[IDSTM: January 2017]

ISSN 2348 – 8034
Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

A REVIEW ON APPLICATION OF SOLAR CELL IN STATIC COMPENSATOR FOR REGULATION OF ACTIVE & REACTIVE POWER IN THE DISTRIBUTION NETWORK

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ABSTRACT

This project provides a technique for static compensator by giving active and reactive power to the system by using solar cell (PV arrays). As the demanded load is very high during the day time, PV –STATCOM will supply the active power. Whereas for the night time the load is on the lower side which makes it more important to stabilize the system voltage level by injecting reactive power to the grid. This system will automatically decide what is required by the grid at particular interval and will deliver the power as per the requirements of the grid.

Keywords-. *STATCOM, MATLAB, PV (Photovoltaic) Solar system.*

Introduction

We are mostly dependent on non-conventional energy sources that are and will continue to be a major source of pollution and environmental degradations. Solar panels works only during the day time as sunlight is not available during night. Hence the solar power capacity is lost during night times. This will raise a problem in power quality if PV panels are connected to distribution system directly. The ever increasing demand of electric power necessitates the use of renewable energy to a greater extent. Due to the alarming hike in global warming, we need to utilize maximum amount of renewable. The largest available renewable energy is solar energy, where PV panels can be utilized to convert from solar to electrical energy. Here a PV panel is simulated that will work during day and night time. This will use PV as STATCOM which is also known as PV-STATCOM. This will control voltage at the load terminal during night, and during day, PV-STATCOM will provide real power along with power factor correction. This PV-STATCOM could be used at the roof tops of the industries which consumes more power. PV-STATCOM will also help in mitigating global warming by providing clean energy during night and day time.

CONFIGURATION OF PV (PHOTOVOLTAIC PENAL OR CELL)

The photovoltaic cell generates DC electricity when subjected to sunlight. Solar radiations helps all forms of life to sustain on earth. Sun radiates 1.74 x 1017 W of power per hour to earth and the daily solar radiation energy varies from 4-7 kWh per and there are 270 to 300 sunny days in a year. For practical applications many PV cells are interconnected as power generated in the single PV cell is very low. The current and voltage in the circuit is decided by number of cells in parallel and number of cells in series respectively.

ISSN 2348 – 8034
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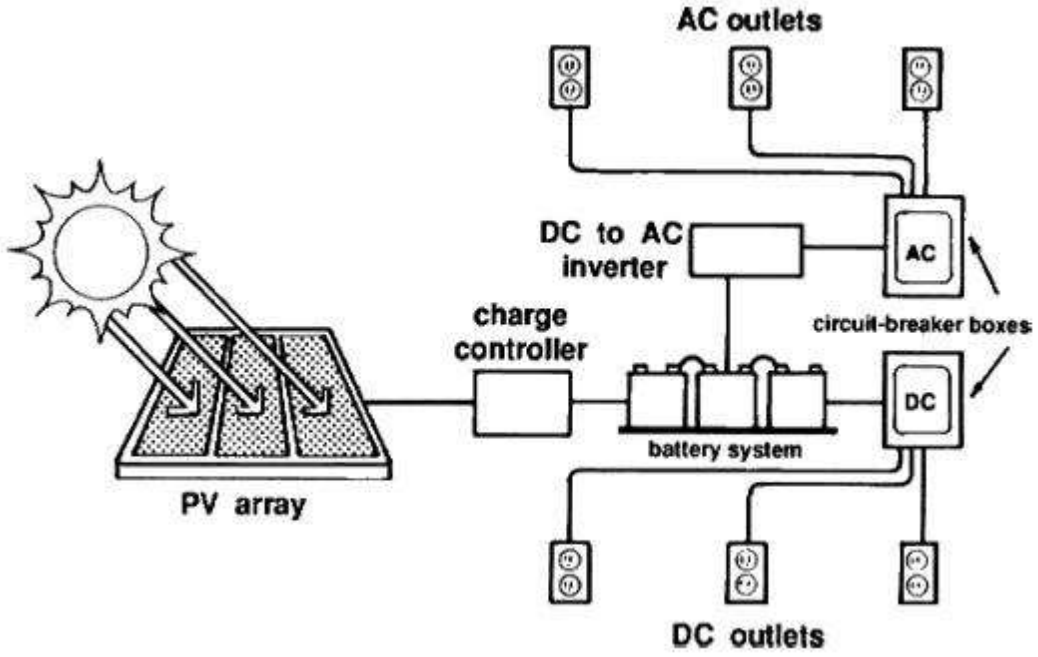

