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Analysis Of Harmonics And Power Quality For Microgrid Connected To 500 Kw Solar Pv Plant

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Abstract- The plant (an arrangement of solar panels) which converts solar energy to light energy from the sun into electrical energy (charge emission) is called a solar power plant process. In solar plant there are many solar panels are connected and in panels there are many cells units which make panels. In which special metal is used which is in the form of lines and these lines are also connected to very thin lines and all these lines are connected to a metal line frame which is mainly quadrilateral in shape. So there is large area to trap light i.e. now there is a suitable area for light to fall on it as the metal arrangement in large to fall on it electrons start's to emit from thin lines to metal frame and current goes into a diode box which is behind the panel and then comes into supply wires.

Keywords- CSP, DER, FIT

I. INTRODUCTION

When a suitable light of certain frequency (i.e E=hv energy of light depends on its frequency) is fall on a special metal like silicon, electrons get some energy of suitable frequency which is greater than work function[work function is minimum energy required by an electron to emit from metal surface . So there is no photoelectric emission possible below work function (w≤E) and emit from the conduction band and come out from metal surface. Like that other electron come out and form a big unit of charge flow which is responsible for electric current.

- First, the projects tend to reduce the overall cost of the energy technology as large Scale utilization of a particular technology, in general, tends to reduce the cost of that technology. This has also encouraged the entrepreneurs to invest in solar energy technologies.
- Second, the projects are serving as test platforms for large scale solar energy Utilization technologies.
- Third, these projects are engaging the academic institutions in long-term solar Energy research, development, and pedagogical activities.
- Fourth, these projects have increased the awareness of green technologies.

II. RESEARCH MOTIVATION

Nowadays, due to the decreasing amount of renewable energy resources, the last ten years become more important for per watt cost of solar energy device. It is definitely set to become economical in the coming years and growing as better technology in terms of both cost and applications. Everyday earth receives sunlight above (1366W approx.) This is an unlimited source of energy which is available at no cost. The major benefit of solar energy over other conventional power generators is that the sunlight can be directly converted into solar energy with the use of smallest photovoltaic (PV) solar cells. There have been a large amount of research activities to combine the Sun's energy process by developing solar cells/panels/module with high converting form. the most advantages of solar energy is that it is free reachable to common people and available in large quantities of supply compared to that of the price of various fossil fuels and oils in the past ten years. Moreover, solar energy requires considerably lower manpower expenses over conventional energy production technology.

III. LITERATURE REVIEW

BASE PAPER-Renu, Arun Kumar Nayak, (2019) "Performance Evaluation of 400 kW Grid Connected Rooftop Solar Photovoltaic Power Plant Installed at SKIT, Jaipur" [1]:

In this paper, the energy in and out study has been carried out on grid connected solar photovoltaic plant (SPV) installed at SKIT, Jaipur from January 1, 2018 to June 30, 2018.The results obtained from this study are compared with previous year data 2017 on the same period. The performance of this 400 kWp plant is analyzed on the basis of parameters, namely average generated energy (kWh) per day, performance ratio (PR), capacity utilization factor (CUF), reference yield, and final yield.

Mary George1, Anil Kumar V M (2013), "Multilevel Inverters for Grid Connected Photovoltaic System" [2]:

Two multilevel inverter topologies, a single phase five level inverter and a seven level inverter which is suitable for interfacing a photovoltaic system to the grid is presented. The multilevel inverter uses a pulse width modulation scheme using two reference signals for five level inverter and three reference signals for seven level inverters. The reference signals are identical to each other with an offset equivalent to the amplitude of the carrier signal. A PI controller is used to keep the current injected into the grid sinusoidal and also to keep the DC link voltage constant under varying atmospheric conditions.

YuliAstriani, KhotimatulFauziah, HamzahHilal (2017) "Load Sharing Control Between PV Power Plant and Diesel Generator to Mitigate Effect of PV Fluctuation Using PID Algorithm" [3]:

The Sumba smart microgrid project was built in2012 as a research means to demonstrate PV power plant integration into utility grid that implemented modern control and information technology to reduce effects of intermittency PV output. It consists of PV, battery, diesel generator, and SCADA subsystem. Since battery subsystem had a problem in its PCS system then some changes in compensation algorithm are needed to maintain grid reliability.

