

Power Quality Issues and Challenges in Grid Connected Solar PV System: A

Review

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Abstract- The paper presents power quality power quality issues and challenges in grid connected solar PV system. The power quality problems such as, harmonics, voltage sags, swells, interruptions and transient. There are various control techniques available in the paper those have successfully presented. Newly a large interest has been concentrated on power quality issues due to: interruption caused by the non-linear loads, Rise in the number of electronic devices and growing of non-conventional energy sources. Power quality compute the efficiency of electric power dispatched from generation to the domestic, industrial, and commercial customer. At least fifty per cent of power quality trouble is of voltage quality type. In a power system voltage sags and voltage distortion established by harmonics are considered to be the most severe affecting power quality, because of both consumers and utilities are affected by this disruption. This difficulty could be resolved by: several control techniques available in the paper.[1] This paper gives an overview of power quality compensators, analysis and control technologies under the new circumstance of smart grid. It focuses on the control methods and topologies for power quality conditioners, especially new characteristics of applicable control technologies and power quality in micro grids.[2]

I. Introduction

To mitigate power quality issues had been through the use of control techniques. However within the present management scheme plays the most big reason in any power electronics based device. It is the control method which decides the preferred operation and behaviour of a specific device. Power

high-quality is a very key problem in distribution system. Power excellent is truthfully defined as a best of power. It is an opinion this is used to describe the clarity of the transferred power. Electrical strength of machine is design to offer high great strength for high-quality operation of various electrical systems. On top of the latest years, power has been given acceptable attention because of the rarely use of electricity digital managed programs in all types of industry, such as controlling or converting of AC strength to feed nonlinear loads. These types of load have caused the worries over the permissible amounts of harmonic distortion feed into the carriage device. With the enlarge software of nonlinear load, the coming of power satisfactory problems is unavoidable. In addition to this the energy-thing of the accumulation are usually poor. On the alternative hand current devices of industrial and domestic uses are very sensitive to electricity adequate issues.[3-4]

II. Power Quality Issues

The usage of electrical power is counting more on the gracefully of intensity with controllable voltages and frequency while its transmission and age occur at ostensibly consistent levels. The voltage twisting brought about by the consonant creating load is a component of both the measure of harmonic current infused and system impedance. The disparity accordingly, requires some type of intensity molding or change, ordinarily executed by power electronic hardware that distorts voltage and current wave forms. A harmonic creating burden can influence the nearby delicate burdens if noteworthy voltage distortion is begun.

Voltage Swell- It is regularly delivered by system shortcomings, capacitor exchanging and load exchanging. A voltage swell is an extend in the RMS voltage in the scope of 1.1 to 1.8 p.u. for length under 1 minute and greater than half a main cycle.

Voltage Sag – It is regularly brought about by flaws, expanded transitional occasions and burden request, for example, enormous motor starting. Voltage sag is a decrease in the RMS voltage in the scope of 0.1 to 0.9 p.u. (held) for span under 1 minute and greater than half a main cycle often referred to as ‘sag’.

Voltage Flicker- Voltage flicker is created by an arcing condition on the power system. flicker issues can be improved with the establishment of filters and static compensators. A waveform may show voltage flicker if its waveform amplitude is managed at frequencies under 25 Hz, which the natural eye can see as a variety in the light power of a standard bulb.

Voltage Interruption- A voltage interference is the complete loss of electric voltage. Interference's can be long span or brief term (enduring under 2 minutes). A disengagement of power causes an interference as a rule by the opening of fuse or a c electrical breaker, line reclose.

Voltage Unbalance – A circumstance, wherein either the voltages of a three phase voltage source are not indistinguishable in the phase contrasts or magnitude between them are not 120 electrical degrees or both.

Voltage Notches – It is typically created by the commutation procedure in a.c.- d.c. converters. Intermittent transients happening inside each cycle because of the phase-to-phase short circuits.