Figure 1: PV effect converts the energy of photons into ac & dc

Control Scheme

Through this section we will discuss about database used for this work, performance parameters, results and implementations. The Photovoltaic (PV) cell use in analysis the PV model and then simulate the PV model in MATLAB. Then output of the PV model is compared with the different temperature & insolation.

STATCOM

STATCOM is a type of shunt FACTS device, which employs power electronics devices such as Gate Turn Off, Insulated Gate Bipolar Transistors for regulating the power flow and stability of the electrical power system. STATCOM is an active and reactive power compensator. If we want to provide Active Power form STATCOM, Active Power side voltage and current both should be in phase. When injecting current from PCC (Point of common coupling) it must be in phase with supply voltage.

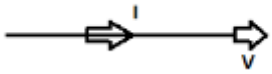

Figure2: In phase current & voltage.

If we want to get Reactive Power form STATCOM. Reactive Power side voltage and Injecting current should be perpendicular to each other. When injecting current form the STATCOM must be 90 shifted from the supply voltage.

Figure 3: Current & Voltage 90^0 shifted

STATCOM controller provides voltage support by absorbing and generating reactive power at the PCC without the need of more external capacitors or reactors storage.

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Simulation for PV

PV module (penal) is taken as the reference module for simulation data details are given in Table 1.

Voltage at Maximum power (Vmp)	40.1 V
Current at Maximum power (Imp)	9.01 A
Short circuit current (ISCr)	2.55 A
Total number of cells in series (Ns)	36
Total number of cells in parallel (Np)	1

