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To Study and Simulate Various Power Quality Issues in Grid Integrated Solar System

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Abstract— In day-to-day life we need more power for the daily need of power consumption, and we need a more and more alternative for power generation. Nowadays the more power demand is more, and we need to catch the power demand of the world for daily purposes and various needs. Green energy resources play an important role in the power system and they like solar energy and wind energy and many are the alternatives for the power system. Also, the photovoltaic system is majorly used in generation of electricity. This is the green energy resource for a generation of an electricity The PV generation is it is the clean type of green energy, and this is the low in maintenance and easy for install low in maintenance also. The quality of a power is to focus for use and to avoid issues in power quality. Along with the quantity there is a big need to focus on the quality of the power. There are many power quality issues like poor power factor, voltage variations, harmonics, and excessive reactive power etc. To overcome all power quality related issues various filters are used. STATCOM is the static synchronous compensator is a fast-acting device capable of providing or absorbing reactive power and thereby regulating the voltage. measured according to national/international guidelines. In this paper, the proposed scheme Static Compensator (STATCOM) is connected to the loads of the grid to improve the power quality. The proposed model is simulated, studied, and analyzed in MATLAB/Simulink. This compensator is proposed to improve power quality to keep different problems with the IEEE standards.

Keywords: FACTS devices, Power quality issues, STATCOM, solar, Point of Common Coupling etc.

INTRODUCTION

The environmental effect is more than enough from the several plants for generating electricity from many years we need to change the way of producing the electricity and the best way to use and produce an electricity is using a solar energy The PV system helps in savings more environment issues like pollution, dust and burning of coals.75% of total global energy demand and many more is supplied by the burning of an fossil fuels. But increasing air pollution, global warming concerns, diminishing fossil fuels and their increasing cost have made it necessary to look towards renewable sources as a future energy solution. More than 25000-28000 solar-generating turbines are currently operational worldwide. The solar system, transmission, and distribution network, the energy quality issues can be considered. The PV array is constructed by many series or parallel connected solar cells to obtain required current, voltage and high power This paper demonstrates that the power electronic based power conditioning using custom power devices like STATCOM can be effectively utilized to improve the quality of power supplied to the customers large voltage fluctuations are caused by the constant-velocity solar panel operation's use of electricity from the grid. A constant variable output power is produced by solar panels at some point during normal operation. Recently grid connected photovoltaic systems have been spreading in residential areas and in industrial areas and many more.

. These issues include Voltage sag, Voltage swells, harmonics, and many others. The integration of Photovoltaic (PV) arrays into power systems has increased rapidly in recent years. As the penetration of PV systems into the grid increases, it has become essential to ensure the quality and reliability of the power generated by these systems. Induction Generator directly connected to a grid device is one of the easy ways to run a solar-generating device. The induction generator comes with built-in benefits of affordability and durability. The magnetization of induction turbines requires solar power generation device is necessary to enable proper control over the production of energetic energy. A battery electricity storage system for solar electricity producing equipment is typically needed to compensate for the variation produced by solar panels increased the grid disturbance.

In this context, the development of effective power quality improvement strategies for grid-integrated solar systems is essential for the growth of the renewable energy industry and for achieving a more sustainable and resilient energy system for improving the strength quality that can technically manage the power level associated with the industrial solar mills, a STATCOM-based control has been presented.

• The simple reactive is the ideal AC line supply by the utility system by the utility system should be a fundamental frequency (50/60Hz). port from STATCOM to cargo and solar panels.

•bang-bang controller helps the STATCOM to achieve quick dynamic response.

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I. PROBLEM FORMULATION

To identify the specific power quality issue that needs to be addressed. This may include voltage fluctuations, harmonic distortion, or reactive power imbalances. determine the impact of the power quality issue on the system. This could include damage to equipment, reduced system efficiency, or increased downtime. This includes identifying the specific systems that are affected by the power quality issue. The paper analysis demonstrates the issues with energy quality brought on by the grid installation of solar panels. To minimize power quality issues in the suggested system, (STATCOM). The effectiveness of the solution needs to be evaluated to ensure that the power quality issue has been adequately addressed. This may involve implementing new equipment, adjusting operational procedures, or modifying the system design. This may involve testing the system, monitoring performance, or conducting simulations.

II. LITERATURE SURVEY

The integration of Photovoltaic (PV) arrays into power systems has increased rapidly in recent years. As the penetration of PV systems into the grid increases, it has become essential to ensure the quality and reliability of the power generated by these systems. Power quality (PQ) is a critical factor that affects the performance of PV systems, and it is essential to investigate the various power quality issues that can arise in PV arrays. This literature review aims to provide an overview of the existing research on power quality issues in PV arrays.
Power Quality Issues in PV Arrays:

1. Voltage Fluctuations: Voltage fluctuations can occur due to sudden changes in PV system output power caused by varying weather conditions, changes in load demand, or faults in the system.

