

Analysis of Voltage Profile Enhancement Using FC-TCR in Power System

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Abstract: This paper discuss and demonstrate how Static Var Compensator(SVC) FC-TCR has been applied to control transmission system dynamic performance for system disturbance and effectively regulate system voltage. Power switches are use like GTO,MOSFET .SVC type are TCR,TSR,TSC and FC-TCR. Better utilisation of existing power system capacities by installing new devices such as Flexible AC Transmission system(FACTS) has become very important.SVC is the type of FACTS devices .The necessary modelling and simulation of static var compensator for power system stability and improvement of power flow capability studied .Power flow studied for sag which describe a short duration voltage decrease. This voltage sag eliminate by using FC in system. Swell means voltage rise in the system. This voltage swell eliminate by using TCR in system. The necessary Modelling and Simulations are carried out in MATLAB environment using simulink and power system block set tool boxes. A methodology for determining the power flow margin is simply briefed.

Keywords: Flexible AC Transmission Systems (FACTS), Static Var compensator (SVC) ,FC-TCR(Fixed capacitor thyristor controlled reactor), Voltage Sag, Voltage Swell Voltage Profile , Matrix laboratory (MATLAB).

1. Introduction

FACTS Technology is becoming more and more popular due to improvement in Power Electronic Technology and reduction in costs. Several FACTS controllers for shunt, series or both shunt & series compensation are now operating in power systems around the world. FACTS controller can control the power flow as required [1]. 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 Attention. The number of devices and electrical machines that absorbs the reactive power has 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. The main objective of the present paper is to study a new control method for SVC (FC-TCR) controllers for transmission system to achieve better improvement in voltage.. 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 aim to achieve this with the most beneficial compensation devices. Usually placing adequate reactive power support at the weakest bus enhances the Static- Voltage stability margin. So, this can be done using the conventional Capacitors and Flexible AC transmission (FACTS) devices. Facts May be defined as power electronic based device which can absorb reactive power in a system as per requirements [2]. The FACTS devices have 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 Improvement.

2. Basic Operation of FC-TCR

The circuit of FC-TCR is shown in fig 1.TheFC-TCR is use. Fixed capacitor is to reduce the voltage drop due to this voltage profile increases. Therefore fixed value of capacitance is added in transmission line [3].

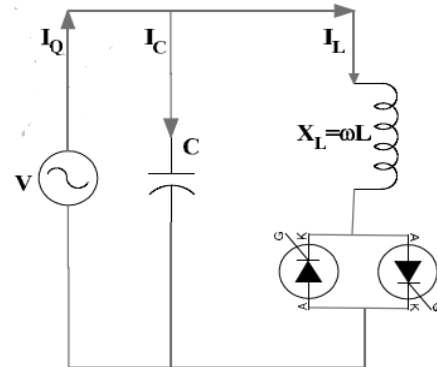


Figure 1: Circuit of FC-TCR

It also consist of thyristor controlled reactor some time known as thyristor switched reactor. A shunt connected, thyristor controlled inductor whose effective reactance is varied in a continues manner by partial conduction control of the tyristor.TCR is subset of svc in which conduction time and hence ,current in a shunt reactor is controlled by thyristor based ac switch with firing angle control.[12]

3. Modeling of Basic System

Fig.2 shows the modeling of basic system. Modeling has been done using 11kv transmission line connected with two constant bus voltage . Fixed load is use in the system.sag creation is done by Programmable voltage source.

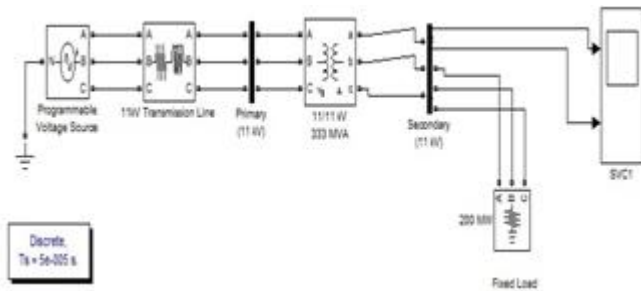


Figure 2: Modeling of basic system

4. Modeling of FC-TCR

Fig.2 Shows the modeling of FC-TCR in which Fixed capacitor is providing necessary voltage to eliminate the sag present in the system. Sag means deep voltage fluctuation at any instant time.