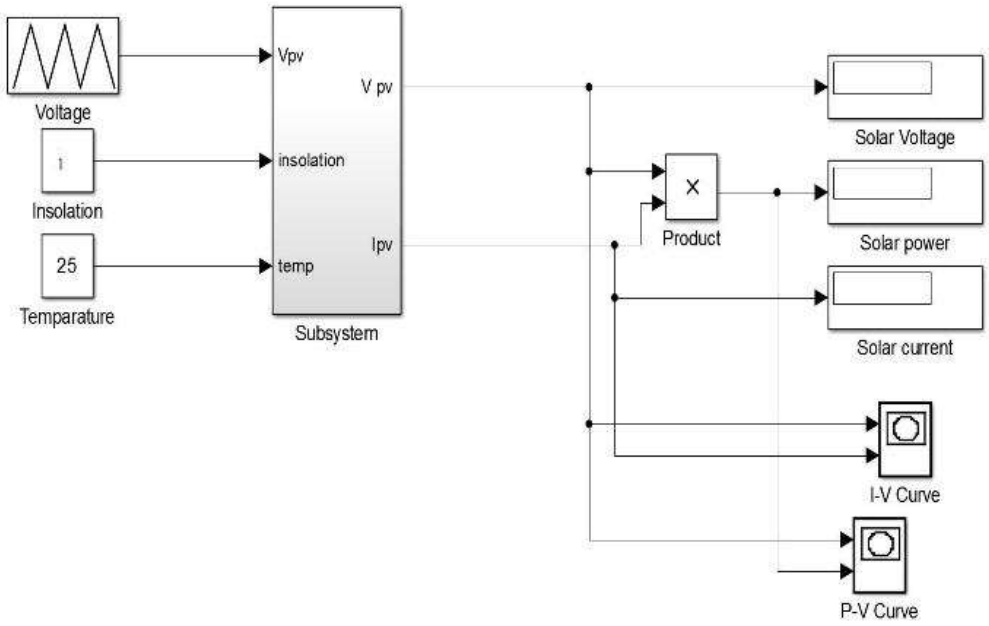

Figure 4: Simulink model of PV module

Simulation Results

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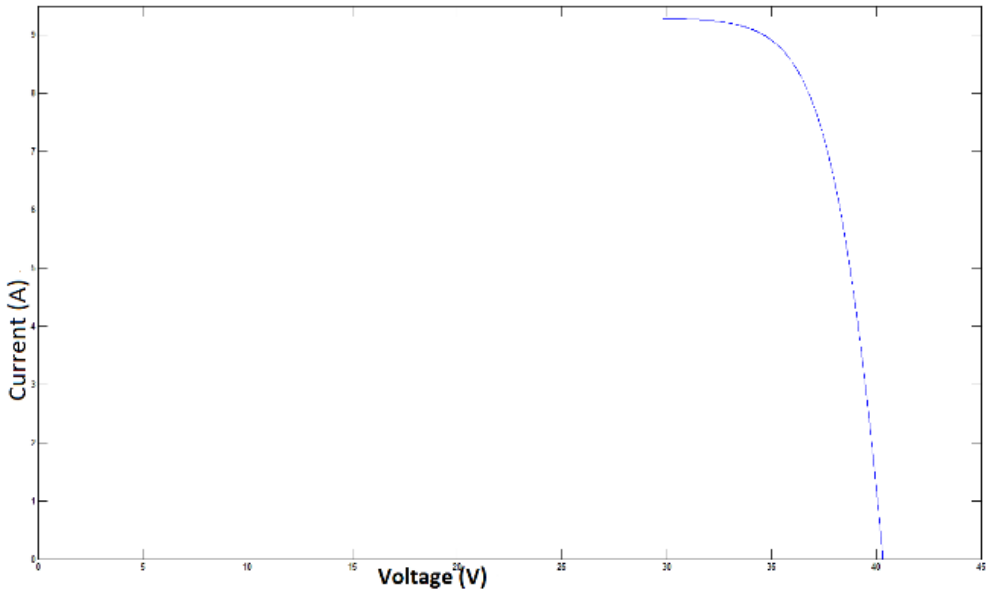

