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A Review Paper on Power Quality Improvement Techniques in Power System with Renewable Distributed Generation Source

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***Abstract*:- Power Quality Improvement in Distributed Generation has been fast growing, challenging and interesting area in modern era. A large number of Power Quality Improvement techniques have been developed in last few decades. In this paper an attempt is made to review a wide range of methods used for Power Quality Improvement in Distributed Generation comprehensively. This include use of Active Filters, Dynamic Voltage Restorer, DSTATCOM, Reactive Power Compensation Techniques and Unifified Power Quality Conditioner. This review investigates all these methods with Power Quality parameters like Reverse Power Flow, Voltage Stability and Current Harmonics.**

Keywords: DSTATCOM, DVR, Reverse Power Flow, PV, Distributed Generation

INTRODUCTION:

Power Quality is an important part of proper operation of consumer Loads. In recent era, the environmental constraints and increasing energy requirement are moving power system towards Distributed Generation. It is well known fact that if Distributed Generation Sources are installed than power quality problems like Reverse Power Flow, Voltage instability and voltage or current harmonics are inevitable. To improve voltage quality Dynamic Voltage Restorer has been adopted as an effective equipment to protect voltage-sensitive loads from voltage instability. DVR inserts three single phase voltages of suitable magnitude and phase in series with the supply voltage through booster transformer to achieve power quality. PV systems are gaining more and more popularity. In [2] an inverter is used to provide active power to the grid along with PV interfacting. Fuzzy Logic Controller is used to control the Maximum Power Point Tracking. The shunt active power filter uses a control technique to eliminate the harmonics in grid current and increase the power factor. The PV power generation depends to a greater extenton weather conditions and represents intermittence which influences the grid and cannot be ignored. STATCOM [3] is a static compensator is a new device which brings about reactive power compensation closer to the load. By adjusting the amplitude and phase of injected current/voltage at the PCC the reactive power compensation can be achieved thereby achieving voltage stability. In [4] the performance of solar PV has been examined depending on variation in irradiance produced and the operation of PV based inverters. In this paper the author has tried to mitigate the effect of Solar output power on the Low Voltage network through the VAR control strategy of the inverter. Many people have come up with different ideas to relieve the power quality problems in association with Distributed Generation. None of the previous papers in connection with Distributed Generation have discussed the problem of Reverse Power flow in LV Feeder Network. The author of this paper has proposed a Novel Technique to come up with the solution to the problem of reverse power flow in the LV feeder network with the use of Custom Power Device DSTATCOM.

LITERATURE REVIEW:

Xiaoqing Han, Ruifen Cheng, Peng Wang, Yanbing Jia in [1] "Advanced Dynamic Voltage Restorer To Improve Power Quality In Microgrid" have introduced a device namely dynamic voltage restorer (DVR) based on photovoltaic (PV) generation/battery units to improve voltage quality in a microgrid. The restorer is connected with the grid by a rectifier, which is in series with the point of common coupling (PCC). Using energy management system (EMS), the proposed apparatus could be operated under dynamic voltage restorer mode, uninterrupted power supply mode and micro-source mode, and be switched smoothly among them. The dynamic voltage restorer could handle voltage sag or surge, and thus improves the power quality in microgrid.
Hamad, M.S, Fahmy, A.M, and Abdel-Geliel, M in [2] Power Quality Improvement of a Single-Phase Grid-Connected PV System with Fuzzy MPPT Controller have worked on Photovoltaic (PV) systems which are grid-connected via an interfacing converter which operates with Maximum Power Point Tracking (MPPT) controller in order to feed the grid by the maximum allowable solar power. In this paper, the PV interfacing inverter is controlled using a predictive control technique to perform both functions of power quality improvement in addition to transferring the PV maximum power to the grid. A Fuzzy logic control algorithm is applied for MPPT.

Jing Li, Fang Zhuo, Xianwei Wang, Lin Wang, Song Ni in [5] "A Grid-Connected PV System with Power Quality Improvement Based on Boost + Dual-Level Four-Leg Inverter have proposed a research, which not only allows a wide range of input voltage, but also compensates unbalance current of the local load in three-phase three-wire PV system with the help Dual-Level Four Leg Inverter. Work by V. Hima Leela, S. Thai Subha in [6] "Control of Power

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Converter for Power Quality Improvement in a Grid Connected PV System focuses on the design, modeling and control of power converters for power quality improvement in a grid connected Distributed Generator system. In this paper Photovoltaic is considered as DG. All the simulations are carried out in MATLAB/Simulink environment and. the results with priggish analysis are exhibited.

