ISSN 2349-0292
Impact Factor 2.675

GLOBAL JOURNAL OF ADVANCED ENGINEERING TECHNOLOGIES AND SCIENCES

IMPROVING THE PERFORMANCE OF POWER SYSTEM STABILITY OF THYRISTOR CONTROLLED SERIES CAPACITOR CONTROLLER IN NIGERIA USING FACT METHOD

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ABSTRACT

Thyristor can be defined as a dynamic flow state and steady state stability as two to four lead solid state semiconductor device with four layers of an alternating materials such as N and P type materials. Thyristor find itself in a relatively amount of application such as power and voltage with small devices, control of electric power ranging from light dimmer and electric motor speed control to a high voltage direct current power transmission. In this paper, the design for both dynamic and steady state stability is proposed and completes analysis is presented of various measurements.

KEYWORDS: Forwarding Blocking, mode reverse blocking mode.

INTRODUCTION

In Nigeria today, the engineers and scientist have come to understand the potential benefit of the using flexible alternating current transmission systems controllers in optimization of power system. Stability because the need for higher transmission is a world during motivation in dynamic and steady state stability as required having a high performance quality standard provided good power and transmitting improved utilization. Moreover, various control techniques and designs have been proposed for damping power oscillation to improved system response in a dynamic and steady application of Thyristor Controlled Series Capacitor (TCSC) [1]. The major interest of users and researchers has been the use of this controller for power flow control in transmitting line and distribution lines usually considering the optimization scheduling methods [2]. To fully understand and property utilize these type of controller, a number of control tasks for both dynamic and steady state system improvement must be jointly considered because most of the available technical literature in thyristors Controlled series capacitor usually deals with steady state and dynamic control and application independently[3]. The major challenges of thyristor has been alternation, loss cooling, improper pressure, level control temperature handling, loose of gate terminal connection or terminal board has been the biggest challenges faced by thyristors in transmission line system [4]. These challenges come about from this imperfect nature of the transmission channel. However, each attempt to mitigate these problem from further occurring results to complexity of the while design and therefore create more problems [5]. In order to proffer a solution to this existing problems, turning of the control parameters is mainly carried out via MATLAB simulation of severe fault condition to compacts the major fault and this can also be achieved using fact method.

FORWARDING BLOCKING MODE

In this, voltages is applied in the direction that would cause diode to conduct to conduct but thyristor has not be triggered into conduction and will remain conducting until the forward current drops below threshold values also known as the holding current.

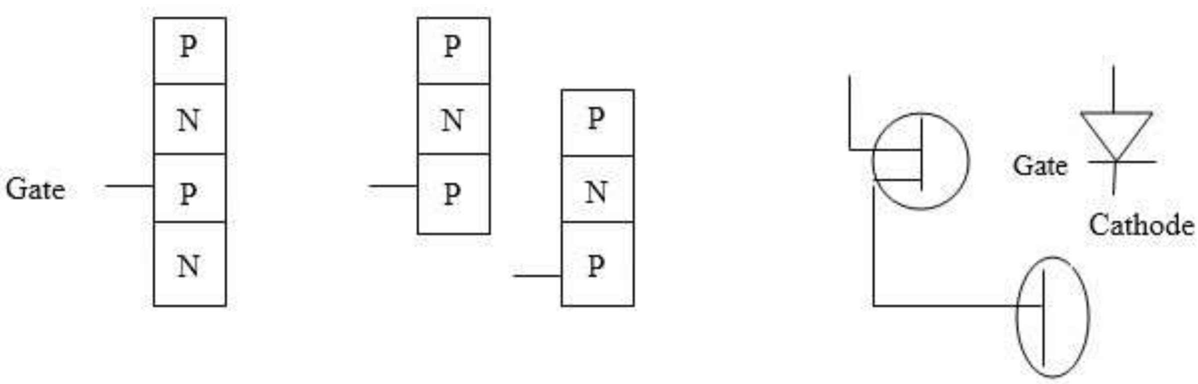

Fig 1: Presents the physical, electronic level and thyristor symbol.

The External Control Design

In the particular case of proportional integral derivatives power flow control, a protection logic scheme may be implemented to avoid contradictory control signal that would degrade the overall controller performance, the power control is assigned to be disabled after large disturbance keeping Xeo at a fixed value during severe transit. If the systems is subjected to a severe disturbance, the system control hoop must provide maximum compensation level during the immediate post fault period so that the synchronizing torque is increased to optimize the first swing stability of the system.