Figure 5: I-V Curve

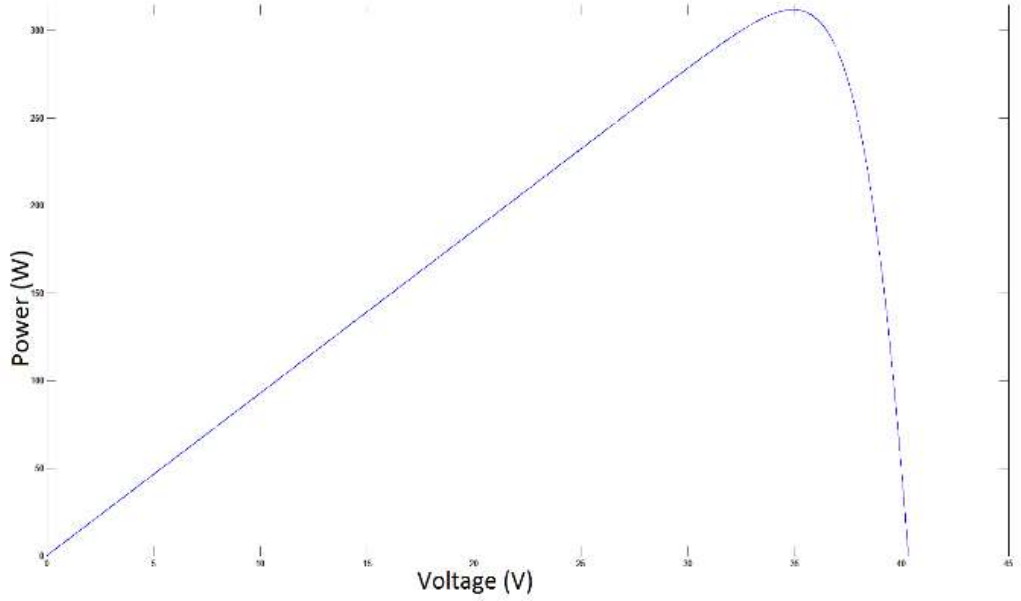

Figure 6: P-V Curve

In I-V curve when I_{sc} is maximum, at that time voltage is zero and when V_{oc} is maximum then at that time current is zero. In I-V curve any term current or voltage is zero that's why power will be zero. But in case of P-V curve when multiplication of current and voltage is done, we get maximum power at one point it is called maximum power point (MPP).

Simulation of complete system

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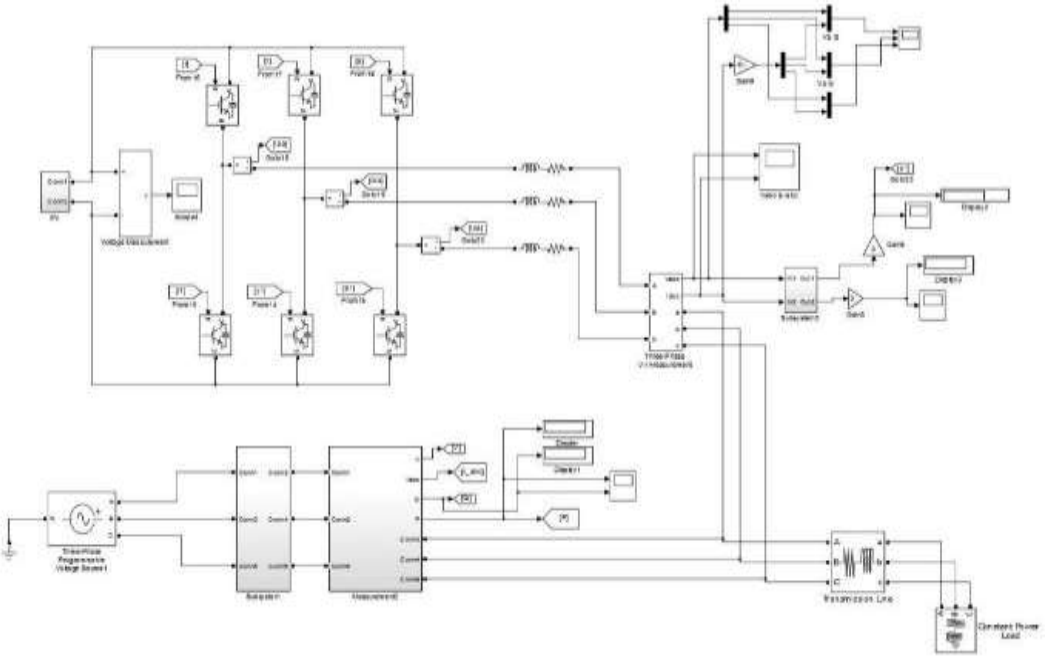