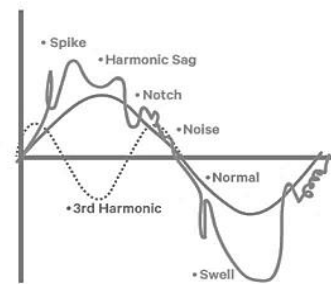
Harmonics - A harmonic of an electrical signal is characterized as the substance of the signal whose frequency is a whole number various of the crucial system frequency. That is, the third request harmonic will have frequency of three times the fundamental frequency. It is a consistent state intermittent phenomenon that produces constant bending in voltage and current waveform. It is ordinarily brought about by power electronics devices, saturable devices and nonlinear consumer loads. Depending upon the sort of burdens, inter harmonics or sub harmonics are likewise created.

Solutions for issues brought about by harmonic distortion incorporate introducing passive filters or active at the load or bus taking lead of transformer associations that permit crossing out of zero-succession parts.

Frequency Deviation-It is an inequality in frequency from the nominal supply frequency below/above a foreordained level, typically +0.1%.

Transients – Transient unsettling influences are unwanted flitting deviation of the load current or supply voltage and brought about by the injection of energy by lightning or by switching. Voltage disturbances shorter than swells or sags, which are brought about by moment changes in the power systems.

Common Power Quality Problems



III. Power Quality Problems and Challenges

Voltage waveform distortions and harmonic currents can cause additional losses and so cause poor power quality. Current and voltage harmonics have undesirable effects on power system components and operation. In some instances, interaction between power system parameters and the harmonics can cause harmonics to amplify with severe consequences.

Poor power factors are responsible for a substantial increase in the currents flowing in consumer installations and power supply systems, causing a drop increasing the losses in the feeder voltage. Also, harmonics can lead to improper operation of protective devices, such as fuses and relays. Harmonic currents, particularly of the third order, cause overheating of neutral conductors and transformers. Distribution systems and consumers are sometimes forced to derate their transformers because of the heating effects of harmonic currents. Neutral conductors of installations and supply systems have the same cross-sectional area as phase conductors. There is already confirmation of the use of neutral conductors of larger cross-section in newer commercial installations to take account of the increased third harmonic currents.

The retroactive installation of such larger neutral conductors in existing networks would result in enlarged costs, including significant increase in demand

for aluminium and copper. Also, the flow of harmonic currents in power supply systems may affect telephone communication. Harmonic voltages in excess of the recommended limits can result in distributors having to replace their switchgear, transformers, and lines at prohibitive cost. The resulting networks would be unfit as harmonic distortion represents reactive power flow.

Due to the presence of unstable loads, voltages become unbalanced and zero sequence and negative voltages are generated, which if applied to an induction motor may give rise to extra losses and sometimes reduction and torque pulsation. The current quality and voltage quality affect each other by mutual interaction. Thus, both suppliers and consumers of electricity are responsible for maintaining the power quality parameters within the standards limits [45].

III. Mitigating Techniques

There are various types of techniques to mitigate the power quality issues.

a) Adaptive droop control technique-The Adaptive droop mode is based on the stoop method, which uses a few forecast grid parameters consisting of the frequency and voltage and the angle and magnitude of the grid impedance.[5] Hence, the inverter is capable of inject independently reactive and lively power to the grid. DC micro grids (MGs) are becoming well known as strong means to integrate unique electricity sources. Regularly, the stoop manage is adopted as a decentralized manage approach for power sharing in DC MGs. However, present day sharing necessary or voltage regulation deteriorates due to the results of line impedances.[6-7]

a) Repetitive control technique-Repetitive Control is a manipulate method grown by means of a collection of Japanese students in 1980s.[8] It is based completely at the Internal Model Principle and used specifically in managing periodic signals, for tracking, instance periodic reference or rejecting periodic disturbances. The replicative control device has been proven to be a completely effective and practical approach handling periodic indicators. [9]

b) Dual-loop control strategy, simplified feedback linearization (SFL) control strategy-An growing simplified feedback linearization (SFL) control approach is proposed for the PV inverter with the LCL filter out, which gives acceptable overall performance, particularly, in Decoupling the manage device, enhancing the powerful overall performance, and improving the adaptability. Furthermore, the SFL controllers are convenient than the high-order

monitoring controllers used in old remarks linearization manage.-[10]

