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DEGRADATION OF ENVIRONMENTAL POLLUTION BY THE EFFICIENT USE OF SOLAR ENERGY

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Abstract - In Nature sun is the big source of energy. Due to large amount of pollution emancipating from various sources, the environment is becoming unhealthy for human beings. The generated solar energy is a function of uncontrollable environmental conditions. It requires extra caution to design controllers that handle unpredictable events and maintain efficient load matching power. In this paper, some measures are presented for the optimal use of solar energy to save the pollution of environment. A large number of electrical drives are used in the industry and in homes. A model of efficient use of solar power drive is presented to make optimal use of solar energy to save environment from pollution.

Keywords - Power Electronics/Mechatronics, Photovoltaic power systems, Power generation, Solar drives, Matlab/Simulink/GUI Modeling, MPPT tracking

1. INTRODUCTION

The use of new efficient Photo Voltaic Solar Cells (PVSCs) has emerged as an important solution in energy conservation and demand side management during the last decades. Due to high installation costs, PVSCs have not yet been an attractive alternative for electrical energy users. Users are able to buy cheaper electrical energy from the utility grid. However, they have been used extensively for water pumping and air conditioning in remote and isolated areas where utility power is not available or is too expensive to transport. Although Solar Cell (SC) prices have decreased considerably during the last years due to new developments in the film technology and manufacturing process [1-5], PV arrays are still considered rather expensive compared with the utility fossil fuel generated electricity prices.

After building such an expensive renewable energy system, the user naturally wants to operate the PV array at its highest conversion efficiency by continuously utilizing the maximum available output power of the array. The electrical system powered by solar cells requires special design considerations because of the varying nature of the solar power generated resulting from unpredictable changes in weather conditions which affect the solar radiation level as well as the cell operating temperature. Shah and Rai [6-7] have presented a model. It considers the effect of shadowing on solar panels. Walia and Rai [8] have presented efficient use of solar energy for electrical drives. Sharma and Rai [9-11] have made use of MPPT to make maximum use of solar energy. All these measures have lead to energy conservation. It has been presented by Rai [12-14]. Due to changes in the solar radiation energy and the operating temperature of solar cell, the output power of a solar array is not constant at all times. Consequently, a maximum solar power tracking controller is always needed in any scheme with solar cell arrays to ensure maximum utilization. Therefore, works to solve the problems on MPPT have always been a hot topic for PVA utilization systems. PVA operating schemes consist of mainly four different controlled parts as MPP tracking controller, backup battery charge regulator and controller, load bus voltage controller, and special load controllers. A PVA scheme must be considered as a whole unit. In this all these parts are tied up together. They need to be controlled together. Separate consideration usually results in the failure of required operation. They affect the system efficiency.

Some measures for optimal use of solar energy are presented in this paper.

II. SOLAR PHOTOVOLTAIC

Brief *"Milestones of Solar Photo Voltaic"* journey are;

Sir, Edmund Becquerel discovered Photovoltaic effect in 1839. In 1883 first solar cell was made from wafers of Selenium by Sir, Charles Fritts. It had an efficiency of 6%. Sir, albert Einstein explained the theory of photovoltaic effect in 1923. Solar Photo Voltaics got commercial in

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1955. The first PV-powered satellite was launched in 1958. It was called, *"Vanguard I"*. In 1987 REDA took over the challenge to build India with Solar Energy to save the fast consuming sources of conventional energies. It was followed by REDA of various State Governments. HREDA gives subsidy and incentives to produce and utilize Solar energy to save the environment in Haryana.

III. MARKET EVOLUTION

Since 1955 SPV Technology has been in commercial mode. It has grown from limited space application to GW scale Solar power plants. From 1997, SPV Technology has emerged as a potentially major technology to generate renewable energy in India.

Since 2000, there has been explosive growth in industry. The growth has been sustained by uncapped incentive programs of Department of Renewable Resources in Government of India. The programs of Ministry are notably minimal restrictions on the criteria of project qualification to generate energy from Sun. Feed In Tariffs (FITs) have been set at a level, that allows most cost efficient PV manufacturers and market investors alike to earn a sufficient return on their respective investments. It is more than enough to attract their capital investments.

IV. SOLAR PROMISE FOR INDIA

SPV program of Government of India began in 1977. It is one of the largest in the World. The need of SPVs in India is in two parts:

(i) ***Energy Security****:* To offset the growing demand supply gap and mitigate carbon footprint.

(ii) ***Distributed Generation:*** To reach clean and reliable power to remote rural areas as well as offset use of Diesel generators.

India lies in the sunny regions of the world. Most parts of India receive 4-7 kWh of solar radiation per square metre per day with 250-300 sunny days in a year. The highest annual radiation energy is received in western Rajasthan. The North East region of India receives the lowest annual radiation.

SPVs hold huge promise for India. Electrical energy from Sun and social development go hand in hand. Rural areas of india are so far flung, that in some cases it is decided not to lay down conventional electricity lines due to small populace to be served and high cost of laying lines. Department of Rural electrification mentions that more thn 80,000 villages are non electrified. There is an increased use of DG Sets in the semi urban and urban sectors. These DG Sets are source of polluting the environment. Thus, it is a clear case for SPVs to save the environment from pollution and sustainable development of India. SPVs are a proven solution for distributed energy right on tops of our roofs.