Figure 7: 415 v System for Active & Reactive Power with PV

415 v Result for Active Power

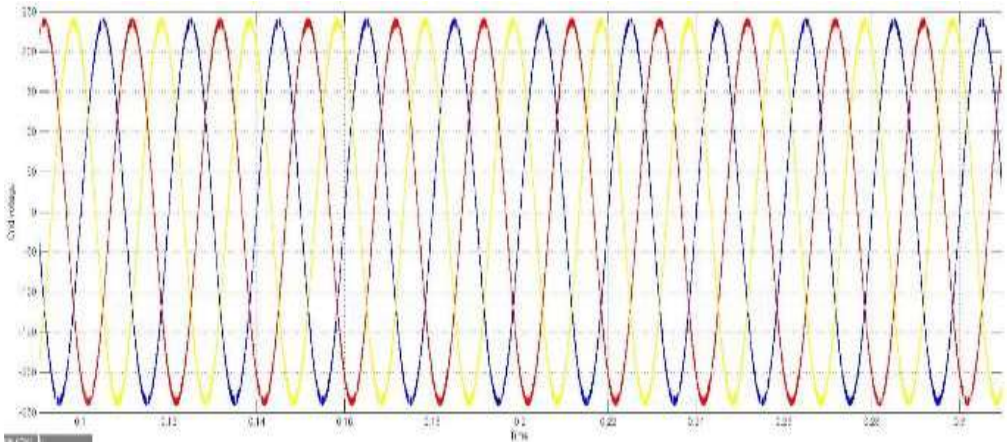

Figure 8: Grid Voltage

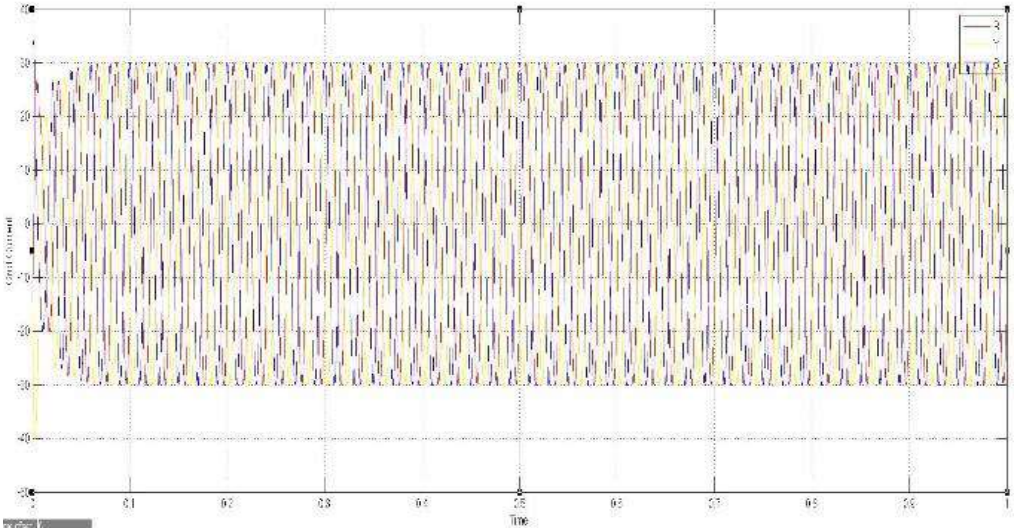