Meenakshi Jayaraman1, Sreedevi V.T. and Rajkiran Balakrishnan in [7] "Analysis and Design of Passive Filters for Power Quality Improvement in Standalone PV Systems" have used passive filters which include LC, LCL and LLCC filter topologies. A comparison study of the total harmonic distortion reduction with the above filters is done. Further, the paper attempts to show that the use of LLCC filter with a standalone PV system can highly improve the power quality of the system. Results are verified using simulations in MATLAB-SIMULINK environment.

Digvijay B Kanase A. R Thorat H. T Jadhav in [8] in" Distribution Static compensator for Power Quality Improvement using PV

Array" have proposed distribution static compensator for improvement of power quality using PV cell. Dstatcom is used for reducing the reactive power that resulted various types of load on the distribution systems. The Dstatcom is used for compensating harmonics at PCC.

Power Quality Improvement Techniques: In [1] Dynamic Voltage Restorer (DVR) is used for Power Quality Improvement. DVR is connected in series with the point of common coupling.

The main components of DVR include PV source, two DC-DC boost converters, battery and a coupling transformer. When the supply fails because of which voltage on the Load side sags or swells the DVR operates in the dynamic voltage restoration mode. The DVR injects voltage in the transmission line which is the difference between the load voltage under normal conditions and load voltage. The 30 percent dip or sag in voltage is compensated by DVR. Whenever there is a voltage outage because of fault the voltage is restored in 0.2s by the DVR. In [2] an inverter is used as a means of active power injection into the grid along with PV. The proposer has used Fuzzy Logic Controller for MPPT Tracking. Here the inverter which is a source of Active Power is controlled by predictive control technique to alleviate the grid current harmonics. The proposed system consists of PV Array, Boost Chopper, DC-Link capacitor and a multifunctional inverter connected at the PCC through interface inductive filters. The compensation objective is to compensate for Load current harmonics and reactive power compensation. The multifunctional inverter is controlled with predictive control strategy. This method requires measurement of grid voltage, current at Point of common coupling and inverter DC link voltage. The DC link voltage is subtracted from the reference voltage and the PI controller acts on the resultant error. In [3] a grid-connected PV simulation through D-STATCOM has been presented. As grid connected converter D- STATCOM controls power maintains voltage and improves power quality. DSTATCOM is a device connected in shunt with the distribution network. The D-STATCOM controls voltage or reactive power absorption or injection into the transmission line.

On AC side the variation of reactive power is achieved by means of H-bridge Voltage Source Inverter which is interfaced with the Power system by means of H-bridge Voltage Source Converter which is energized by DC- Link capacitor. H-bridge utilizes forced-commutated power electronic devices (GTO, IGBT or MOSFET) to generate voltage to be injected into transmission line. The Inductance L and R represent connecting impedence.

People have put forth different power quality issues concerning Distributed Generation. However none of the papers have discussed about Reverse Power flow in LV feeder network because of excessive power generation at the interfacing point of PV with the grid. When consumers are not in their residential places there is a possibility of excessive power generation through PV when sunshine is at its peak. This excessive power can flow in reverse direction from the point of common coupling towards the Substation resulting in unequal power in the three phases consequently leading to unbalance in the three phase currents. Thus the current in each phase is not same and also there is distortion in phase difference ie phase difference is not 120 degrees between each of the phase currents. The author of this paper has come up with a new technique to eliminate this problem. DSTATCOM is a custom power semiconductor device which is connected to LV feeder network to alleviate this issue. MOSFETS used in the DSTATCOM are controlled by a PWM Controller. The switching of these MOSFETS is so controlled so as to inject current at the output of DSTATCOM into each of the phases of transmission line so that the currents get balanced. This process involves abc to dq0 transformation of unbalance voltages and currents of the transmission line.

CONCLUSION:

Different techniques have been proposed by different researchers for Power Quality improvements with distributed energy sources for Electrical Energy production. Various techniques for alleviation of power quality issues include Dynamic Voltage Restorer, various types of Filters for harmonics elimination, STATCOM

And DSTATCOM. Reverse power flow is one of the major power quality issue which power system is facing now a days with PV as a Distributed Energy Source. This paper thus addresses various power quality issues and techniques to overcome those power quality issues

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