Solar power plants have certain unique characteristics that make it a compelling solution for de centralized demands of energy.

- ***"REACH"*:** SPV Technology should reach to most part of India. India is blessed with wide spread and higher solar radiation.
- ***"RELIABLE"*:** SPV Technology provides reliable solution. The solar panels ensure power for 25 years.
- ***"PREDICTABILITY"*:** Energy obtained from SPV Technology is far better than most other sources of energy.
- ***"FLEXIBILITY"*:** Electrical energy from solar power plants is flexible. Applications can range from few watts (Solar lantern0 to kW size roof top systems to MW scale power plants. The solar power plant can be installed Aon the top of the roof or ground or façade. Some R & D efforts ate in progress to float systems on water.

V. ENERGY SECURITY

The subject of Energy Security has gained impetus since 2010. Thanks to Jawaharlal Lal Nehru Solar Mission. JNSM has transformed the outlook of Solar Energy in India. The vision for 20 GW of solar energy by 2022 has put India into Global footprint. It is attracting due attention of Indians. On January 11, 2010 JNSM was launched by Honorable Prime Minister of India. The Mission provides quite comprehensive plan for setting up grid connected solar power projects in India. It is quite well appreciated that the availability of solar resource in most parts of India is gift of God. This provides opportunity to establish India as a global leader in solar energy, as envisaged by the mission. These include policy formulation to select and set up solar power projects. Policy to launch solar specific RPOs by various states. Policy to roll out mechanism of RECs to augment network of solar radiation monitoring.

VI. VIABILITY OF SPV TECHNOLOGY

To understand the viability of SPVs, the building blocks of SPV system are;

- ***SOLAR PANELS:*** Solar panels have a long life of 25 years. Even at the end of 25 years, solar panels deliver power output of 80%
- ***COST:*** At current cost standing, the life time cost of energy Solar (LCOE) is in the range of ☐ 10 to ☐ 12 per kWh. With increasing scale of deployment steep reduction in cost is expected. This will lead to a *"Grid Parity"* situation. This is expected to happen by 2017-18.
- ***CAPITAL COST:*** Solar power system has a higher cost investment upfront. The capital cost of a 1 MW plant is ☐ 12 to ☐ 13 crores. It includes the cost of land, power evacuation and other administrative costs. The area of land required is 5 acres per MW. To improve the viability of SPV projects, JNSM policy has introduced FIT policy

under various schemes ranging from ☐ 11 to ☐ 18 per kWh of solar energy.

VII. FUTURE OF SPVs

In India, the future of SPV Technology looks more promising than ever. GOI has already taken a number of steps to achieve the target of 1100 MW capacity during first phase of the JNSM by 2013. The target of 1100 MW is 1000 MW of large grid and 100 MW of smaller grid.

Requirement: It is required to get our bankers interested and knowledgeable about SPV Technology. Future plans are great. The real test lies in execution.

It is the interest of all stake holders – GOI, industry, bankers and beneficiaries to ensure the success of JNSM.

VIII. PVA UTILITY SYSTEM

PVA utility scheme consists of a PVA, a PMDC motor driving a fan type load, a constant R-L load, a switch able R-L load, a MPPT unit, a switch able back up battery unit, and a filter circuit. A PMDC motor speed controller unit, a voltage controller unit, and a MPP tracking controller unit are assembled to the scheme. A DC load bus is established with the voltage kept constant using a controlled DC chopper.

IX. GUI MODELING OF THE PVA

The operational functional block diagram of the PVA model for GUI environment of Simulink is given in Fig. 1.

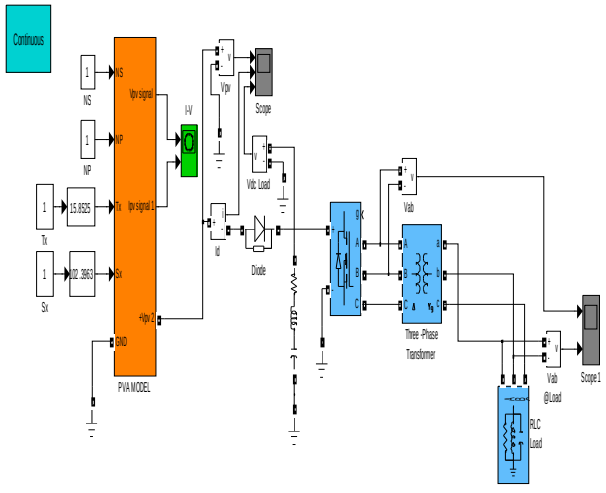

Fig. 1. Operational functional block diagram of the PVA model

The first stage of the PVA modeling is depicted in Fig. 2.