Figure 9: Grid Current

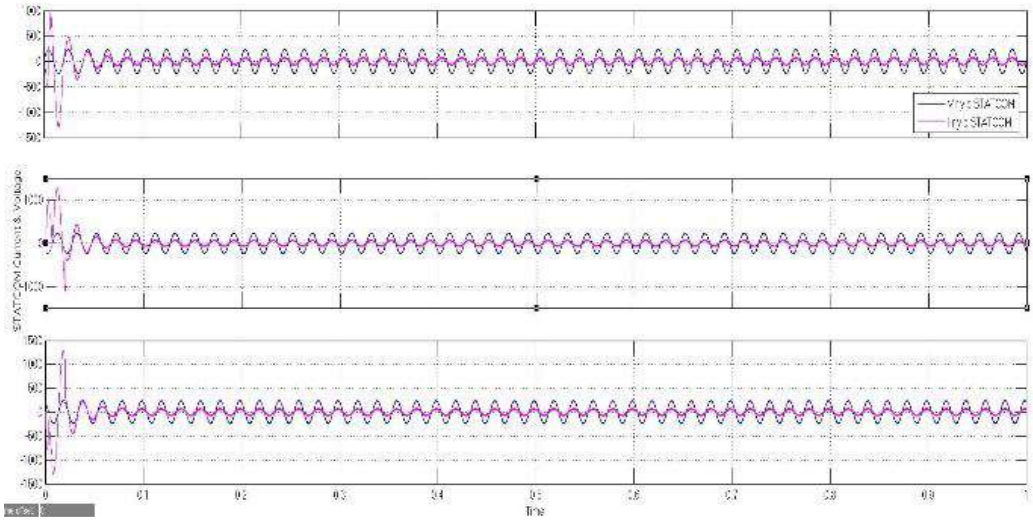

Figure 10: STATCOM Voltage & Current in Phase

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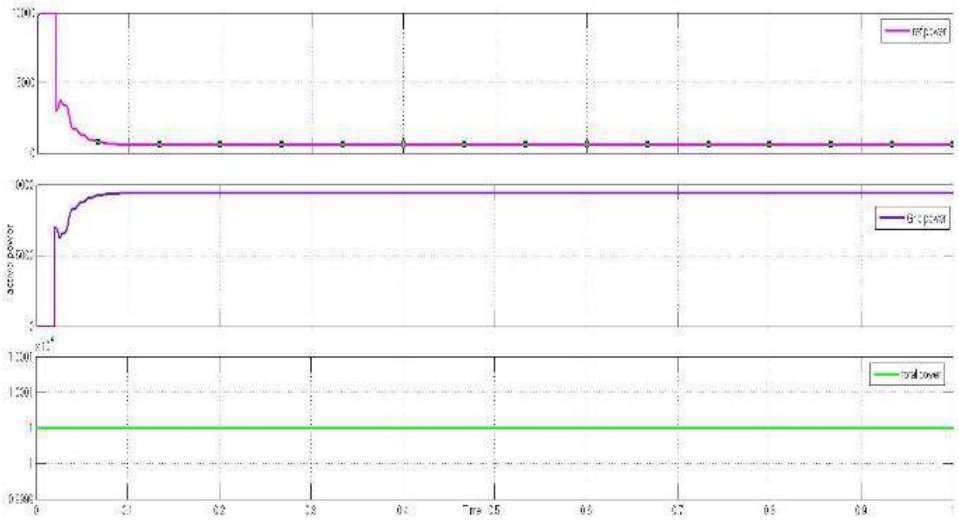

