Transmission Line Reactive Power Stabilization using PV Solar Farm as STATCOM

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Abstract- This paper presents a new concept of utilizing a PhotoVoltaic (PV) solar farm converter as STATCOM, called PV-STATCOM, for improving stable power transfer limits of the interconnected transmission system. The whole converter rating of the PV solar farm, which remains torpid during night time, is utilized with voltage to enhance stable power transmission limits. During daytime, the converter capacity left after real power production is used to accomplish the stabilization of power transfer limits. The PV-STATCOM improves the stable transmission limits substantially during both day and night while generation of real power is high. Power transfer increases are demonstrated in the power system for a solar farm operating as PV-STATCOM. This new utilization of a PV solar farm asset can thus improve power transmission limits otherwise which would have required expensive additional equipment, such as series/shunt capacitors or separate FACTS controllers.

Keywords – PV-STATCOM, Power Stability, FACTS Controllers

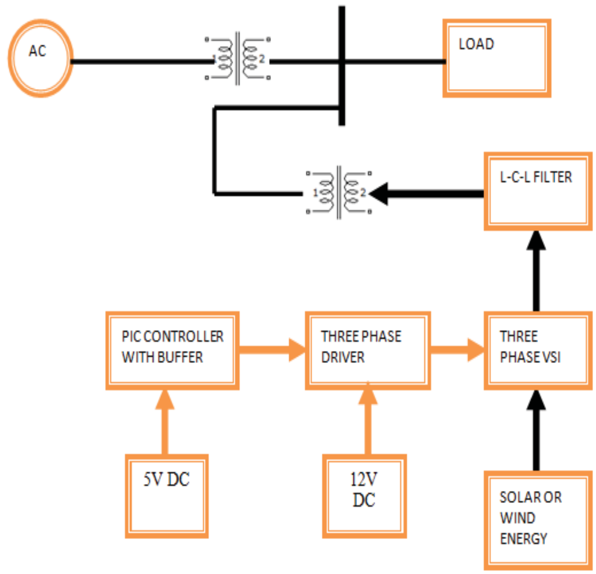
I. INTRODUCTION

Flexible AC Transmission System (FACTS) controllers are highly considered to increase the available power transfer limits/capacity of existing transmission lines universally. New analysis has been reviewed on the night time usage of a photovoltaic solar farm (when it is normally torpid) where a PV solar farm is utilized as a STATCOM–a FACTS controller, for achieving voltage control, thereby enhancing system performance and increasing grid connectivity of neighbouring solar farms. New voltage control has also been preferred on a PV solar farm to act as a STATCOM for improving the power transmission capacity. Even if, voltage-control functionality with PV systems have been proposed, none have utilized the PV system for power transfer limit improvement.

II. BLOCK DIAGRAM

A) EXISTING SYSTEM

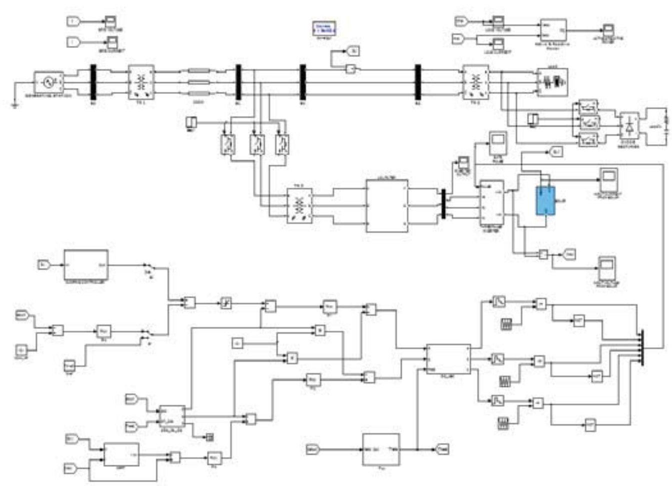
Generally FACTS is based on power-electronic controllers, which improve the value of transmission networks by increasing the use of their capacity. As these controllers operate efficiently, they increase the safe operating limits of a transmission system without risking stability. As the generation of the FACTS was triggered by the development of new solid-state electrical switching devices.. Gradually, the use of the FACTS has given rise to new controlling systems



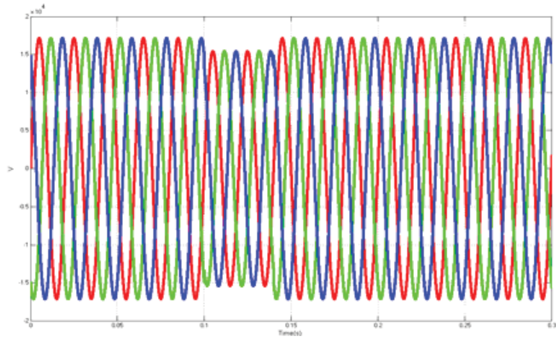
B) PROPOSED SYSTEM

This paper proposes novel voltage control, together with auxiliary damping technique for a grid-connected PV solar farm converter to act as a STATCOM both during night and day for increasing power transmission limit with transient stability. This technology of utilizing a PV solar farm as a STATCOM is called PV-STATCOM. It utilizes the entire solar farm converter capacity in the night and the remainder converter capacity after real power generation during the day. Similarly STATCOM control functionality can also be implemented in converter-based wind turbine generators during no-wind or partial wind scenarios for improving the transient stability in the system. Studies are performed for two variants of a single-machine infinite bus (SMIB) system. One system uses only a single PV solar farm as PV-STATCOM connected at the midpoint whereas the other system uses a combination of PV-STATCOM and another PV-STATCOM or an converter-based wind distributed generator (DG) with similar STATCOM functionality.