D. S. Chaudhari and S. Leva (2008), "Energy comparison of MPPT techniques for PV Systems", WSEAS Trans. on Power Systems [4]:

The solar photovoltaic is considered to be the one of the most promising energy source in many applications, due to its safety and high reliability. Residential that uses solar power as their alternative power supply will bring benefits to them. In order to increases the efficiency of system during rapid changing environmental conditions; system will adapt some Maximum Power Point Tracking (MPPT) methods.

Pawan D. Kale, and P.L. Chapman (2007), "Comparison of Photovoltaic Array Maximum Power Point Tracking Techniques" [5]:

These modern days that consume a lot of energy e.g. fuel-oil, gas, coal etc. that will deplete in its source one day so, much of the focus have been given on the topic of renewable energy. Renewable energies are energy that can be renewed or have no worries of depletion. For instance, wind, thermal, bio-mass and solar energy are some of the examples for renewable energy [1].

Ghislainremy and C. Shen (1998), "Comparative Study of Peak Power Tracking Techniques for Solar Storage System" [6]:

This paper presents a review of maximum power point tracking (MPPT) techniques for photovoltaic systems (PV). After a brief introduction of the key factors for the power extraction of photovoltaic panel, a review of the commonly used MPPT techniques is presented and detailed with an overall approach. Then, a comparison of the main industrialized ones is discussed for a photovoltaic system. In the last part, the pros and cons of each of the considered MPPT techniques are presented. The reduction of the fossil energies and uranium reserves make renewable energies more and more important (Hydro-electricity, Wind turbines, Solar panels…).

IV. SOLAR PHOTOVOLTAIC (PV)

Historical development: Solar Photo-voltaic (PV) is a method of generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect. Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. It is a device that directly converts solar energy into electricity by photovoltaic effect. Photoelectric effect was first time recognized in 1839 by F.C. Becquerel. In this Phenomenon the electrons are emitted from matter after absorption of energy from radiation.

In 1883 – First solar cell was built by coating Selenium with extremely thin layer of gold. In 1958 – Bell laboratories found that Silicon (Si) doped with certain impurities was very sensitive to light. This finding resulted in the production of first practical solar cell with sunlight conversion efficiency ~6% made from materials that emit electrons when exposed to EM radiation. Mainstream materials presently used for photovoltaic include monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium gallium selenide/sulfide. Due to the increased demand for renewable energy sources, the manufacturing of solar cells and photovoltaic arrays has advanced considerably in recent years.

Benefits Of Solar Power

i. Solar energy is a clean, renewable resource that is continuously supplied to the earth by the sun.

ii. Solar resources are available everywhere in the world. It gives out no emissions i.e. environmentally safe.

iii. Energy security to the country. No dependency on foreign resources for electricity generation.

iv. Can be permitted and installed faster than other traditional or renewable power plants.

v. Produces local, on-site energy, which reduces the need for extensive high-voltage transmission lines or a complex infrastructure.

vi. Reliable over the long term. With no moving parts, fixed photovoltaic systems last longer than other energy sources.

V. HARMONIC ANALYSIS

Harmonic analysis is a branch of mathematics concerned with investigating the connections between a function and its representation in frequency. The frequency representation is found by using the Fourier transform for functions on the real line, or by Fourier series for periodic functions. Generalizing these transforms to other domains is generally called Fourier analysis, although the term is sometimes used interchangeably with harmonic analysis. Harmonic Analysis has become a vast subject with applications in areas as diverse as number theory, representation theory, signal processing, quantum mechanics, tidal analysis and neuroscience.

The term "harmonics" originated as the Ancient Greek word harmonikos, meaning "skilled in music".[1] In physical eigenvalue problems, it began to mean waves whose frequencies are integer multiples of one another, as are the frequencies of the harmonics of music notes, but the term has been generalized beyond its original meaning.

The classical Fourier transform on Rn is still an area of ongoing research, particularly concerning Fourier transformation on more general objects such as tempered distributions. For instance, if we impose some requirements on a distribution f, we can attempt to translate these requirements in terms of the Fourier transform of f. The Paley–Wiener theorem is an example of this. The Paley–Wiener theorem immediately implies that if f is a nonzero distribution of compact support (these include functions of compact support), then its Fourier transform is never compactly supported (i.e. if a signal is limited in one domain, it is unlimited in the other). This is a very elementary form of an uncertainty principle in a harmonic-analysis setting.

