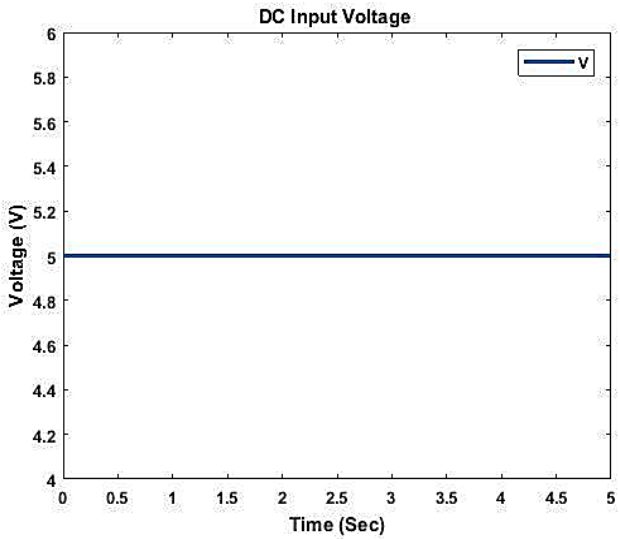

FIGURE 9. DC input voltage.

From Fig. 10, it has been observed that the output voltage of the inverter is pure in AC form with exact 50 Hz frequency. we can change the frequency of the signal by variations in the time period of the pulses. Furthermore, with the help of passive filter, we can remove harmonics in signal and can be converted into other forms of AC.

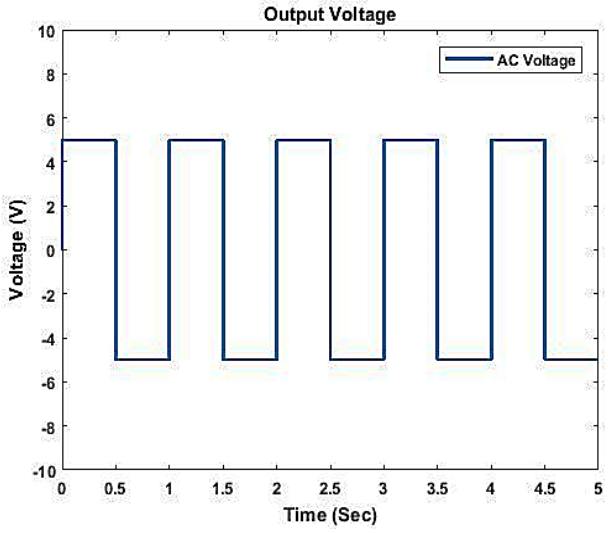

FIGURE 10. Output voltage of inverter.

B. TECHNICAL CONSIDERATIONS FOR INSTALLATION OF SOLAR

Solar field calculations have been made by taking into account DNI data of the Punjab region (Multan) under consideration. Solar field area has been calculated by using the expression as under:

$$\text{No of plates required} = \frac{\text{Max load}}{\text{Max (w) of single PV}} \quad (1)$$

$$\text{Max wattage of single PV} = 230\ \text{W} \quad (2)$$

$$\text{Load calculated per unit} = 20\ \text{MW} \quad (3)$$

$$\text{No of plates required} = \frac{20\text{X}10^6}{230} = 86956 \quad (4)$$

$$\text{Length of the PV panel} = 5.10\ \text{ft}$$

$$\text{Width of the PV panel} = 3.10\text{ft}$$

$$\text{Area of single panel} = 5.10\text{ft} \times 3.10\text{ft} = 15.81\text{ft} \quad (5)$$

$$\text{No of solar plates in one pannel} = 2$$

$$\text{No of panels required} = \frac{86956}{2} = 43478$$

$$\text{Total area required} = 43478 \times 15.81 \quad (6)$$

$$\text{Total area required for PV} = 687387.18\text{ft}^2 \quad (7)$$

Total area required for installation of PV in Acre $= \mathbf{15.7}$ ***Acre***

From the technical analysis it has been observed that for the generation of 20MW electricity, the 15.7 acres are required of installation of PV system.

C. TECHNICAL CONSIDERATIONS FOR BIO-MEDICAL WASTE

For the production of electricity from medical waste, data has been collected from Nishtar Hospital and elaborated into graphical representation as shown in Fig. 11.

From the graph, it has been observed that the medical waste has been collected from the seven different units of the hospital. By using these medical wastes, we can generate electricity and meet our energy demand.

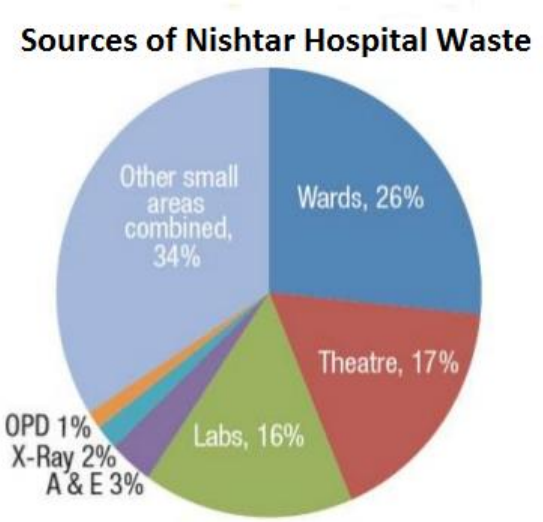

FIGURE 11. Equivalent Circuit of DFIM [14]

D. ECONOMIC ASPECTS

By implementation of the solar and biomedical power station, we can generate free electricity. With the help of the solar system, we can generate green and eco-friendly generation and can minimize the fuel consumption cost and reduce our energy crises. So, in this research work, we have been implemented 20MW combine cycle power plant that is based on renewable energy resources and biomedical waste. By using this idea, we can generate cost-effective energy and it would be helpful for our economy.

IV. CONCLUSION

Clean energy sources are the major sources of energy for human being and recent industrial applications. Generation from Solar does not produce greenhouse emissions and any heat-trapping agent which may cause global warming. The predictive model of energy generation through solar and medical wastes has been implemented in this research work by employing the combine cycle power station. Characteristics of PV module from different radiation and temperature has been investigated and proper MPPT curve has been analyzed for the generation of maximum voltages. From the analysis, it has been concluded that proper frequency and voltage must be generated to drive the load. For the generation of electricity through medical waste, the Rankine cycle has been used in this research work.

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