MODELLING AND SIMULATION OF FC-TCR FOR REACTIVE POWER COMPENSATION USING THE MATLAB/SIMULINK

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ABSTRACT

In this paper, discussion and demonstrate how SVC (Static VAR compensator) is used to improve reactive power and voltage profile. The modern system is complex. There are many static and dynamic devices included in the system. To increase the loading of the existing AC transmission system, Problem of Voltage flicker and voltage stability has become important subject in Power system. Better utilisation of existing power system capacities by installing new devices such as Flexible AC Transmission System (FACTs) has become very important. Here in this paper modelling of the FC-TCR are verified using the MATLAB/Simulink. First power flow results are obtained and power profile have been studied for an uncompensated transmission line then results are compared with the results obtained after compensating using the FC-TCR.

KEY WORDS:-*FACTS, Real and Reactive Power, FC-TCR, Voltage Flicker, Voltage Profile MATLAB/ Simulink, Thyristor controlled reactor.*

I. INTRODUCTION

With the power system growths and the increase in their complexities, many factors have become influential to the electric power generation and consumption. In recent years Voltage stability and Voltage regulations becomes a point of Attentions. The number of devices and electrical machines that absorbs the reactive power have been increased with either developments at technology or rising wealth levels in offices and houses. In power systems the load models are classified in the two categories: static and dynamic load models. The static load models are not dependent on the time; there for it describes the relation of the active and reactive power at any time with voltage and frequency and the same instant of time.

There are many reactive power compensation devices are used by the utilities for voltage stability. Each of which has own characteristics and limitations. However the utilities aims to achieve this with the most beneficial compensation devices. Usually placing adequate reactive power support at the weakest bus enhance the Static- Voltage stability margin. So, this can be done using the conventional Capacitors and Flexible AC transmission (FACTS) devices. The main objective of the Present paper is to discuss a new control method for SVC (FC-TCR) controllers for distribution system applications to achieve maximum power factor correction. The need for the tuned filter is to filter out the harmonics generated by the svc, and their effect on the svc controller design is also discussed.

Reactive power imbalance occurs when system is faulted, heavily loaded and voltage fluctuations is there. Reactive Power balance can be regained by connecting a device with the transmission line which can inject and absorb reactive Power based on the system requirements. Facts May be defined as power electronic based device which can absorb reactive power in a system as per requirements. This device allows "Flexible" operation of the AC system without stressing the system. The FACTs devices has a advantages as follows

- Improvement of the dynamic and transient stability.
- Voltage stability and security improvements.
- Less active and reactive Power loss
- Voltage and Power Profile Improvements

- Power Quality Managements
- Increasing Power flow Capability Through transmission line
- Voltage Regulations and Efficiency of power system operation improvements.
- Steady state Power Flow improvements, Voltage margin improvements, loss minimisation and line capacity, load ability of transmission line

This paper structured as follow: Section II represent basic function of FC-TCR (fixed capacitor – thyristor controlled reactor), Section III shows modelling and simulation of FC – TCR, Simulation and waveforms are represented in section IV, Section V gives conclusion, Future scope is discussed in section VI.

II. FC-TCR (FIXED CAPACITOR- THYRISTOR CONTROLLED REACTOR)

The TCR continuously provides controllable reactive power only in the lagging power factor range. To extend dynamic controllable range to the leading power-factor range, a fixed capacitor bank in shunt with the TCR.