Fourier series can be conveniently studied in the context of Hilbert spaces, which provides a connection between harmonic analysis and functional analysis. There are four versions of the Fourier transform, dependent on the spaces that are mapped by the transformation:

- Discrete/periodic–discrete/periodic: discrete Fourier transform,
- Continuous/periodic–discrete/aperiodic: Fourier series,
- Discrete/aperiodic–continuous/periodic: discrete-time Fourier transform,

Continuous/aperiodic–continuous/aperiodic: Fourier transform.

Need of solar power system

The increasing demand for energy, the continuous reduction in existing sources of fossil fuels and the growing concern regarding environment pollution, have pushed mankind to explore new technologies for the production of electrical energy using clean, renewable sources, such as solar energy, wind energy, etc. Among the nonconventional, renewable energy sources, solar energy affords great potential for conversion into electric power, able to ensure an important part of the electrical energy needs of the planet. Solar energy is free, practically inexhaustible and involves no polluting residues or green gases emissions.

Voltage Source Converters

Voltage Source Converters (VSC) are self-commutated converters to connect HVAC and HVDC systems using devices suitable for high power electronic applications, such as IGBTs. VSCs are capable of self-commutation, being able to generate AC voltages without the need to rely on an AC system. This allows for independent rapid control of both active and reactive power and black start capability. VSCs maintain a constant polarity of the DC voltage for their building blocks, such as the 2-level or 3-level converter as well as the so-called 'modules' in an MMC. The change of power flow direction is achieved by reversing the direction of the current. Thereby, VSCs are more easily integrated in multi-terminal DC systems. VSC-based HVDC systems offer a faster active power flow control with respect to the more mature CSC-HVDC, while also ensuring flexible and extended reactive power controllability at the two converter terminals.

The following factors make VSC-based transmission attractive:

• Independent control of reactive and active power
• Reactive power control independent of other terminal(s)
• Simpler interface with ac system
• Compact filters

VI.PROPOSED METHODOLOGY

The Proportional-Integral (PI) controller has been used and dominated the process control industries for a long time as it provides the control action in terms of compensation based on present error input (proportional control) as well as depending on past error (integral control). As the term PI suggests, it comprises of two separate constant parameters, i.e. proportional constant and integral constant which are adjusted in order to get ideal, steady and faster response and to reduce the steady state error to zero or at least to a very small tolerance limit. This paper aims to present a study of the development of a dynamic model based on theories of PI control and optimization to design voltage regulator circuit. The Controller design is demonstrated through MATLAB/Simulink in order to get an output of better dynamic and static performance. The resultant output from controller is observed using the oscilloscope.

P-I action provides the dual advantages of fast response due to P-action and the zero steady state error due to I-action. Block diagram of PI controller is shown below:

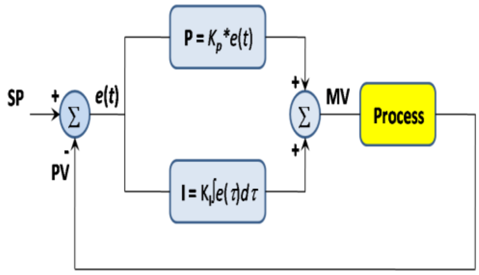

Figure 1 Block Diagram of PI Controller

The proportional gain, by design, also changes the net integration mode gain, but the integration gain, can be independently adjusted. It is understood that the proportional offset occurred, when a load change required a new nominal controller output, and this could not be provided except by a fixed error from the set point. In the present mode, the integral function provides the required new controller output, thereby allowing the error to be zero after a load change. The integral feature effectively provides a 'reset' of the zero error output, after the load change occurs. At time t1 a load change occurs, that produces the error. The accommodation of the new load condition requires a new controller output. The controller output is provided through a sum of proportional plus integral action that finally leaves the error at zero. The proportional part is obviously just an image of the error.