Figure 11: Active Power

415 v Result for Reactive Power

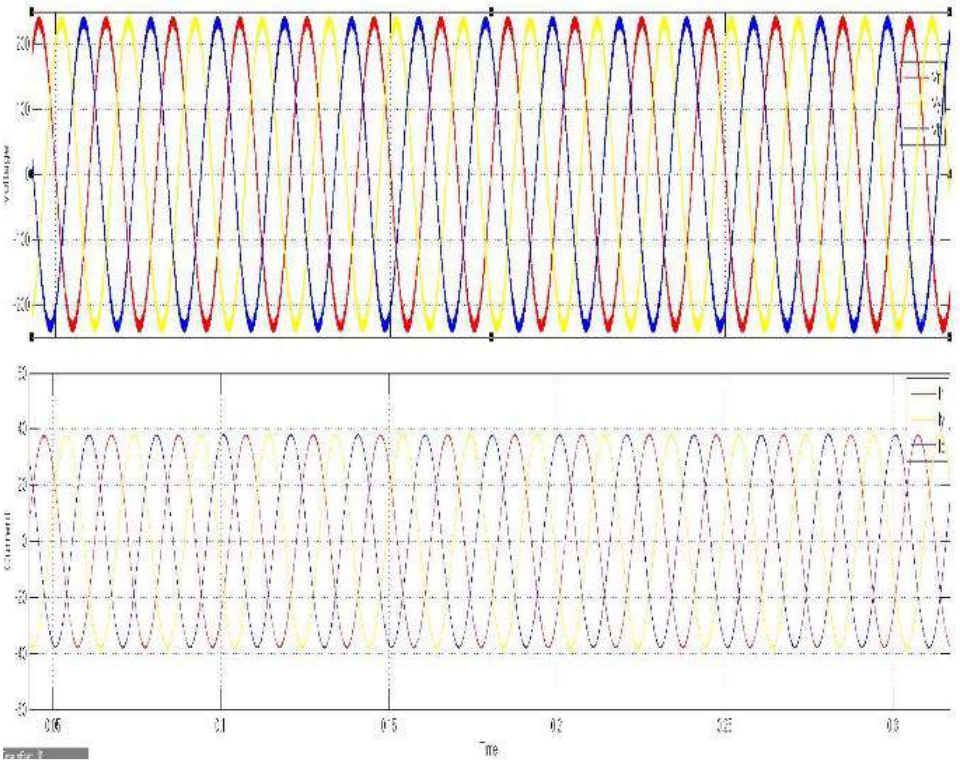

Figure 12: Grid Voltage & Current

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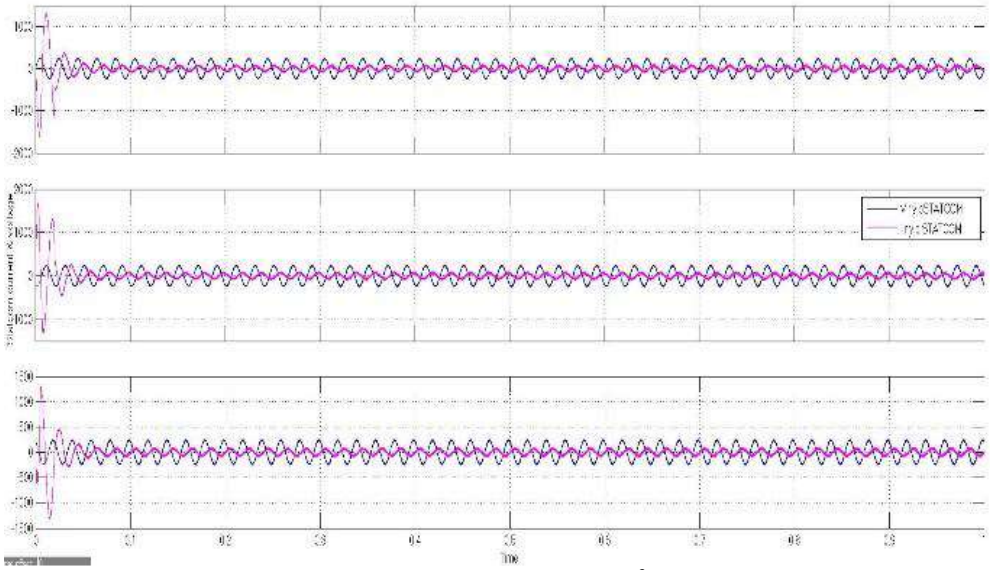

