PV Cell Based Dyanmic Statecom for Power Quality Improvement

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Abstract— Reactive power compensation is an important issue in the control of electric power system. Reactive power from the source increases the transmission losses and reduces the power transmission capability of the transmission lines. Moreover, reactive power should not be transmitted through the transmission line to a longer distance. Hence, Flexible AC Transmission Systems (FACTS) devices such as static compensator (STATCOM), unified power flow controller (UPFC) and static volt–ampere compensator (SVC) are used to alleviate these problems. In this paper, single phase STATCOM using hysteresis band current control is presented as the final year project. The detail MATLAB simulation study has been done, with addition to that, a hardware design to realize the system has been proposed, simulated, fabricated and tested in the lab. The MATLAB simulation model uses capacitor as DC source and PI controller to maintain its voltage. But, in order to reduce the complexity because of technical and time constraint, the hardware is designed with DC battery source eliminating the PI controller. The output gives the positive results.

Keywords: PV Cell, Power Quality, STATCOM, MATLAB

I. INTRODUCTION

Today, we are mostly dependent on non-renewable energy that have been and will continue to be a major cause of pollution and other environmental degradation. Finding the sustainable alternative is becoming increasingly urgent because of these problems and the dwindling supply of petroleum. Perhaps, the greatest challenge is in devising a sustainable future, which relies on integration and control of renewable energy sources in grid distributed generation.

This chapter presents the modelling of current and voltage module of PV arrays and their characteristics. The formation of PV array using V_{PV} module is also explained. Also the basics of STATCOM along with the controller are also presented. The modelling of PV array as STATCOM along with the MPPT algorithm for constant and variable insolation values are carried out using MATLAB SIMULINK.

II. METHODOLOGY

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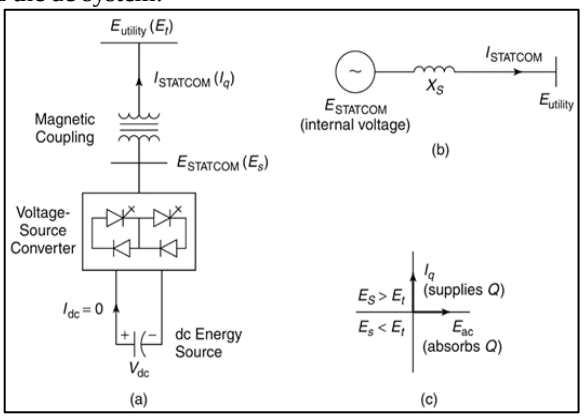
The whole project work consists of simulation, software and hardware work. The works to be performed are listed in a chronological order as follows:

1) Step 1: Literature review of the STATCOM and development of strategy to meet the objective,
2) Step 2: Simulation development of proposed system in MATLAB,
3) Step 3: Simulation of proposed hardware model in PROTEUS with microcontroller Step 3: Simulation of proposed hardware model in PROTEUS with microcontroller programming using MPLAB,
4) Step 4: Hardware fabrication,
5) Step 5: Testing and debugging.
6) Step 6: Final documentation of the project

III. OPERATING PRINCIPLE

A STATCOM is a controlled reactive-power source. It provides the desired reactive-power generation and absorption entirely by means of electronic processing of the voltage and current waveforms in a voltage-source converter (VSC). A single-line STATCOM power circuit is shown in figure. , where a VSC is connected to a utility bus through magnetic coupling. In), a STATCOM is seen as an adjustable voltage source behind a reactance—meaning that capacitor banks and shunt reactors are not needed for reactive-power generation and absorption, thereby giving a STATCOM a compact design, or small footprint, as well as low noise and low magnetic impact. The exchange of reactive power between the converter and the ac system can be controlled by varying the amplitude of the 3-phase output voltage, Es, of the converter, as illustrated in figure (c). That is, if the amplitude of the output voltage is increased above that of the utility bus voltage, Et, then a current flows through the reactance from the converter to the ac system and the converter generates capacitive-reactive power for the ac system. If the amplitude of the output voltage is decreased below the utility bus voltage, then the current flows from the ac system to the converter and the converter absorbs inductive-reactive power from the ac system. If the output voltage equals the ac system voltage, the reactive-power exchange becomes zero, in which case the STATCOM is said to be in a floating state. Adjusting the phase shift between the converter-output voltage and the ac system voltage can similarly control real-power exchange between the converter and the ac system.



IV. APPLICATION

A STATCOM can improve power-system performance in the following areas:

1) dynamic voltage control in transmission and distribution systems
2) power-oscillation damping in power-transmission systems
3) transient stability
4) voltage flicker control

V. ADVANTAGES

- Voltage Regulation and Stability
- Power Transmission Capability of transmission and distribution.
- Reduce Line Losses

VI. CONCLUSION

Reactive power compensation is an important issue in AC electrical system. Capacitor bank cannot give effective and flexible compensation. Hence, FACTS devices are needed.

The hysteresis band current control shows the effective control over the operation of STATCOM.

Each hardware components has given the required simulation results. The integration of these components in source isolated mode was only simulated (in Proteus) because of the CPU overload. The result obtained proves the ability of hardware designed to apply the hysteresis band current control method for STATCOM.

Each hardware components were successfully fabricated. The test of these hardware components gave the desired output, proving their capability to operate. The tracking of the actual current in hysteresis band around the reference current is obtained in the hardware.

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