III. SIMULATION CIRCUIT DIAGRAM

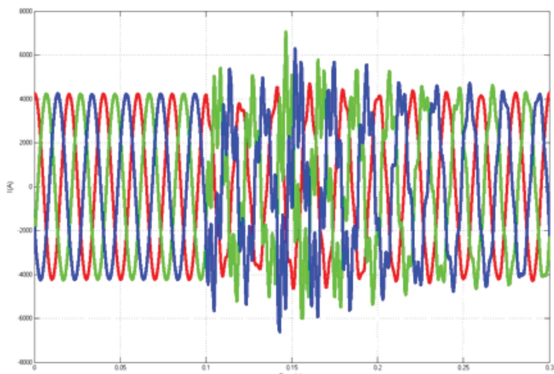


IV. RESULT

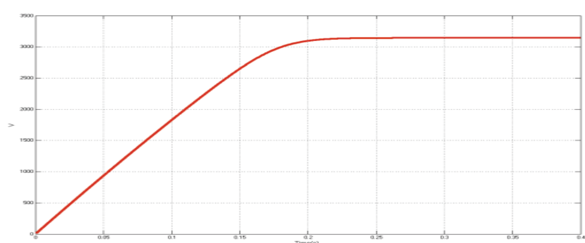


Grid voltage

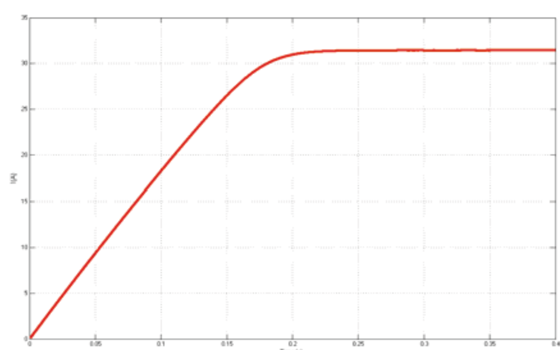
Above graph represents the sag created in the grid voltage. From 0 to 0.1 second no sag is developed hence voltage in the transmission line remains constant. When the load is represented in the simulation. the voltage is stabilized Then grid current represents the current variation when the load is injected. Simultaneously the current is inversely proportional to the voltage current. The magnitude of current is 400A such that when sag occurs the magnitude of the current gets increased. The reactive power is injected to stabilize the current.



