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A Review paper on Power Quality Improvement Techniques in a Grid Integrated Solar Photovoltaic System.

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Abstract - : *In the modern period, improvement in grid-integrated solar power quality, Photovoltaic generation systems has been a rapidly expanding, and difficult. In the previous few decades, numerous methods for improving power quality have been developed. Reactive Power Compensation Techniques, DSTATCOM, Active filters, Dynamic Voltage Restorer (DVR), and Unified Power Quality Conditioner (UPQC) are some examples of this. In this study, the power quality of a grid-integrated solar Photovoltaic production scheme was improved using SAPF techniques. The Shunt Active power Filter (SAPF) with fuzzy logic and a DC to DC PID controller must be designed in order to progress the value of the power in a solar scheme integrated into the grid.*

Key Words: **SAPF, fuzzy logic, DC to DC PID controller, Grid.**

1 .INTRODUCTION

One of the most useful types of energy is electrical, which completely depends on the availability of power. As a result, the power quality is a critical aspect that is crucial for the efficient handling of user-side equipment. Power ranges for voltage and frequency play a role. The quality of power suffers if the variety deviates from the usual range

Semi conductor devices have undergone a significant advancement due to technological advancement. Semi-conductor devices are essential in the energy sector because they make system control easier. The semi conductor devices, however, pull nonlinear current from the source because they themselves nonlinear. Reactive power and Harmonics are produced when nonlinear loads are used. Harmonics are seen as a serious issue with power quality .Harmonics must be removed in order to keep power quality and keep Total harmonic distortion below 5% according to IEEE 519 harmonics standard.

The changeable dc output of a solar array must be transformed into a constant voltage and fixed frequency ac output that feeds into a grid via a photovoltaic (PV) system. This role of power conversion has been performed by power converters. A distributed generation system's power converter is an essential part, especially if it employs renewable energy. Power converters have changed from being a usual "power conversion device" to a "system integrator" since DG systems have developed rapidly and are used in more applications. The shift up to high power DC converter technology finds increasing demand for power and necessary when converting low dc input voltage into greater dc output voltage, as is the case in applications like UPS, electric vehicles, and solar systems. Because the energy stored in the inductor is transferred to the load, causing the output voltage to always be greater than the input voltage, the output voltage of a boost converter, also known as a dc-dc converter, is the sum of the input voltage and the voltage across the inductor. By adjusting the duty cycle with a PID controller, dc-dc converters may regulate the output voltage.

2. LITERATURE REVIEW

The availability of conventional energy sources has been decreasing and running out recently. Solar Photovoltaic (PV) systems are utilized as a substitute because they are easily available for free, are renewable, and have low running costs. However, by applying maximum power point tracking (MPPT) algorithms and effective converters to provide the greatest power output, problems like low efficiency and dependability on weather conditions are solved. Modeling and analysis of PV arrays, MPPT algorithms, and various efficient converters are done using MATLAB/Simulink [1]

It is suggested to use a PWM inverter to improve power quality, specifically to lower total harmonic distortion (THD). Equipment performance and lifetime are affected by power quality issues. The THD produced by the nonlinear loads is decreased by this system. Because the existence of harmonics causes issues like overheating, insulation failure, etc. [2]

A boost converter based on PV that is governed by a closed-loop PID system. After modeling the PV module in the MATLAB software, the duty ratio manage is established by a PID controller, and the PV unit is simply fed to the boost converter. [3]

PI-Controller is used to regulate the specified system, and its performance is compared with that of a few additional controllers using simulation in the MATLAB/Simulink environment. [4]

It is not possible to directly connect small-scale renewable generators to the grid. A connection between the generator

and the utility distribution grid is necessary due to the generation technology. To get the most power out of a photovoltaic array, a maximum energy point tracking topology using the classic Perturbed & observed technique is used. An integral conventional controller by a phase detector and PLL synchronization is employed to generate reference current. It provides a pulse width modulation topology control unit for inverters, which is utilized to maintain a steady output voltage. [5]

The degradation of power feature at the PCC , which occurs as more distributed generation units based on renewable energy are connected to utility power grids, is a major concern. DG units are related to both the primary kind of harmonics created by power electronic apparatus and the secondary type of harmonics produced by further nonlinear loads, PCC, and utility loads in the scheme. [6].