2. Harmonic Distortion: Harmonic distortion is another PQ issue that can arise in PV arrays. It occurs when the output voltage or current of the PV system contains unwanted harmonics, which can result in distortion of the waveform and cause equipment malfunction.

3. Voltage Flicker: Voltage flicker is a PQ issue that can occur in PV arrays, and it is caused by sudden changes in PV system output power. Voltage flicker can lead to flickering of the lights and can cause discomfort to the users.

4. Power Factor: Power factor is an essential PQ parameter that indicates the efficiency of the power delivery system. Low power factor can result in increased losses and decreased efficiency of the power system.

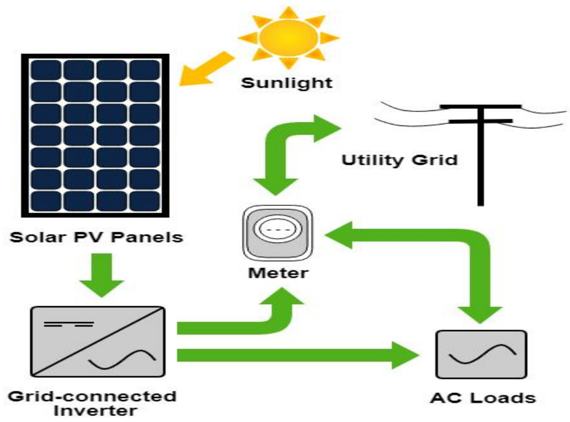

Fig.1. Simplified Grid connected PV System

Photovoltaic (PV) cells, also known as solar cells, convert the energy of s The various components of the system are briefly described below:

- PV ARRAYS
- Solar inverter
- Isolation switches
- Circuit breaker boxes
- Electric KWH meter

III. SIMULATIONS AND RESULTS

The proposed operation and control scheme is simulated in the power system block set using Simulink MATLAB

- Block Diagram without STATCOM

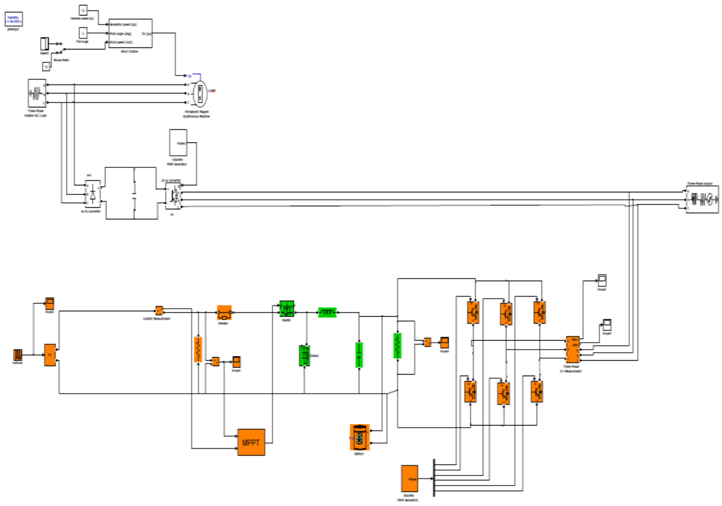

Fig.2. Simulation Without STATCOM

- Block Diagram With STATCOM

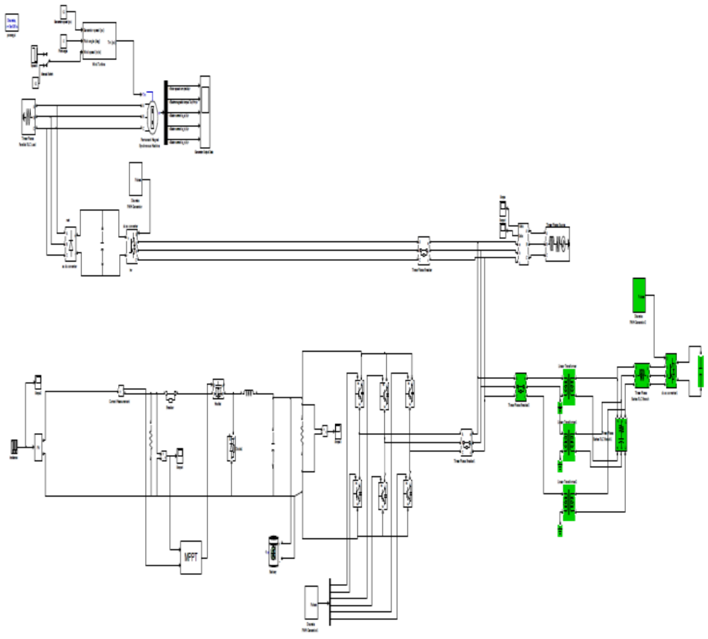

Fig.3 SIMULINK model of the proposed operational scheme.