In the same way as in integral control, we can conclude that the steady state error would be zero for P-I action. Besides, the closed loop characteristics equation for P-I action is:

$$\xi = \left(\frac{1}{2}\right)\sqrt{\frac{\tau_i}{K\tau}}$$

VII. RESULT AND SIMULATION MODEL

This chapter has presented the modeling of PV module and the development of the MPPT techniques. In particular, the performances of the controllers are analyzed in these four conditions with are constant irradiation and temperature, constant irradiation and variable temperature, constant temperature and variable irradiation and variable temperature and variable irradiation. The proposed system is simulated by using MATLAB-SIMULINK. Based on the simulation result, the project is successfully achieving the objective.

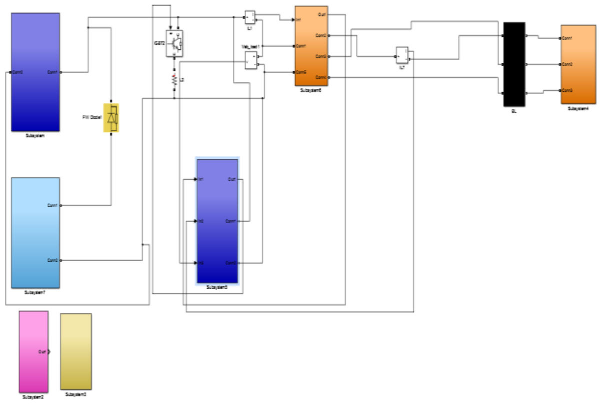

Figure 2 PI with MPPT system.

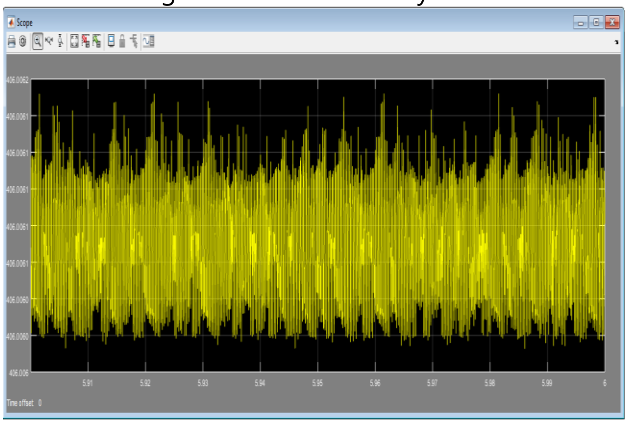

Figure 3 Single Solar cell across voltage Generation.

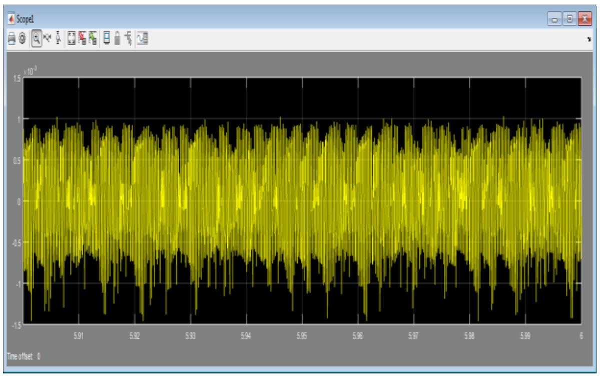

Figure 4 Current Generation across single Solar cell.

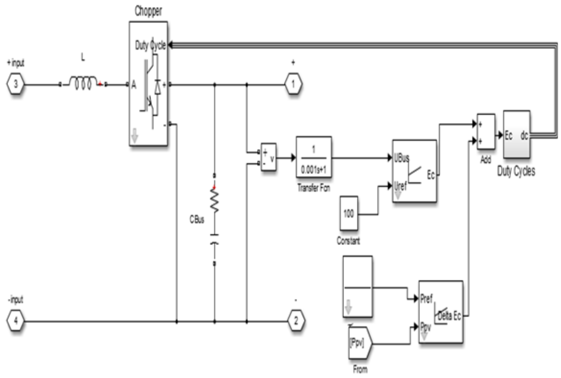

Figure 4 Solar Converters.

