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Novel Optimization of Power Quality Problems Using Genetic Algorithm

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Abstract: This project proposes a voltage stability for an interline photovoltaic (I-PV) system. In an I-PV system, the inverters in a PV plant are reconfigured in such a way that two or more distribution networks / feeder are interconnected. The I-PV system is operated as a flexible ac transmission system (FACTS) device STATCOM to regulate the point of common coupling voltage on either feeder. One of the key features of the I-PV system is that real power can be exchanged between two feeders via PV plant inverters. This method is thus proposed, especially for switching loss reduced, to facilitate power quality problems such as voltage flicker and harmonics which are control to regulate the point of common coupling voltage.

Keywords- Energy Storage System, I-PV, IPS, interline power system, Power Quality, PCC, STATCOM, Voltage Flicker.

I. INTRODUCTION

PHOTOVOLTAIC (PV) and wind power plants are considered as solutions to generate clean electric energy. Power quality improvement in distribution system has been attracting an interest increasing during recent years. Research studies include the quality of voltage supply with respect to voltage swell, voltage sag temporary interruptions, voltage dips, harmonics, and voltage flicker. Sudden variation in reactive power demands lead to a fluctuating voltage drops across the impedance of a distribution system which result in voltage fluctuation at the point of common coupling (PCC). Voltage Flicker is the disturbance of lightning induced by voltage fluctuations. Very small variations are enough to induce lightning disturbance for human eye for a standard 230V, 60W coiled-coil filament lamp. Huge non-linear industrial loads such as the welding machines, electrical arc furnaces pumps, rolling mills and others are known as flicker generators. Just as flexible ac transmission systems (FACTS) controllers are used to improve the quality and reliability of transmission systems, these devices can be reliability of power that is A distribution static compensator or DSTATCOM is a fast response, solid-state power controller that provides flexible voltage control at the point of coupling (PCC) to the utility distribution feeder for mitigations of power quality problem. If it is coupled with energy storage system (ESS), it can exchange both active and reactive power with the distribution system by varying the amplitude and phase angle of the converter voltage with respect to the system voltage. The result is a controlled current flow through the interfacing inductance between DSTATCOM and the distribution system.

Flexible ac transmission systems (FACTS) devices are widely used to enhance the quality of power system networks. Among useful FACTS devices are the static synchronous compensator (STATCOM), unified power- flow controller (UPFC), and interline power-flow controller (IPFC). The IPFC connects more than one electric network together using back-to-back inverters. These back-to-back connected inverters can control the power flow (both active and reactive) through series-connected transformers. Such a system configuration gives an opportunity to improve overall system performance.

A nine-bus system is exploited to fulfill the investigation of the presented procedure. All the simulations are done according to the usage of MATLAB software. 6-pulse voltage-source converter STATCOM was used to compensate for the voltage flicker. With respect to the harmonic problem in this stage, a 12-pulse voltage-source converter STATCOM was designed to isolate load harmonics and mitigate the propagation of voltage

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flicker to the system in the next stage. The obtained results clearly confirmed the efficiency of the 12- pulse STATCOM to complete the voltage. For distribution networks equipped with underground cables, the resistance cannot be neglected with respect to the reactance of the feeder.

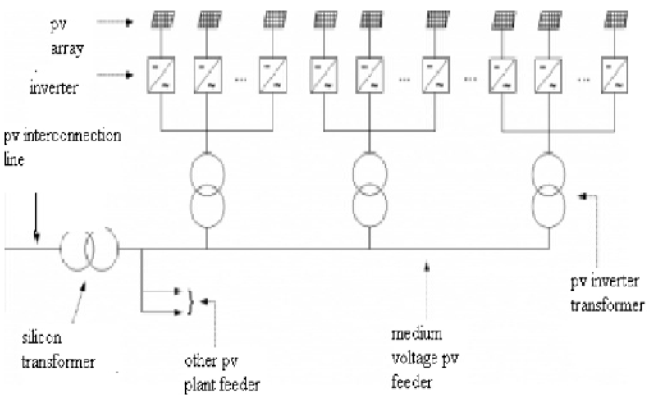

Fig. 1. Interline-PV (I-PV) power plant system configuration.