System Performance

The proposed control scheme is simulated in the power system block set using Simulink. The system parameters for a given system are given in Table 1. The system performance of the proposed system in dynamic condition is also displayed.

Voltage Source Current Control—Inverter Operation

Voltage Source Current Control (VS-CC) is a method of controlling the output current of an inverter. Inverter is a device that converts DC power to AC power, and is used in various applications such as motor drives, renewable energy systems, and uninterruptible power supplies. VS-CC is a widely used control technique for inverters because of its simplicity and ease of implementation. The IGBT-based three-phase inverter is connected to the grid via a transformer. The VS-CC technique operates by regulating the output current of the inverter based on a reference current. the inverter output voltage is continuously adjusted based on the difference between the reference current and the actual current flowing through the load. Overall, Voltage Source Current Control is a simple and effective way of controlling the output current of an inverter. It provides stable and reliable operation of inverters in various applications, with precise control of output current. The generation of signals switching from the reference current is simulated in the hysteresis band of 0.08. Control signal of the switching frequency in its operating band 0.08 as shown in Fig.4 The three-phase inverter injected current is shown in Figure 5.

Table 1 System Parameters

S.N.	Parameters	Ratings
1	Grid Voltage	3-phase ,415V,50 Hz
2	Induction Motor/Generator	3.35 kVA,415V, 50 Hz, P = 4, Speed = 1440 rpm, Rs = 0.01Ω, Rr=0.015Ω,Ls =0.06H,Lr=0.06H
3	Line Series Inductance	0.05mH
4	Inverter Parameters	DC Link Voltage = 800V, DC link Capacitance = 100 μF. Switching frequency = 2 kHz,
5	IGBT Rating	Collector Voltage =1200V, Forward Current =50A,Gate voltage =20V, Power dissipation = 310W
6	Load Parameter	Non-linear Load 25kW.

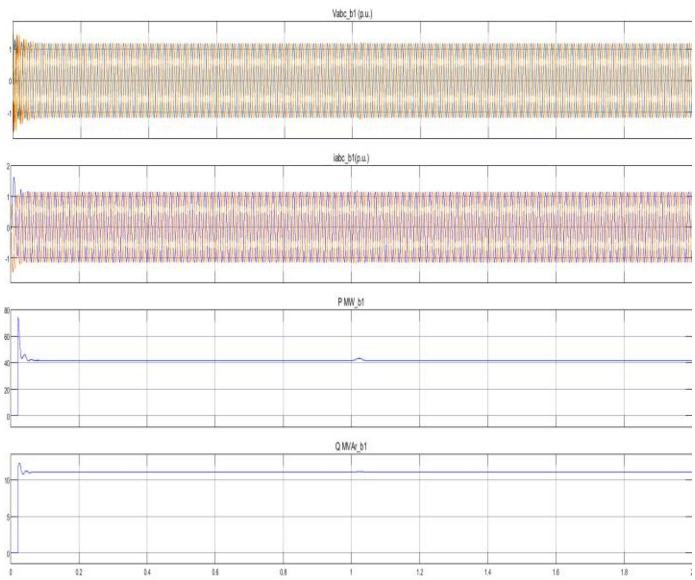

Fig.4 Variation in parameters before fault

The waveforms are shown in fig.4 this waveform is the before the fault occur in solar PV as the initial stage of the grid there is no fault at a sudden. As we have a voltage scale, current scale power rating scale and reactive power scale. The voltage and the current are at initial stage there is no change in the voltage and current and in the power rating scale there is a sudden spike in voltage in start and voltage swell at a starting stage and then afterwards the waveforms is in steady state and the reactive power scale the sudden change in voltage there is an change in waveform the waveform is peaking the voltage swell is there so minor changing the scale and then steady the waveforms. As there are no such major fluctuations and variations in voltage before fault.