Figure 13: STATCOM Voltage & Current 90^0 apart to each other

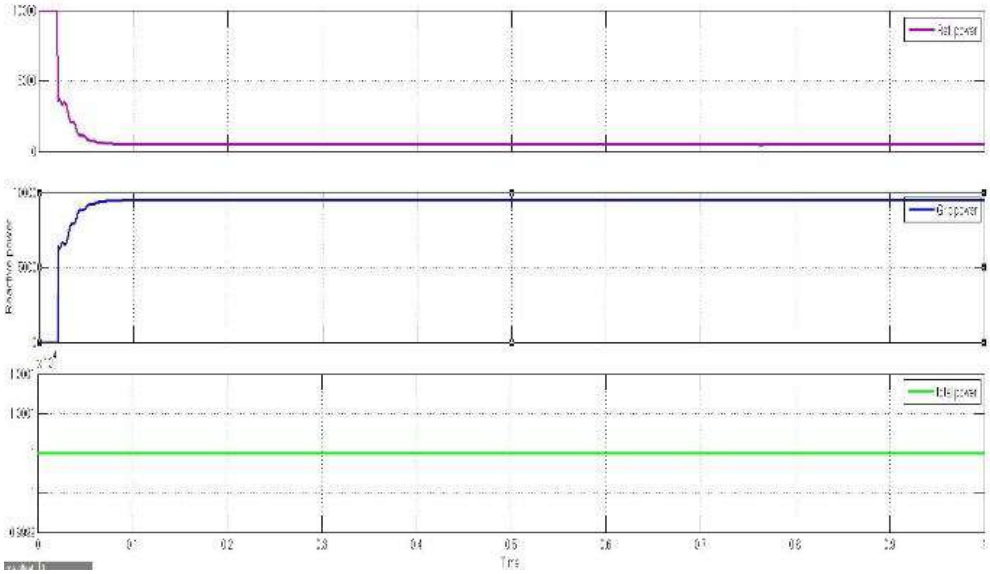

Figure 14: Reactive Power

CONCLUSION

The given grid integrated STATCOM system can supply the required deficit of reactive power into the grid for better stability purpose, efficiency as well as power factor. In this case STATCOM will inject current at 90 degree lagging with grid voltage

[1] As the injected current from the STATCOM is in phase with grid voltage that we can see from the MATLAB results. It proves that STATCOM can provide only active power to the grid for this simulation work.

[2] As the injected current from the STATCOM is 900 phase shift with the grid voltage that we can see from the MATLAB results. It proves that STATCOM can provide only reactive power to the grid for this simulation work.

[3] For supplying this active/reactive power STATCOM is supplied by the PV system.

REFERENCES

[1] Gunjan A. Patel, "Application of PV Solar System in Statcom to Regulate the Active & Reactive Power in the Distribution Network", Paper Presented in "International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 2015.
[2] Rajiv. K. Varma, Ehsan M. Siavashi, Byomakesh Das, and Vinay Sharma, "Novel application of a PV Solar Plant as STATCOM during Night and Day in a Distribution Utility Network: Part 2", Paper Presented in Panel Session on "FACTS/Power Electronics Installations" 2012 IEEE PES Power Systems Conference &Expo,May, 7- 10, Orlando, Florida, USA.
[3] Rajiv. K. Varma, Byomakesh Das, IurieAxente, and Tim Vanderheide, "Optimal 24-hr Utilization of a PV Solar System as STATCOM (PVSTATCOM) in a Distribution Network", Proc. IEEE PES GeneralMeeting, Detroit, USA, 2011.
[4] Rajiv. K. Varma, Shriram. S. Rangarajan, IurieAxente, and Vinay Sharma, "Novel application of a PV Solar Plant as STATCOM during Night and Day in a Distribution Utility Network", Paper Presented in Panel Session on "FACTS/Power Electronics Installations" 2011 IEEEPES Power Systems Conference & Expo, March 20-23, 2011, Phoenix, Arizona, USA.
[5] R. K. Varma and V. Khadkikar, "Utilization of a PV solar farm Inverter as STATCOM," U.S. Patent, Sep. 15, 2009.
[6] R.K. Varma, V. Khadkikar and R. Seethapathy, "Nighttime Application of PV Solar Farm as STATCOM to Regulate Grid Voltage," IEEETranson EnergyConversion (Letters), vol.24, no.4, pp.983-985, Dec.2009.
[7] INTERNATIONAL JOURNAL OF SCIENTIFIC & TECHNOLOGY RESEARCH VOLUME 3, ISSUE 8, AUGUST 2014 ISSN 2277-8616 33 IJSTR©2014 www.ijstr.org " Utilization Of PV Solar Farm As STATCOM During Night Hours In A Distribution Network" M. SaiEswarRao, K. Obulreddy
[8] M. Sai Eswar Rao, K. Obulreddy, " Utilization Of Pv Solar Farm As Statcom During Night Hours In A Distribution Network", International Journal Of Scientific & Technology Research Volume 3, Issue 8, August 2014
[9] S., R.K.Nema, and G.Agnihotri, "Matlab / simulink based study of photovoltaic cells / modules / array and their experimental verification," International Journal of Energy and Environment,
[10] M. H. Rashid "Power Electronics Handbook". London, U.K.: Academic (2010)