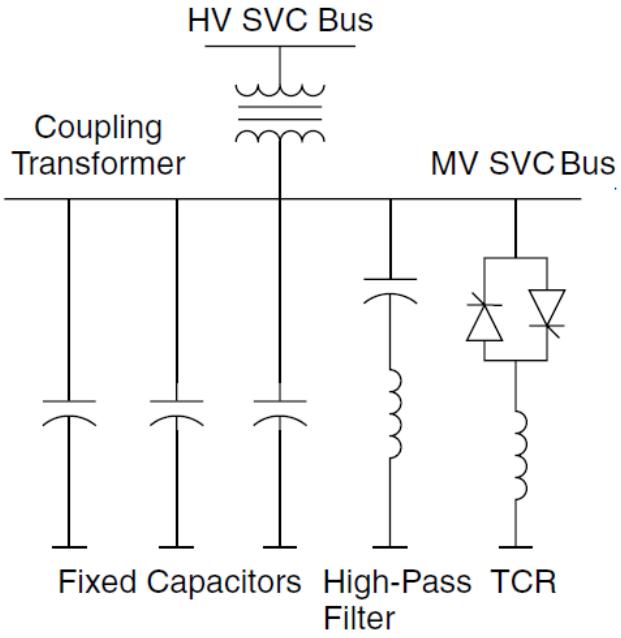

Figure 1. Basic Circuit of FC-TCR

The TCR MVA is rated higher than the fixed capacitor to compensate the capacitive MVA and Provide net inductive –reactive power should a lagging power factor operation be desired. The Fixed capacitor bank is usually connected in star configuration are split into more than one 3-phase group. Each capacitor contains a small tuning inductor that is connected in series and tunes the branch to act as a filter for a specific harmonic order. For instance, one capacitor group is tuned to the 5^{th} harmonic and another to the 7^{th} harmonic where as yet another is designed to act as a high pass filter. At Fundamental frequency the tunning reactors slightly reduces the net MVA rating of the fixed capacitors. FC-TCR Compensator is shown in figure1.

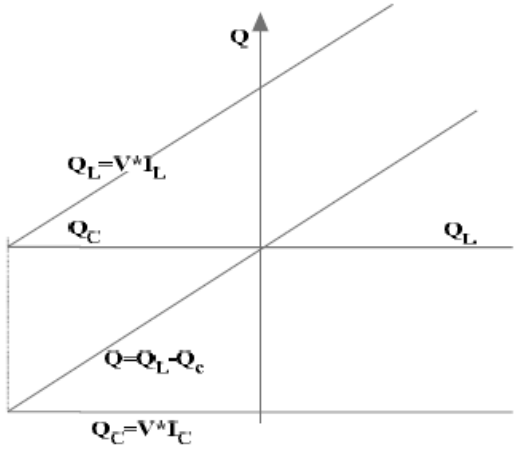

Figure2. Reactive demand Vs Reactive Supply Characteristics

To decrease the capacitive output, the current in the reactor is increased by decreasing delay angle α. At zero VAR output, the capacitive and inductive currents become equal and thus both the VARs cancel out. With further decrease of angle α, the inductive current becomes larger than the capacitive current ,resulting in a net inductive output.