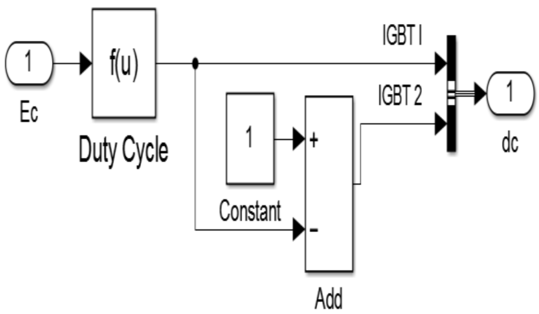

Figure 5 Solar Pulse generators.

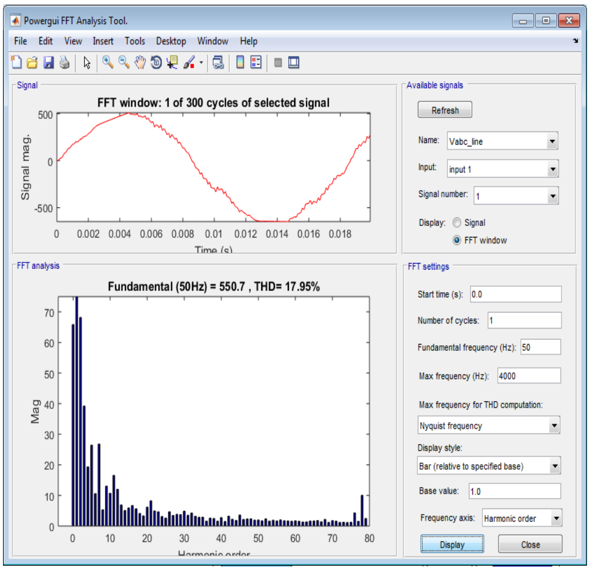

Figure 6 Harmonic Signal.

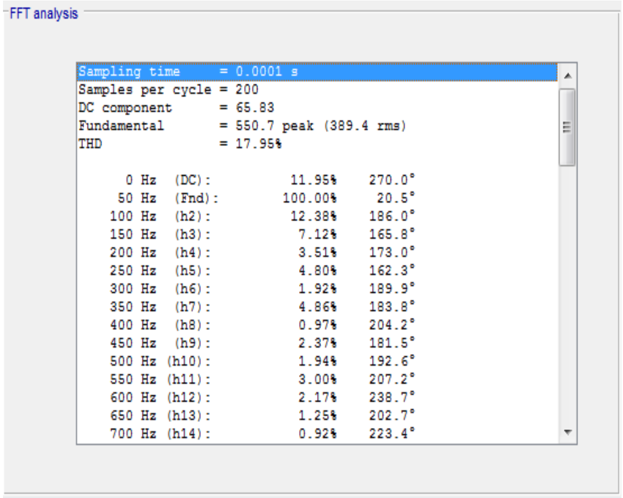

Figure 7 Harmonic Parameters.

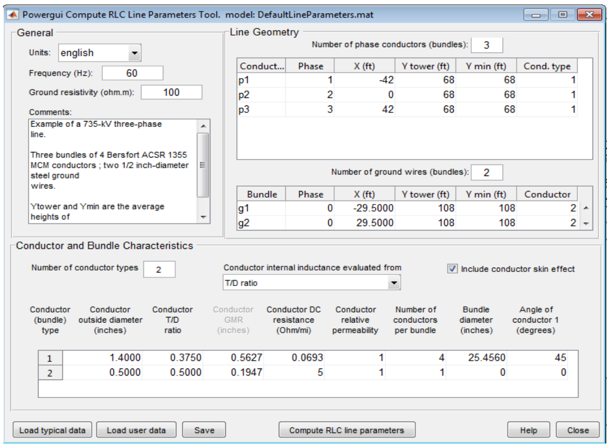

Figure 8 RLC harmonic parameters values.

VIII. CONCLUSION

Most of the people are aware about non-renewable energy resources. Solar energy has become increase more popular due to their economic benefits. By on Battery Backup, Solar Energy can even provide Electricity 24x7, even on cloudy days and at night. This also used with inter-grid System with Continuously Power supply. It has more benefits compared to other forms of energy like fossils fuels and petroleum deposits. It is an alternative which is promise and consistent to meet the high energy demand. Research on solar cell and solar energy is promise has a future worldwide.

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