II. SYSTEM CONFIGURATION

Fig. 1 shows a multi -feeder distribution system in whichfeeder-1 and other feeder are considered to be located close to each other. A large-scale PV solar power plant is connected at feeder-1. The PV plant inverters are reconfigured in such a way that the two feeders could be interconnected with each other. This configuration is referred to as an 'Interline-PV' (I-PV)system .The flexibility of I-PV power plants to inject the solar energy into feeder-1 only or feeder-2 only or to share it with both feeders. These operations can be achieved by opening and closing of different switches. Switch is used for islanded/non islanded operation of feeder-2.

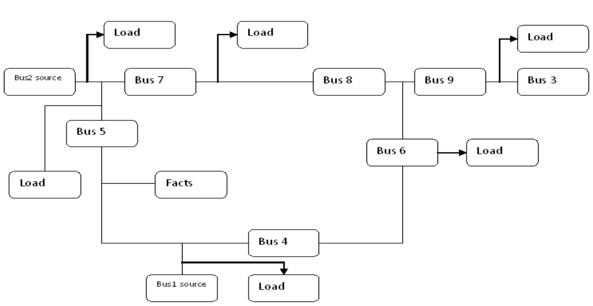

Fig.2. Block Diagram of Proposed System

III. COMPENSATION SYSTEM

A typical nine-bus power system shown in figure 2 is simulated in MATLAB for this study. It can be seen that the voltage oscillation was produced by a voltage flicker and harmonics source connected to the main bus-bar. The complete STATCOM control system and PV cell plant scheme implemented on MATLAB.

IV. SIMULATION AND ANALYSIS OF THE RESULTS

In order to investigate the influence of the STATCOM as an effective mitigating device for voltage flicker, three types of compensators are simulated in MATLAB. First, the voltage flicker compensation is adopted using PV cell. Then a 6-pulse voltage-source converter STATCOM is used and finally for a complete voltage flicker mitigation a 12-pulse voltage-source converter STATCOM is designed. The compensation techniques and their results are presented in this section.

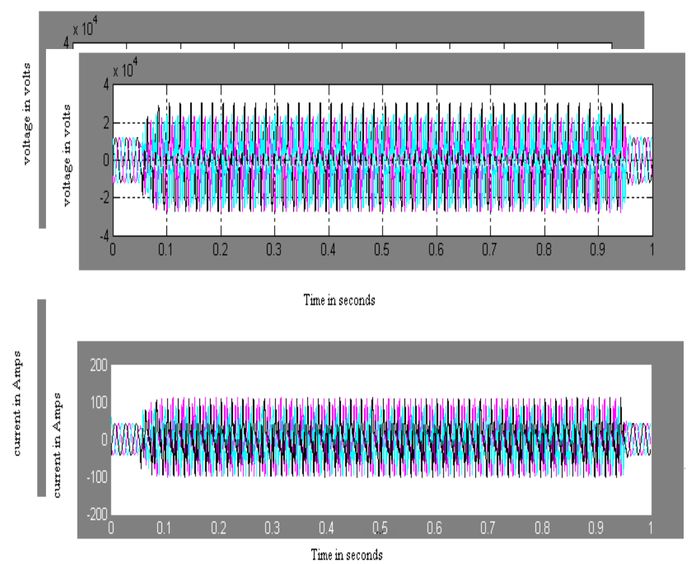

Fig.3. with fault

1) Compensation using with PV Cell

In this stage with a PV ; one of the FACTS devices being controlled by a thyristor is used to mitigate the voltage flicking. In this case, the

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exerted voltage flicker into the system and the compensated voltage are shown in figures 5.In these proposed system which has three source and nine bus is connected through transmission lines, here three phase is supplied. Converter can be acted either rectifier or inverter. Isolated transformer can be used to convert digital to analog through transmission lines.