III. MODELLING AND SIMULATION

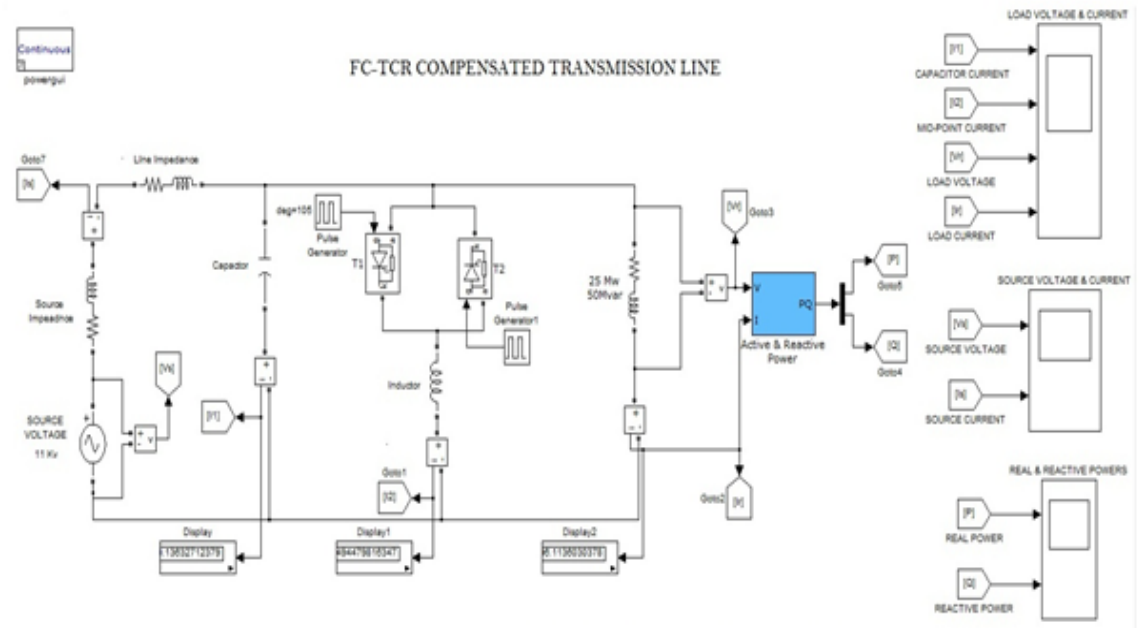

Figure 3. MATLAB Simulink Model of FC-TCR

For the AC voltage source is of 11KV, 60 Hz, Source impedance 1+j0.01, line R=1 Ω&L= 10mH,For measurement of instantaneous current flowing in the transmission line, Current measurement block is used. For measurement of source voltage, voltage measurement block is used. Scope displays the signals generated during a simulation. Scope is used to view the line current and line voltage. The real power and reactive power in the load is measured using the Active & Reactive Power measurement block. Here we keep the inductor value constant and try to vary the reactive Power with different values of the reactive power.