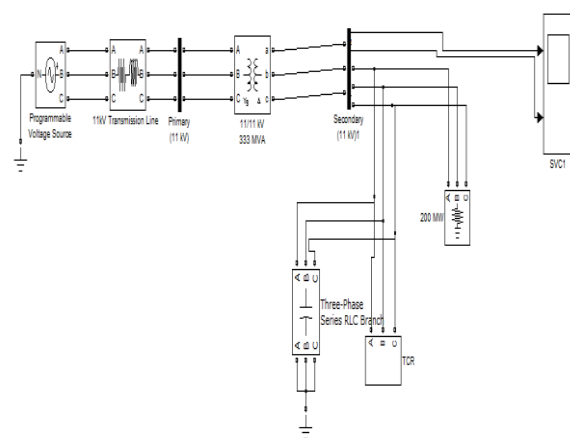


Figure 3: Modeling of FC-TCR

Due to heavy intermittent load disturbances in grid side. The voltage swell or shoot up for some finite period. Voltage rise is leading to capacitive effect in system. To counterpart we should add inductance Thyristor controlled reactor is providing by varying the firing angle to eliminate the swell present in the system. MATLAB studied for sag and swell elimination is given in different cases.

5. Test cases and Simulation Analysis

CASE 1: Sag and Swell in system

Fig 4 shows the sag and swell in system by using Matlab simulation. Sag describes a short duration voltage decrease. Swell describes a sudden rise in voltage. sag and swell are transients in power system .sag present in system for 0.7 sec to 0.9 sec .swell present in the system for 0.9 sec to 1 sec. sag and swell creates due to programmable voltage source shown in fig 2.

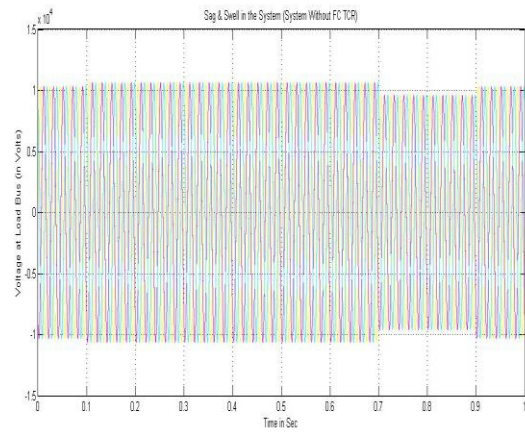


Figure 4: Sag and swell in system

CASE 2: FC-TCR Firing angle

Fig 5 shows the result of firing angle which is given for FC-TCR. The variation of TCR firing angle alpha has been shown by using mathematical modeling of FC-TCR.

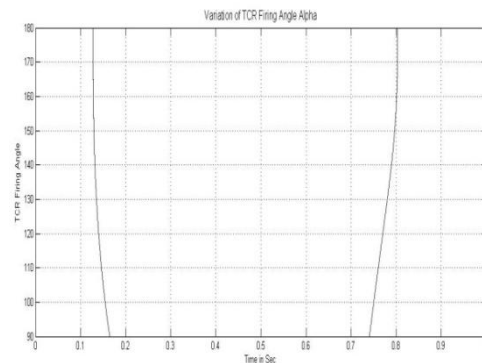


Figure 5: FC-TCR Firing angle

CASE 3: Sag and Swell elimination in system

Fig 6 shows the sag and swell elimination in system. Sag and swell eliminate by connecting FC-TCR in System. We have to compensate the Fig 3.by using svc system so that we get the actual voltage profile. so the fig 5 shows the result that this device can improve and maintain the voltage profile constant so that the system may not collapse for the small duration at which the transient will occur. FC-TCR is connected in parallel to the system to compensate the transients or sag of the system. swell must also have to remove for better power quality.