c) Predictive control-Model predictive manage (MPC) is an advanced approach of process control that is used to operate a technique whilst pleasing a fixed of constraints. It has been in use inside the technique industries in oil refineries and chemical plant life since the Nineteen Eighties. In present years it has also been used in strength system balancing fashions and in strength electronics. Model predictive controller relies on powerful models of the technique, most often linear empirical models obtained through machine identification. The primary advantage of MPC is the reality that it lets in the present-day timeslot to be advanced, even as maintaining destiny timeslots in account. This is performed through optimizing a finite time-horizon, but only executing the cutting-edge timeslot after which is optimizing again, again and again, for that reason differing from Linear-Quadratic Regulator (LQR). Also MPC has the power to expect destiny events and may take control moves accordingly. PID controllers do now not have this predictive potential. MPC is almost universally executed as a digital control, even though there is research into attaining quicker reaction instances with especially designed analogue circuitry.[11]

d) Feedback Linearization control technique-A new nonlinear present day controller using partial comments linearizing approach has been offered on this paper which solvesthe issues of conventional PI controllers. Electricity based completelyLyapunov feature is preferred toexamine the stableness of inner dynamics of a PV system. The grid connected PV device with the proposed controller shows its work.[12]

e) Novel modulation technique-A novel modulation technique and a latest balancing control way for an unmarried-phase 5-stage flying-capacitor (FC)-based completely active-impartial-point-clamped (ANPC) converter. A novel hybrid allotted and centralized control of hybrid renewable power system along with AC/DC micro grids. An Interlinking Converter (IC) is utilizing to connect each aspect of the micro grid systems broadly. Improved Particle Swarm Optimization (IPSO) which works as a grasp controller is used to manage the power of the sources based completely upon IC manage. Also, there are exceptional slave controllers for wind, fuel cells and photovoltaic, which might be designed to deliver non-stop load strength. Coordination among grids is satisfied by slump manage for both AC and DC micro grids to gain energy sharing method and work of renewable power resources offering special hundreds. The proposed controller succeeded to control energy among micro grids under

special situations. The control technique the usage of IPSO method upgrade the dynamics of the hybrid device linked to the grid.[13]

f) **Narrow-band digital filtering technique**-This technique offers with damping of resonance between the strength grid and grid-connected inverters strength. The proposes a narrow-band virtual filtering approach to clean up the resonance hassle thru shaping the inverter output impedance at elected frequencies without affecting the traits of the inverter outdoor the selected frequency range. A frequency sampling technique is used to enforce the narrow-band virtual filter out which allows direct manage of the filter out's amplitude and section reaction in accordance with damping requirements-[14]

g) **Phase shifted- carrier technique**-The section shifted- service method, is usually used in extra power multi-converter schemes, is applied to a modular grid-connected inverter to upgrade the output current waveform. Phase-shifted service modulation is an enterprise chosen in its software to multi-degree H-bridge converters. The basic advantage of this scheme over level space vector modulation is shifted and space vector modulation schemes is its inherent capability to evenly distribute losses between semiconductor devices[15]

h) **Linear-approximation method (LAM)**-In arithmetic, a linear approximation is an approximation of a trendy feature the use of a linear function (greater exactly, an affine function). They are hugely used within the technique of finite differences to supply first order techniques for approximating or fixing answers to equations. To draw maximum power from PV arrays, a linear-approximation method (LAM) is advanced to complete the maximum strength factor monitoring (MPPT). Based on the LAM, a reference dc-hyperlink voltage is elected. ... The experimental measurements and simulation consequences have validated the feasibility of the proposed PV gadget.[16]

i) **Advanced control strategy**-With this configuration a latest control technique may be used to maximizes machine efficiency in both standalone operation mode -59 and grid connection, Micro-grid structures are based on disbursed strength assets (DERs) for instance sun, wind etc., scattered masses and electricity storage devices which could carry out islanded in addition to grid-related operation. The idea of micro-grid has brought a paradigm shift from huge scale centralized strength generation to Distributed Generation (DG). It has lowered the dependence on most essential energy grid and permits the consumer to turn out to be a part of energy deliver system. However, such strength system calls for enhance strength