By using fuzzy logic to optimise the PID in the tracking of the maximum power point, the boost converter's voltage or output power is kept steadily constant. The fuzzy inputs are energy and radiation, and the output is a modification of the PID parameters that will be utilised to put up the boost converter. [8]

To lower the proposed system's overall harmonic distortion, various filters are created and analyzed. Topologies for the LC, LCL, and LLCC filters are included. A single PV system's power quality can be significantly enhanced by using an LLCC filter. Simulations run in the MATLAB-SIMULINK environment are used to confirm the results. [9]

In order to reduce current harmonics and compensate for reactive power, a single-phase SAPF can be utilized. For MPPT, a fuzzy logic control method is used. Explains the challenges and problems with power quality caused by the analysis of solar power integration into the grid. The SAPF with PI controller must be built in order to get better the quality of the power in the grid-integrated solar system. [10]

FACTS controllers have mostly been used to handle different issues with power system steady state control. New studies have demonstrated that, in adding to their primary function of controlling power flow, FACTS controllers can also be utilized to enhance power system stability. [12]

Devices like the Voltage Source Converter-based HVDC, Fault Current Limiter (FCL), Static Synchronous Compensator (STATCOM) and Dynamic Power Flow Controller (DPFC) are taken into consideration (VSC-HVDC). [13]

To examine the impact of UPFC on the system's transient stability performance, a two-area power system model with UPFC was used. Other FACTS devices, like the Static Synchronous Series Compensator (SSSC), and Static Var Compensator (SVC), Thyristor Controlled Series Capacitor (TCSC), are used to compare the performance of the UPFC. [14]

Implementing FACTS components will improve the voltage profile and power flow of IEEE 30 & 57 bus systems while reducing power losses. For the purpose of enhancing power quality, four types of FACTS controllers STATCOM, SVC, TCSC, and UPFC are deployed conventionally. In this case, a comparison between the traditional approach and the evolutionary computation method is also done to verify performance. Among the ways for enhancing power quality are active filters for distributed generation, a reactive power compensation methods, dynamic voltage restorer (DVR), DSTATCOM, and a unified power quality conditioner(UPQC). Utilizing Voltage Stability, Reverse Power Flow, and Current Harmonics as Power Quality measures, this review analyses each of these methods. [15]

3. BLOCK DAIGRAM

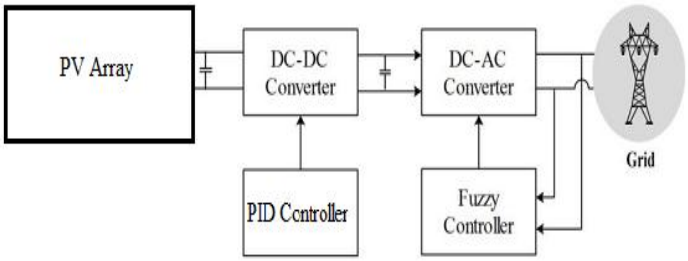

Fig-1: Block diagram of the system

4. OBJECTIVE

Harmonics lead to the source voltage being distorted, additional loss from undesired current flowing in the source, and the malfunction of mains, relays, CB and other control devices. Therefore, reducing the harmonics is necessary. There are numerous ways to lessen the impact of harmonics. One of these techniques involves the use of SAPF, which generates harmonic current in the system with opposite polarity and identical magnitude. This cancels the harmonic current. It responds quickly and operates with versatility techniques involves the use of SAPF, which generates harmonic current in the system with opposite polarity and identical magnitude. This cancels the harmonic current. It responds quickly and operates with versatility.