Reverse Blocking Mode

In this mode, voltage is applied in the direction that would be blocked by a diode unlike the forward blocking mode that voltage would be applied in the direction applied in the direction that causes a diode to conduct/but the thyristor would not been triggered into conduction.

MATERIAL/DESIGN AND IMPLEMENTATION

$$P = \frac{E_1 V_S}{X - X_e} \sin(\delta) \quad - \; - \; - \; - \; - \; - \; - \quad (1)$$

X is the equivalent reactance of the transmission link without the compensator including the reactance of the transformer and the line as well as the generators transient reactance, E_1 is the constant transient electromotive force of the generator and δ is the internal generator phase angle. Assuming in the signal machine infinite bus that a system of a three phase fault is applied and their cleaned at the generator terminals, the prefault equivalent impedance are the same and if the classical machine model is used and the resistance of the network is neglected the generator real power can be expressed in equation one above. Neglecting the thyristor controlled series capacitors first order lag association with natural response of the controller, the thyristor controller series capacitor equivalent impedance is by Xe = Xeo + Xm, the magnitude of the line current is given by.

$$1 = \frac{1}{X - X_e} \sqrt{E'^2 + V_S^2 - 2E'VS \cos(\delta)} \quad - \; - \; - \; - \; - \; - \quad (2)$$

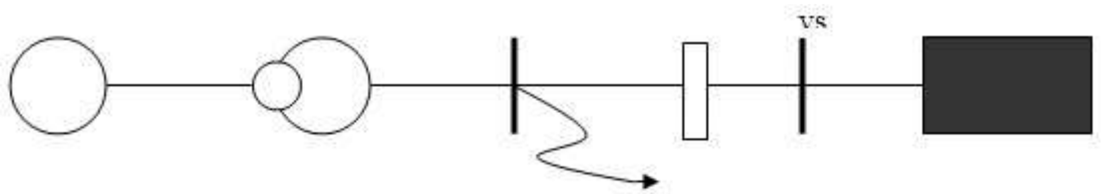

Fig. 2 Single Machine- Infinite bus system example

For simplicity, it is assumed here that the stability control is comprised of a pure derivatives block and constant gain Kc. Hence, denoting the input signal signal as T (representing either p or 1) the controlled reactance may be define as;

$$Xm(t) = Kc \frac{dy(t)}{Dt} \quad - \; - \; - \; - \; - \; - \; - \; - \quad (3)$$

If the sensitivity of t with respect to the net transmission reactance (x-xe) is neglected in both equation 1 and 2, the derivative of the input signal t can be expressed as follows;

$$\frac{dy(t)}{dt} = \frac{dy}{d\delta dt} = \frac{dy}{d\delta} DW \quad - \; - \; - \; - \; - \; - \; - \; - \quad (4)$$

Thus for a any given derivation DW, the value of control reactance xm, the control output is determined by the value of the partial derivative dy/dδ when the line active powere p is t he input signal, dy/dδ is the largest at δ = 0 and decreases as δ approaches 90^0 becomes zero at δ = 90^0 turning for δ > 90^0. This indicates that for δ values near 90^0, when the control should provide the largest possible compensation since p is at maximum value, xm is practically zero and hence ineffective.

DATA PRESENTATION ANALYSIS AND RESULT

Power System Tool box (PST) was used here for all time domain simulation, eigenvalue calculation and mode observability analysis. This is a MATLAB based power system analyze power systems using user defined models.

ISSN 2349-0292
Impact Factor 2.675

It has a several graphical tools, such as voltage stability tool and a small signal stability tools. The model for Thyristor Controlled Series Capacitor (TCSC) and other controller device are included into the tool box by user defined modules:

Table 1: Eigen value and mode observability

LINE OUT	MODE	DAMPING RATIO	FREQUENCY	1 OBS	P OBS
None	1	0.070	0.606	0.824	0.855
	2	0.046	0.711	0.861	0.877
Line B	1	0.011	0.480	0.823	0.298
	2	0.080	0.684	0.809	0.279

For the purpose of this paper, the following thyristor controlled series capacitor is assumed to be installed at the midpoint of line A.