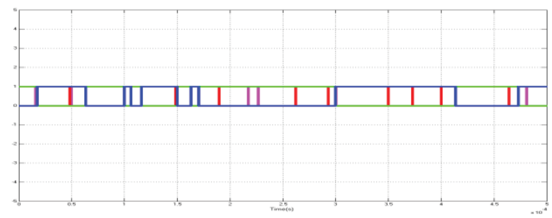
Grid Current



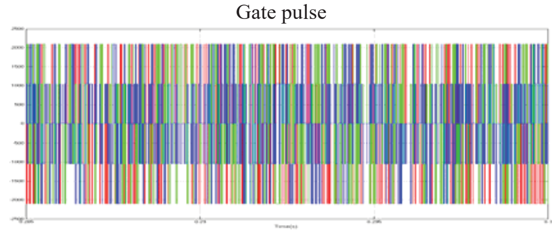
Input voltage from solar



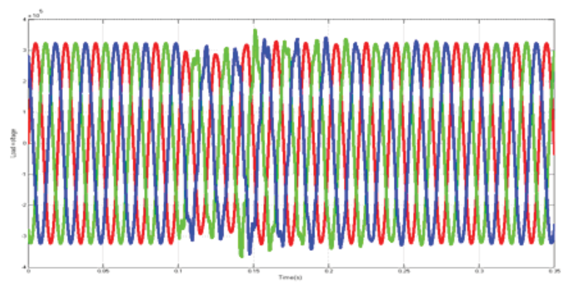
Input current from solar



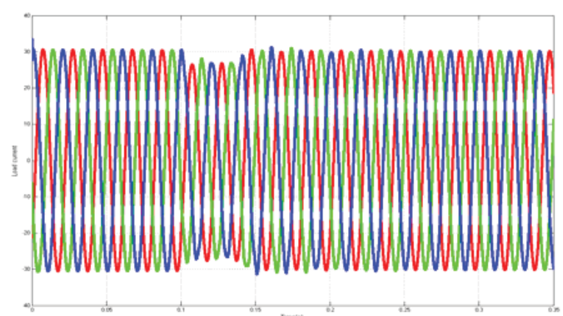
Gate pulse



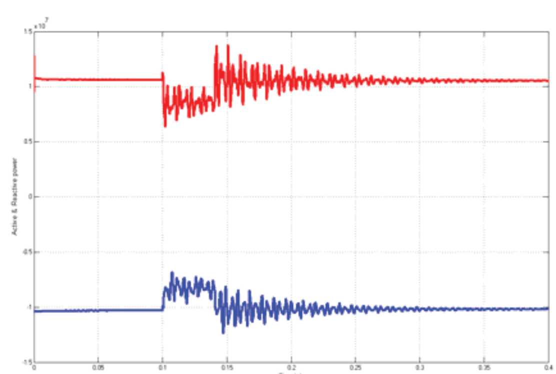
converter output



load voltage



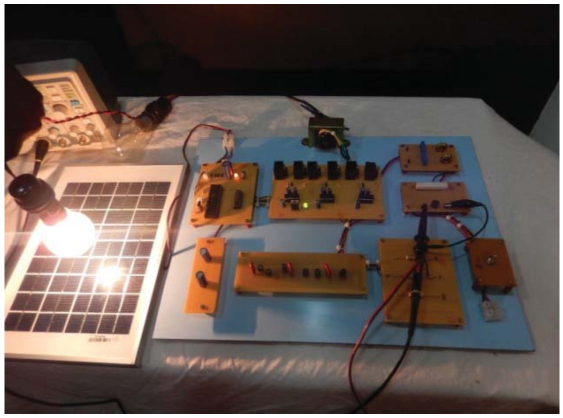
load curve



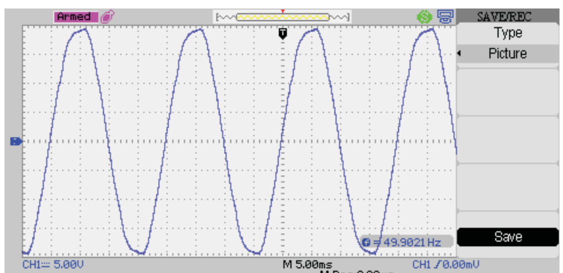
Active and reactive power

V. HARDWARE KIT

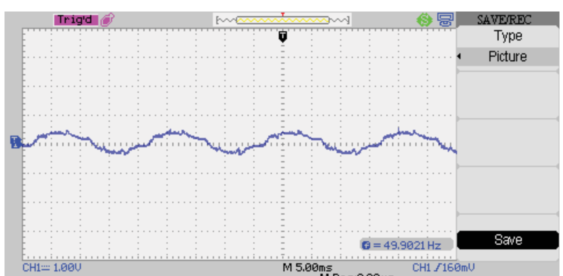
Active & reactive power Graph represents the Active and Reactive Power. The dip in the active power occurs when load is connected and the reactive power is injected to the system to compensate the sag created in the system



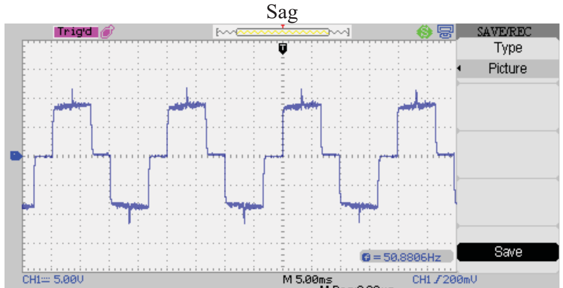
VI. WAVEFORM



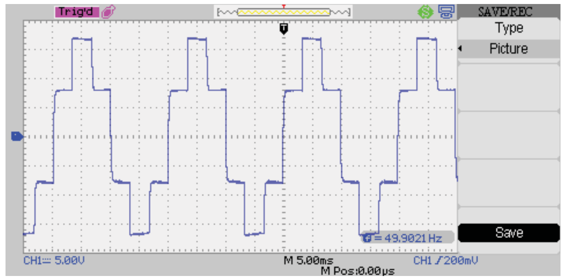
before sag



Sag



phase voltage



line voltage

VII. CONCLUSION

A new method of PV solar farm is presented where they can operate during the night as a STATCOM with full converter capacity and during the day with converter capacity remaining after real power generation, for providing significant improvements in the power transfer limits of transmission systems. This new control of PV solar system as STATCOM is called PV-STATCOM.

This project thus makes a strong case for relaxing the present grid codes to allow selected converter-based renewable generators (solar and wind) to exercise damping control, thereby increasing power transmission capability. This control on PV solar DGs (and converter-based wind DGs) will potentially reduce the need for investments in additional expensive devices.

The PV-STATCOM operation opens up a new opportunity for PV solar DGs to earn revenues in the night time and daytime in addition to that from the sale of real power during the day.

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