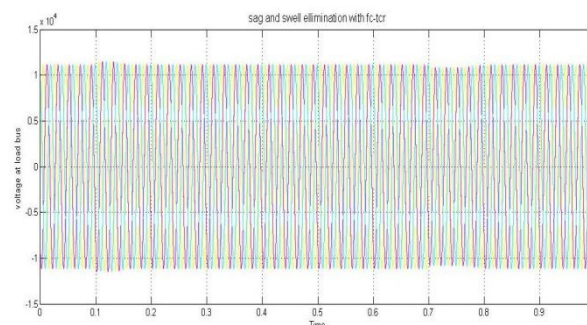


Figure 6: Sag and swell elimination in system

CASE 4: FFT Analysis without FC-TCR

Fig 7 shows FFT analysis without FC-TCR. FFT is the fast Fourier transform converts waveform data in the time domain into the frequency domain. The FFT accomplishes

this by breaking down the original time based waveform into series of sinusoidal terms ,each with unique magnitude, frequency, and phase.FFT analysis without FC-TCR gives the result is that increase in THD level .

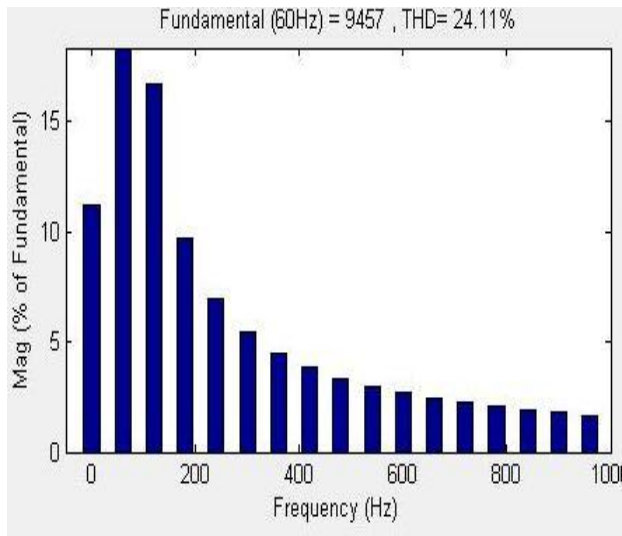


Figure7: FFT analysis without FC-TCR

CASE 5: FFT analysis with FC-TCR

Fig 8 .shows the result for FFT analysis with FC-TCR. When FC-TCR taken in consideration then effect on THD level change that means total harmonic distortion is going to reduce and result are shown as below.

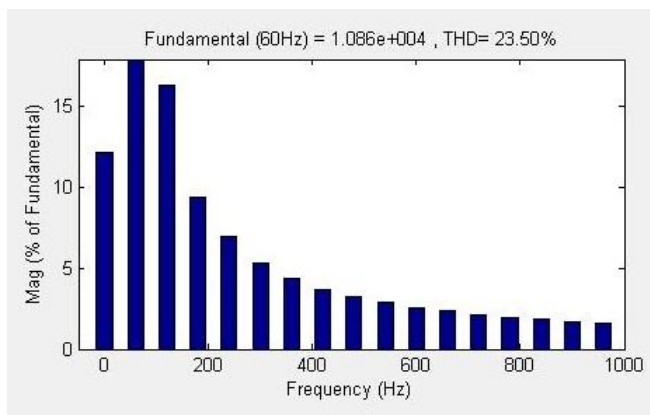


Figure 8: FFT analysis with FC-TCR

6. Conclusion

From the above simulation we conclude that SVC is able to compensate the voltage sag and swell. It also increases the power transmission capability. The simulation results indicated a considerable increase in power flow limit by svc compensation. Study on voltage swell elimination is also studied. It can be study for the most effective way of increasing the power flow limit. In addition to this effect on THD level in the system current after the introduction of FC-TCR is to be studied.

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