The capacitor fundamental frequency reactance at 50HZ is Xc = 39η
The thyristor controlled series capacitor ratio rc= xc/KL is assumed to be rc = 10 (XL is the fundamental frequency impedance of the thyistor controlled series capacitor which yields a responant point at ar = 150.
The firing angle limits are assumed to be a_{max} = 180^0 a_{min} = 1550 which corresponds to limits in the thyristor controlled series capacitor equenance capacitive reactance of X_{emin} = 39η, and X_{max} = 96.4η. the set point for simulation is Xeo = 58η (a_0 = 158.6^0) which corresponds to a compensation level of 4

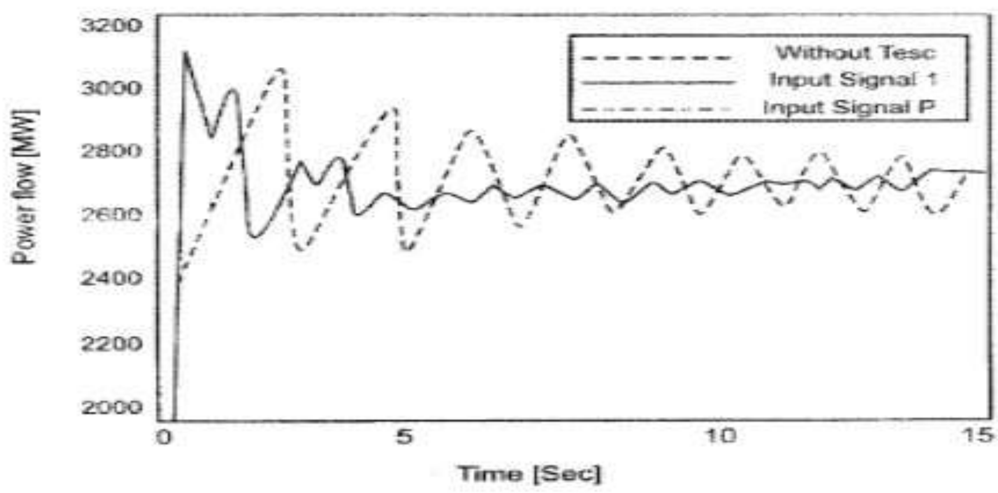

Fig: 9. Power flow variation on Line A. Case 1

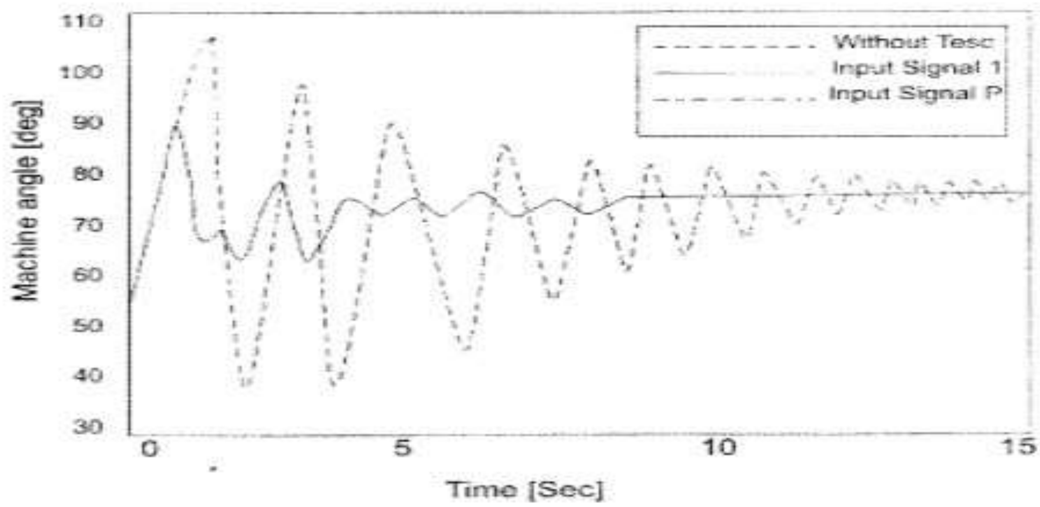

Fig. 10 Machine angle variations Case 1

ISSN 2349-0292
Impact Factor 2.675

CONCLUSION

This paper presents some of the fundamental aspect of proper schematic diagram. The limitation of using linear control techniques for controller design are also discussed at some length and illustrate detail by studying the effect of large disturbance in a realistic power system networks. A detailed analysis of thyistor controller series capacitor performance for improving the performance of power system stability of thyristor controlled series capacitor in Nigeria using fact method

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