5. CONTROL SCHEME

5.1 PID Controller DC to DC Converter

The boost converter's output exceeds the PV input. In order to enhance the voltage of a PV system using a PID controller, a boost converter is required. A boost converter is recommended since the PV output needs to be scaled up.

Three types of DC-DC converters are frequently distinguished: boost, buck and buck-boost. The DC-DC boost converter includes an capacitor, inductor, diode, and MOSFET. The output voltage may vary based on the switch duty cycle.

5.2 The Shunt Active Power Filter (SAPF)

To enhance the power quality in the grid-integrated solar system, the Shunt Active Power Filter (SAPF) with fuzzy logic controller and DC to DC converter with PID controller must be designed. A shunt active power filter serves as a harmonic correction device (SAPF). The SAPF is a voltage source inverter for loads. Under various load scenarios, balanced current can be maintained via shunt active power filters. The conversion of DC to AC electricity is done by power switching devices. A grid-connected solar PV system is an electrical converter that transforms direct current (DC) electricity from a PV module into alternating current (AC). The fuzzy control-based, pulse width modulation approach is employed. A combination of power electronic and traditional power system components served as the foundation for the configuration and design of these devices. It is necessary to develop and simulate the proper fuzzy control technique in order to improve the quality of the power produced by the grid-integrated solar system.

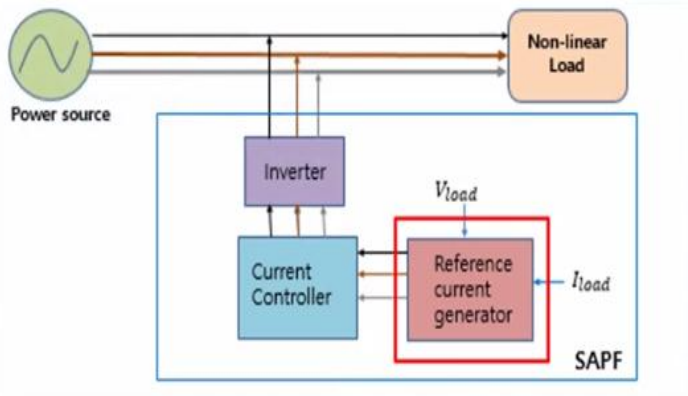

Fig-2: Block diagram of SAPF

6. EXPECTED OUTCOMES

New advancements in solar PV system research, including solar PV array and MPPT systems and converters. The use of a multi-level inverter is applications that demand an output of a clean AC sine waveform with decreased voltage stress and harmonic distortion. A Pulse width modulated inverter is used to reduce Total harmonic distortion in a 3ø system with a nonlinear load after it has been analyzed and modeled. mostly solar panels dependent on temperature and generate very low output voltage irradiance, therefore it's required to use a boost converter to improve the employing a voltage and to keep the output voltage constant, when compared to traditional PID controllers, the fuzzy PID controller improved the performance of the boost converter by supplying a more steady 24 V DC. The PID parameters can be accurately generated in the fuzzy mamdani design. A lower overshoot is produced with a shorter rising time by the fuzzy PID controller. For standalone PV generation systems, various filters are analyzed and designed. Topologies for LC, LCL, and LLCC filters are taken into account. The power quality of a stand-alone PV production system can be improved more effectively with LLCC filter structure.

Using solar electricity coupled to the DC side of the SAPF, this prototype supplies the active power necessary for the unstable grid operation. The findings demonstrate that the proposed model operates source voltages at the inverter and grid with lower THD. The problems and difficulties posed by integrating solar PV systems into the grid were carefully considered.

7. CONCLUSION

This suggested system's harmonics were successfully removed using SAPF. Comparing FUZZY controlled SAPF with other traditional methods reveals that the THD is limited. The results obtained show that the suggested model executes the inverter and grid THD is reduced. The final result of the grid-connected PV system simulation model demonstrates a decrease in harmonics in the inverter when interacting with the grid.

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