The PWM and IGBT which are connected in this model here the GA optimization tool feed in these PWM. According to the selection can be mitigate the power quality problems such as voltage flicker and harmonics. The load fault can be created by using breaker operation of open and closed. Input voltage can be applied through the DC link. Genetic Algorithm and optimization used to reduce switching loss. A MATLAB/Simulink-based simulation model is developed to evaluate performance of the system with the pro- posed controller. the connection of PV cell the input voltage which is given as 11kv after optimization we get the output voltage as 12kv and output current as 48A is achieved.

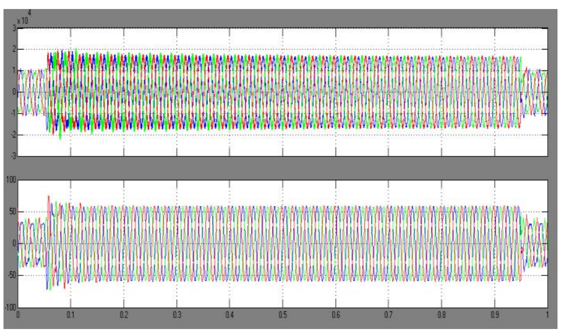

Fig.4. The output voltage mitigated with PV cell

2) Compensation using without pv cell

In this stage without pv cell in the circuit by using breaker circuit operation to open the device ,the input voltage which is given to the circuit as 11kv. After optimization the of the model we get the output voltage as 10kv and current is 40 A so comparatively with pv cell in the circuit has high output voltage and current level .

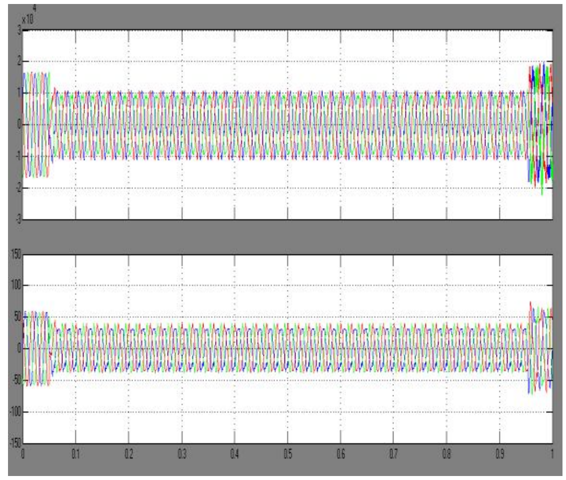

Fig.5. The output voltage mitigated by without pv cell

3) Compensation using STATCOM

The Statcom can be located where more node is presented there can be placed in the transmission lines. Interfacing of STATCOM with DC link and transformer by the breaker operation set as closed mode then optimize the circuit model then we get the high output voltage and current level compared with PV cell. The output voltage of STATCOM has 18kv and output current as 62A is achieved . It can mitigate voltage flicker and harmonics and also reduced the switching loss

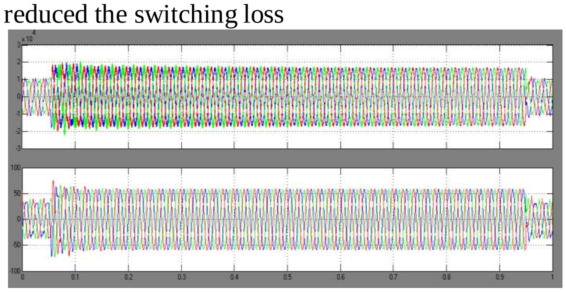

Fig.6. The output voltage and current mitigated by without PV cell

V. CONCLUSION

The paper describes in an I-PV system, the PV solar plant inverters are reconfigured and connected back to back to interconnect two feeders .The I-PV system with the proposed system is then controlled as a FACTS device to regulate the PCC voltage. It is shown in the paper that used to mitigate the power quality problems such as voltage flicker and harmonics and also reduced the switching losses. It indicates that mitigation of flicker with STATCOM and with PV cell is more effective than without PV cell .In future scope multiple device with multiple location by using another optimization tool to mitigate the power quality problems can be implement.

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