IV. SIMULATION WAVEFORM

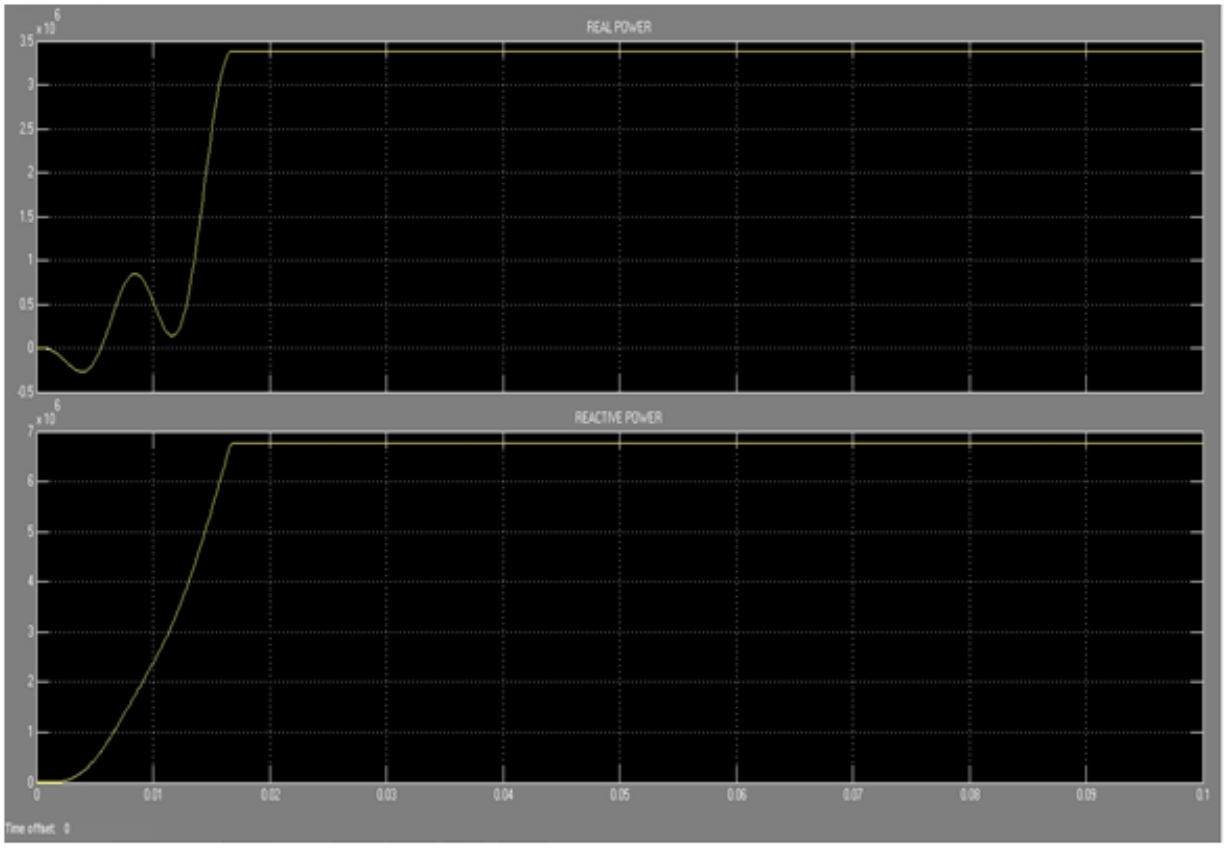

Figure 4. Real power & reactive power

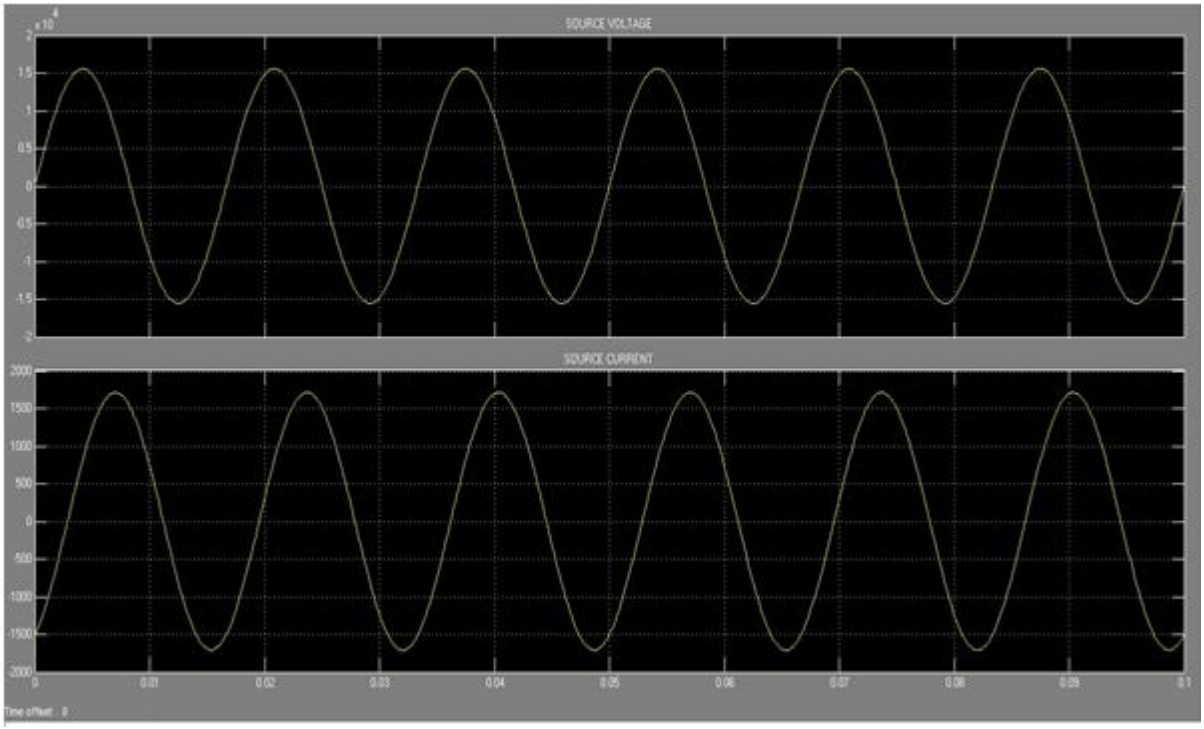

Figure 5. Source Voltage & Source Current

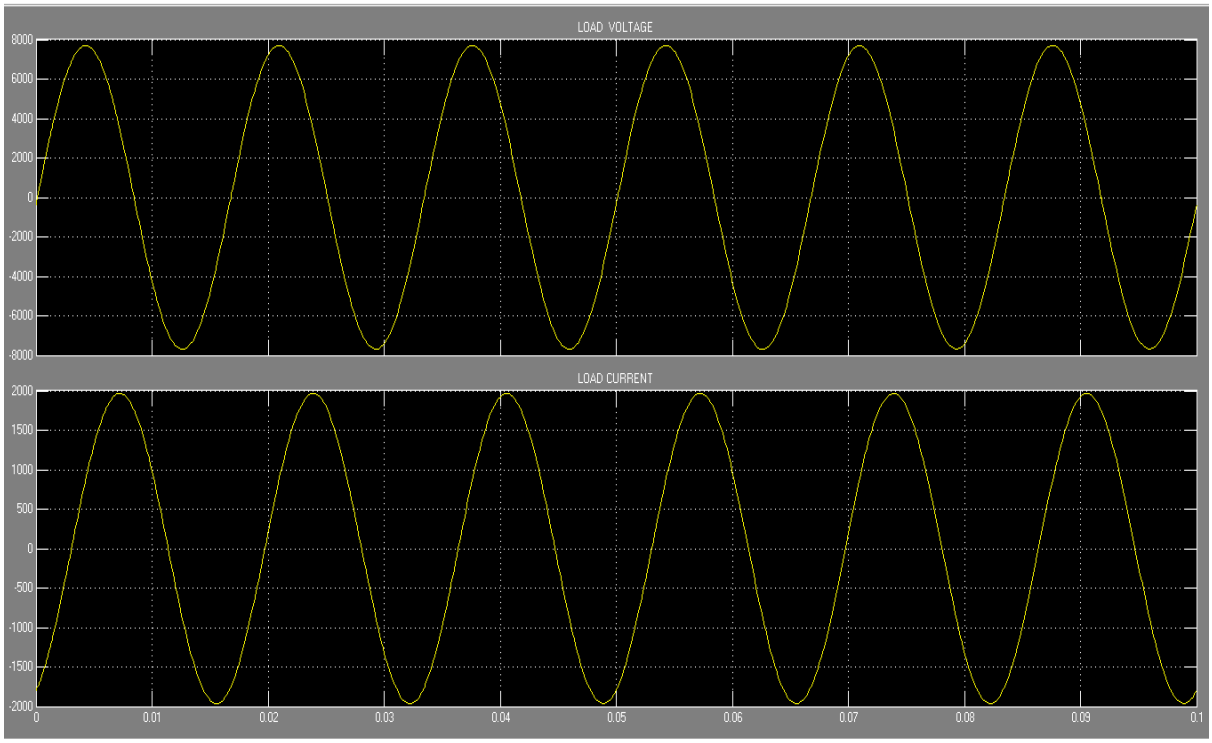

Figure 6. Load Voltage & Load Current

V. CONCLUSION

Hence it is concluded that FC-TCR will successfully control the voltage regulation and dynamic performance of power system. The changes of reactive power with the variation in the firing angle are shown. The range of reactive power control can be increased by FC-TCR. The variation of

reactive power is smoother by using FC-TCR system. From the results we can conclude that if capacitor value is constant and vary the value of inductor then reactive power is increasing and we can also conclude that if we increase firing angle current through TCR decreases with increase of firing angle thereby increasing the Reactive Power output. This shows that reactive power is compensated and that improve power system stability.

VI. FUTURE SCOPE

Here in this paper we just try to show that in today's world we need continuous energy so for that FACTS device has more importance. So we have derived many results from over Simulink model. If anybody wants to work more in this area than here some suggestions are given by us.

- Here FC-TCR is considered; try to show more effective results with other FACTS devices.
- Here MATLAB/Simulink is used try to get results with PSCAD or any other software
- Try to Compliance with implement with industrial problems.

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BIOGRAPHY

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