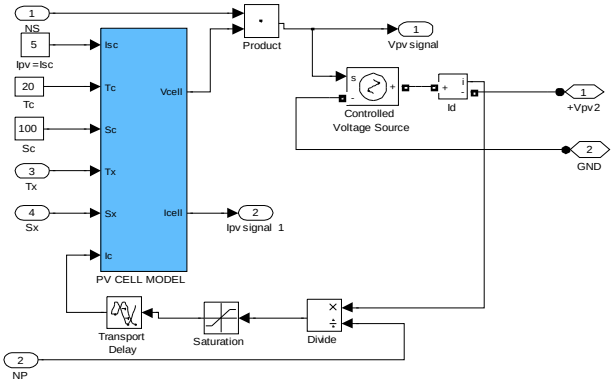

Fig. 2 Modeling stage 1.

The PV cell is represented as a block.

The effects of solar insulation and operating temperature are given in sub mask of stage 2. It is shown in Fig. 3.

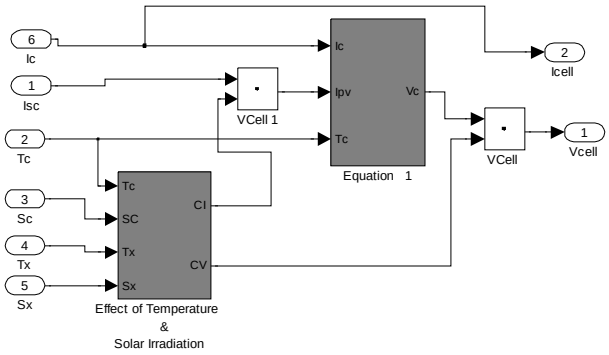

Fig. 3 Modeling stage 2.

The drive can be designed to have an energy conservation industrial drive.

X. TEST MODEL

The proposed model is implemented in MATLAB 7.6. The test model is shown in Fig. 4.

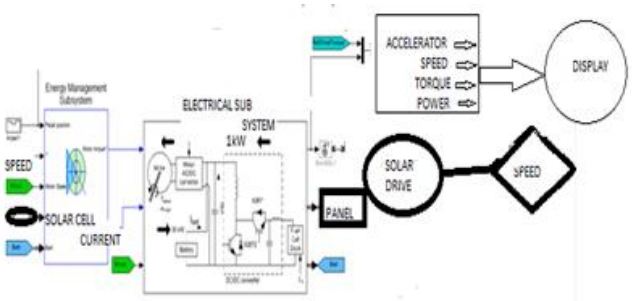

Fig. 4 Test model

XI. DOWN LOADING POWER

A smart grid will be made. It will be connected to all sources of available energy. From the Smart Grid the power will be down loaded on demand. Thus, the solar energy connected to the grid will be utilized to its optimal value.

XII. MILLENNIUM MANTRA

Electric cars on rent to make life easier for commuters. President of Uthaan said, "Mahindera & Mahindera's electric car Reva will be available for rent. If this car is made to run on solar energy, then it will be more affordable. Solar car will make life easiest for commuters. The solar car will be more pollution free. Solar car will be easy to drive. It will require less space for parking. The scheme offers members on demand availability of cars without having to wait for for and haggle with a taxi or an auto rickshaw driver.

XIII. MESSAGE OF HONOURABLE Er D.K. GUPTA, CHAIRMAN GIMT KANIPLA, KUKRUKSHETRA

I am a firm believer of Energy Conservation. In 1994, at IEI Conference on Energy Conservation, I presented the concept of 6 lanes for NH-1. The vehicular traffic on NH-1 has increased manifold. My concept has been implemented. It has been able to control the pollution to a large extent. The Solar Cars are being developed. During the day in sunshine, when these solar cars will run, then they will save the environment to a large extent. At GIMT, Kurukshetra, under the guidance of Prof Raman Gupta, Director/Principal GIMT Kurukshetra, a large number of students have taken up the challenge to build a Solar Car to save the environment from vehicular pollution. An energy park is also being developed in GIMT to spread the awareness of Renewable Sources of energy to the villagers of Kanipla. 20th August, 2012, is the birthday of *"Visionary of India"*, our Honorable Former Prime Minister of India. On this auspicious day, GIMT Kurukshetra is going to spread His dream message of Akshay Urja to villagers of Kanipla.

XIV. CONCLUSIONS

India lies in the sunny regions of the world. Most parts of India receive 4-7 kWh of solar radiation per square metre per day with 250-300 sunny days in a year. SPVs holds huge promise for India. Electrical energy from Sun and social development go hand in hand. Rural areas of India are so far flung, that in some cases it is decided not to lay down conventional electricity lines due to small populace to be served and high cost of laying lines. Department of Rural electrification mentions that more thn 80,000 villages are non electrified. There is an increased use of DG Sets in the semi urban and urban sectors. These DG Sets are source of polluting the environment. Thus, it is a clear case for SPVs to save the environment from pollution and sustainable development of India. SPVs are a proven solution for distributed energy right on tops of our roofs.

Some measures to conserve energy are presented. This paper introduces a Matlab/Simulink unified Functional Block Model for use in Matlab/Simulink GUI environment.

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XVI. BIOGRAPHIES

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