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Design and Analysis of 1.0 KW Standalone Solar Power Plant at New Delhi

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Abstract: *The study is based on the design of solar PV system and cost based analysis of Standalone Solar Power Plant at New Delhi .The software used is PVSQL for the analysis of the standalone system. It is used for the financial analysis of standalone, solar power plant, the expenditure done, tax paid after it.*

Keywords: *Solar Power Plant, MPPT, Inverter, PVSQL software.*

1. Introduction

The electricity has been around us for centuries, growing, and changing day by day. Without electricity the world would have not been the same. The human relies on electricity to be always available and to perform its function. Usage of electricity has been increased every year since 1949.Not only has electricity usage been rapidly increasing, energy cost is rising and energy possibility is decreasing. With this consecutive growth in electricity usage as well as in its cost, new and unique methods of producing electricity are being developed constatntly. Moving to alternative energies to produce electricity is from the sources that renew themselves ,such as the sun, rivers, wind, oceans waves and tides. Solar power systems are becoming more prevalent. The Solar energy is one of the most important renewable energy sources that have been gaining immense attention in recent years. The Solar panel use sunlight to make electricity. The government has decided to help consumers that prefer to invest in solar power in hoping to support the green or sustainable society. The Solar energy is a clean and emission less energy, which is essential for the environment, as it does not give out any pollutants or waste product harmful to environment.

The sun is a virtually unlimited renewable energy source with excessive potential. It is sufficient to think that instant by instant the surface of our terrestrial hemisphere exposed to the sun receives power exceeding 50,000 terawatt's .The quantity of solar energy is about 10,000 times the amount of the total electrical energy used throughout the world. Among the different systems using renewable energy sources photovoltaic is a promising technology due to intrinsic qualities .it has no fuel cost(the fuel is free of charge) and limited maintenance requirement(no moving parts);it is noiseless and quiet .

1) Literature Review

Shahzad Ahsan [1] The exhaustion of conventional resources and its effect on climate requires an urgent call for the substitute power resources to convene up the current power requirement. Solar energy is an endless, unsoiled and prospective energy source among all other nonconventional energy options. As more concentration is being done on focal point for the development of renewable energy capital globally. To ascertain their viability it is necessary to do the economic and technical assessments of these resources. This paper presents designing aspects and assessments of solar PV system based on field and actual performance. The study is based on design of solar PV system and a case study based on cost analysis of 1.0 kW off-grid photovoltaic energy system installed at Jamia Millia Islamia, New Delhi (28.5616° N, 77.2802° E, and about 293 m above sea level) India. Both monthly and weekly costs of energy produced by the 1 kW PV system have been calculated. In addition, the solar PV 1 kW system can give internal rate of return of about 1.714% on investment. Based on assumptions used in this study, solar 1 kW PV system of Rs. 0.9724/kWh is estimated for a project with profitable life of 25 years with no other financial support.
Mounir Bouzguenda [2] Saudi Arabia is in need for clean and renewable sources of energy such as solar for electricity and water heating, wind, geothermal, tidal and biomass. This paper involves the design of a 2-kW standalone solar Photovoltaic system at King Faisal University and presents a methodology for technical and economic analysis of the proposed system with energy storage facility. The PV system will be built on top of the College of Engineering and will be used for research and academic purposes. The design, simulation and analysis were carried out using PVsyst V6.12 software package that takes into account the geography of the site, surrounding trees, buildings as well as the solar energy resources and available solar technologies. It was found that shading due to nearby buildings and trees had limited effects on the system performance. However, the study revealed that even though solar energy resources were abundant in the summer, high ambient temperatures drastically hindered the overall system performance for the given system components and reduced the

solar cell efficiency by up to 16%. Losses due to shading varied between 0.70% and 4.2% depending on the panel spacing and field location.

Payal Suhane [3] The study presents a wind-solar photovoltaic based standalone hybrid energy system (HES) for an un-electrified village for central region of India - Madhya Pradesh. The inputs for the designing of HES are wind speed, solar radiation, temperature and the load demand which are variable with respect to time. In this study, hourly values of meteorological data and hourly load demand are considered over a year. For sizing and performance analysis of this standalone HES, ant colony optimization technique has been used. The performance analysis of the system is done for the various parameters such as total cost of the system, power generated by various sources, state of charge of battery, contribution of various sources, continuity of supply to the load demand and unmet load. The obtained optimal configuration of the proposed HES is found to provide minimal energy cost with excellent performance and reduced unmet load.