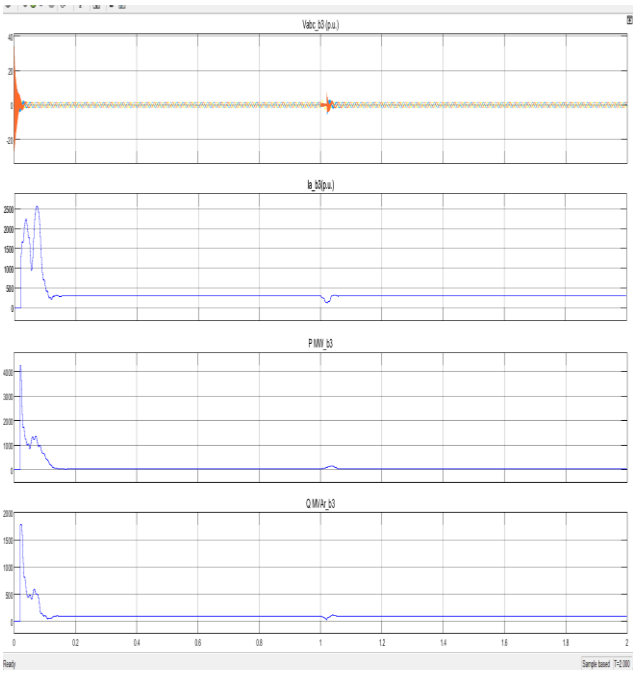

Fig.5 Variation in parameters after fault

In fig.5 the waveforms are steady stage at a voltage scale as we have given the same supply at a same voltage but in this we have connected with fault bus and then the waveform at current scale the waveform start to fluctuating there is a sudden voltage swell in the parameter and after some time there is voltage sag also there is a sudden dip in voltage level after the power rating scale there is an sudden peak at voltage swell and sudden dip in the power rating and steady and then a minor swell and again at steady state. The reactive power scale there is also a voltage swell and sudden dip in form of voltage sag and then again voltage swell, and the voltage sag happens as again a minor swell and sag in the middle stage of the waveform and then steady a waveform as the variation happens at a certain time periods as a voltage fluctuates.

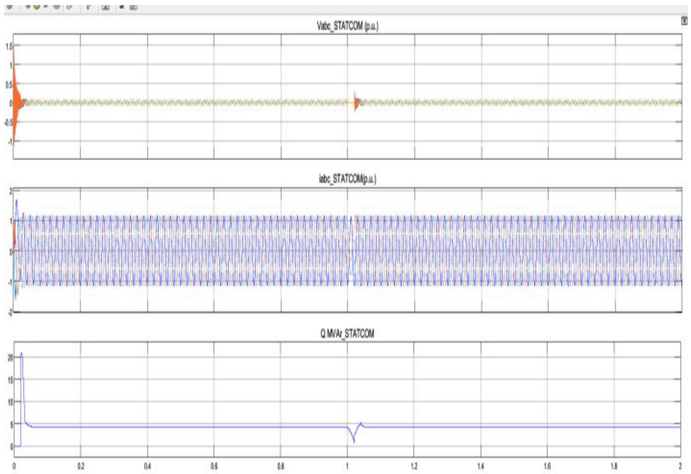

Fig.6 Variation in parameters with STATCOM

In fig.6 As we have connected the STATCOM to overcome the issue in the solar PV as we have connected the STATCOM in the grid the waveform shows the change in the waveforms of the current ratings and the power quality rating as the in current waveform there is minor overcoming the voltage at a stage in which the power quality issue is manageable and the power quality issue the waveforms are in at steady frequency as shown in the current waveform and in the reactive power rating there is a sudden rise in voltage at a initial stage the swell happens to be at a certain time then slightly reduces the voltage and at a steady state and then again having a dip in voltage (voltage sag) and having the same wavelength to the as it was before the voltage sag the waveform shows the with the STATCOM the issue are Sorting the Fluctuations in the Grid the waveforms are not having so much disturbance as having earlier without an STATCOM.

CONCLUSION

This research provided Power system outages cause significant harm, therefore power quality has always been a primary concern. The project demonstrates the power quality and several power quality problems that arise when connecting a PV system with the grid. Power quality problems cause data loss, process interruptions, insulation breakdown, overheating, inefficiency, and shortened equipment service lives. However, PV arrays are prone to power quality issues that can affect their performance and longevity. These issues include voltage and frequency variations, harmonic distortion, and reactive power imbalance. Although the causes cannot be eliminated, steps must be taken to lessen the problems with power quality. The standard for the quality or power supply also the persisting outcome of supply requires attenuation. To improve power quality issues in PV arrays, various measures can be taken such as installing power conditioning equipment such as inverters, using energy storage systems to mitigate power fluctuations, and implementing control strategies to manage the power flow.

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