management and manage algorithms to function efficiently in particular at some point of islanded mode. Power electronic converters have to be re-designed to join micro-grids with primary grid due for better energy sharing and energy nice. This manuscript provides a high level view of control strategies to clean up strength nice issues in micro-grids and permit genuine, green and secure operation.[17]

j) **Unified control strategy**-A unified control approach that allows each grid-tied and islanded operations of three-segment inverter in disbursed generation, without a need for switching amid two essential islanding detection or corresponding controllers. The proposed control strategy composes of a singular voltage loop and an internal inductor contemporary loop in the synchronous reference frame. The inverter is controlled as a modern supply simply by the internal inductor contemporary loop in grid-tied operation, and the voltage controller is daily activated to adjust the load voltage upon the incidence of islanding. Furthermore, the waveforms of the burden voltage in the islanding mode and the grid cutting-edge in the grid-tied mode are distorted under nonlinear local load with the conventional idea. A unified load modern feed ahead in this paper. Moreover, this paper offers the parameter layout of the control method and the distinctive evaluation. Lastly, the fruitfulness of the proposed manage strategy is validated by using the simulation and experimental consequences.

k) **T power balance theory**-The topology used is a conventional 3-section inverter controlled through a energy stability technique by a synchronous hysteresis band. This paper presents a study approximately the power injection of grid related photovoltaic plants whilst there are non-linear hundreds linked to the factor of common coupling. The clever grid scenario advises that the photovoltaic power must take care no longer only about the lively electricity, but in addition approximately the reactive energy. The have a look at compares the ultimate year's criteria of injecting the liveliest strength, with the predicted tendency of representing reactive energy in an enthusiastic filter way for fending off currents harmonics within the grid.[18]

l) **dual-close-loop control strategy**-A twin-loop manage approach for grid-connected inverter with LCL clean out changed into proposed, the gadget stability changed into analysed and the design approach of manager changed into given.[21] The proposed method overcame the flaws of loss increase, performance decrease and fee increase which have been resulting from damping resistance in LCL kind grid-connected inverter, the system performance and power deliver excellent of the output were stepped forward. The

primary manipulate approach is twin-near-loop manage technique. By decoupling reactive power and energetic power, internal loop manipulate algorithm is used to hint active energy and reactive power contemporary one after another. Meanwhile, outer loop regulates grid-related voltage and DC hyperlink voltage and grid-related voltage. When new PV installations hook up with utility grid, some problems, including reactive power compensation, energy pleasant and voltage balance, are across the corner. [19]

m) **Fuzzy logic control**-Fuzzy good judgment is broadly used in device manage. The term "fuzzy" refers back to the fact that the common sense worried can deal with principles that cannot be expressed as the "genuine" or "fake" but instead as "in part genuine". Although opportunity methods consisting of neural networks and genetic algorithms can carry out just additionally fuzzy logic in many cases, fuzzy common sense has the benefit that the answer to the question can be forged in phrases that human operators can identify, so that their enjoy may be utilized within the design of the manager. [20] This makes it easier to mechanize obligations which might be already successfully carried out by humans.

n) **Novel control strategy**-A Novel Control Strategy for Modular Multilevel-Based Drives Considering the System Operating Point. The proposed strategy defines the best control structure to stability the voltage of the converter capacitors including the force working point. The novel control strategy can be utilised for one of kind forms of DG sources as energy quality improvement. The effect of the proposed control strategy in DG software is proposed with ANN Technique to grid, upgrade electricity problem of the utility grid, and lowered total harmonic distortion of grid present-day through simulation.

IV. Conclusion

Current harmonics and voltage sags are the most effective power quality issues in industrial and commercial utility's customers. These power quality issues can cause tripping of sensitive electronic equipment's, irregular operations of tremendous economic losses and facilities. Custom Power devices have now been of interest for more than ten years that are able to improve the quality of power and reliability delivered to electric power customers. UPQC consisting of two voltage source inverters with a common DC link is a custom power device and can simultaneously execute the tasks of APF and DVR. However, UPQC doesn't provide various levels of power for their customers since UPQC work out only end user power quality concerns.

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