2) Architecture

The block diagram of the solar power plant for load requirement of the Uttarakhand Technical University Dehradun. The solar plant of Uttarakhand technical university is used to supplement a load of 1kw to Uttarakhand Technical Campus. The building load of 30000kwh that is total official load .It consist of a solar panel of having a total output of 36w from the array of solar cell in the of the ordered of (17 * 3 =51 cell) .The cell here is of monocrystalline structure having a gross area 0f 0.56m2.The no of bypass diodes are 3 here in it.and the cell here are oriented at an angle of 30 degree

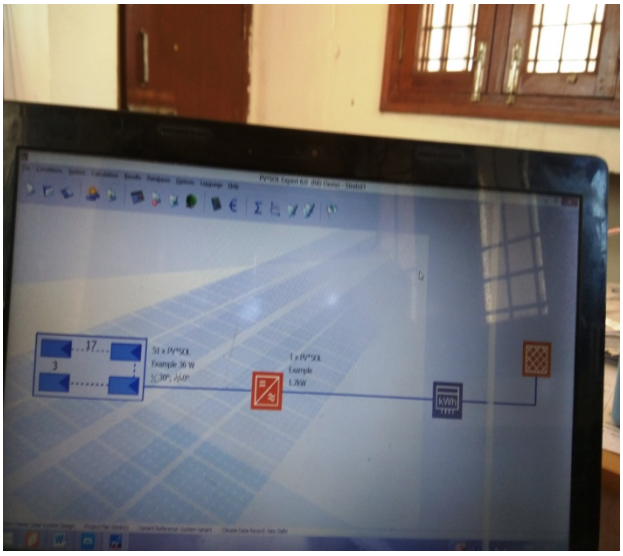

Figure 1: The Block Diagram of Solar Photovoltaic Power Plant.

The block diagram consists of a solar PV array panel connected to an inverter OF 1.7 KW, net metering devices connected to the official building load of 3000kwh.

2) INVERTER CHARACTERISTICS

The inverter connected to the grid is single phase inverter having a DC power rating of 1.80 kW .The current 7.50 A The inverter connected to the grid is 1-phase inverter and the no of DC inlets. The no of MPP

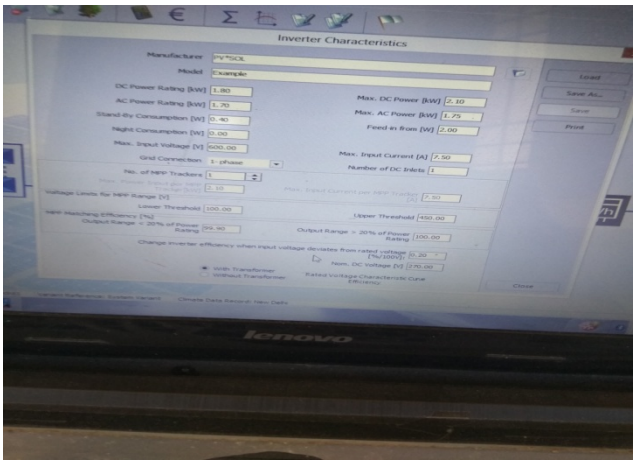

Figure.2 The fig shows the inverter characteristics

Tra .The max DC power {2.10 Kw]. The output range of 20 % of power rating.

3) IRRADIATION

The specific irradiation onto ratio of 1,958KWh/m2 and the wind speed at height of 1.37m/s and external temperature of 24.5 degree. The graph shows the variation of wind speed with different temperature conditions. The figure.3 shows the table of the variation of specific irradiation and wind speed. The graph shows the electricity requirement vs. load for normal official load of 30,000KWh for New Delhi.

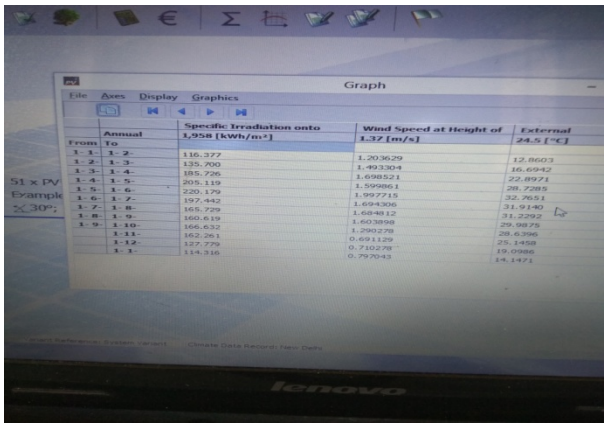

Fig.3 The graph showing the variation of wind speed at height of 1.37 (m/s) and the specific irradiation onto ratio.

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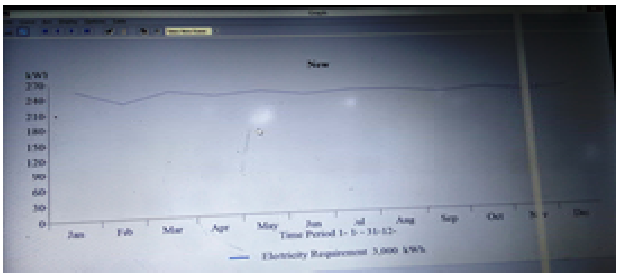

Figure.4 The graph shows the variation of electricity requirement w.r.t time period

Financial Analysis

The Financial analysis calculations are being made for a system having an output of 1.58 Kwp. The electricity feed in for the first 20 years is .1628/kwh and an interest on the capital is 3.00 percent. The electricity production cost 0.07 KWh. The, net presents value is 2, 79.88.88.

RESULT

The result shows total PV array irradiation 62, 10.9 KWh. The energy produced by PV Array (Ac) 2,637.6 Kwh. The energy from grid 0.5 KWh .The system efficiency 4.2%,performance ratio 66.4%.The Specific annual 1,436.3 KWh/KWp.The PV array efficiency 4.5 %, and the inverter efficiency comes out to be 94.1%.