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Reactive Power Control of Transmission Line

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Abstract - Whenever the appropriate energy control system with reactive power has to be considered .we have to consider reliable operation of the power systems. Insufficient reactive power supply remains an important factor that gives rise to the instability and has been a major reason for power outages all over the world. As for as transmission and the distribution are concerned, it is very individual components. FACTS devices are the important technology which can be able to achieve complete deregulation of the power system. SVC is one of the FACTS devices which will be needed to achieve our goal of our project. In this paper we will be going to achieve the design and simulation to vary the firing angle of SVC to achieve the better, smooth and perfect control of the power in the line transmission system. The MATLAB/Simulink used o design model and simulates our design.

Keywords: Flexible alternating current transmission system(FACTS),Static VAR compensator(SVC) Thyristor Contorl Reactor (TCR) , Thyristor Switched Capacitor (TSR), Harmonic capacitor (HC).

1. Introduction

The important discussion regarding importance about Reactive Power and how it is useful to maintain System voltage healthy

A. Significance of Reactive Power: Voltage control in an electrical power framework is essential for appropriate task for electrical power hardware to counteract harm, for example, overheating of generators and engines, to diminish transmission misfortunes and to keep up the capacity of the framework to withstand and avoid voltage fall.

Decreasing receptive power making voltage fall while expanding it making voltage rise. A voltage fall might be happens when the framework attempt to serve considerably more load than the voltage can bolster.

When receptive power supply bring down voltage, as voltage drops current must increment to keep up power provided, making framework devour increasingly responsive power and the voltage drops further . On the off chance that the present increment excessively, transmission lines go disconnected, over-burdening different lines and conceivably causing falling disappointments.

If the voltage drops excessively low, a few generators will disengage consequently to ensure themselves. Voltage crumple happens when an expansion in load or less age or transmission offices causes dropping voltage, which causes a further decrease in responsive power from capacitor and line charging, and still there further voltage decreases. On the off chance that voltage decrease proceeds with, these will make extra components trip, driving further decrease in voltage and loss of the heap. The outcome in these whole dynamic and wild decreases in voltage is that the framework unfit to give the responsive power required providing the receptive power requests

B. Important to Control of Voltage and Reactive Power: Voltage control and receptive power the executives are two parts of a solitary action that the two backings dependability and encourages business exchanges crosswise over transmission systems.

On an exchanging current (AC) control framework, voltage is constrained by overseeing generation and ingestion of receptive power.

There are three reasons why it is important to oversee receptive power and control voltage.

First, both client and power framework hardware are intended to work inside a scope of voltages, more often than not within±5% of the ostensible voltage. At low voltages, numerous kinds of gear perform inadequately, lights give less enlightenment, enlistment engines can overheat and be harmed, and some electronic hardware won't work at. High voltages can harm gear and abbreviate their lifetimes.

Second, receptive power devours transmission and age assets. To expand the measure of genuine power that can be exchanged over a clogged transmission interface, responsive power streams must be limited. Likewise, receptive power creation can confine a generator's genuine power capacity.

Third, moving responsive power on the transmission framework acquires genuine power misfortunes. Both limit and vitality must be provided to supplant these misfortunes.

Voltage control is entangled by two extra factors. First, the transmission framework itself is a nonlinear shopper of responsive power, contingent upon framework stacking. At light stacking the framework creates responsive power that must be retained, while at overwhelming stacking the framework devours a lot of receptive power that must be supplanted. The framework's receptive power prerequisites additionally rely upon the age and transmission setup.

Consequently, framework responsive necessities differ in time as load levels and load and age designs change. The mass power framework is made out of numerous bits of gear, any of which can come up short whenever. In this way, the framework is intended to withstand the loss of any single bit of gear and to keep working without affecting any clients. That is, the framework is intended to withstand a solitary possibility. The passing of a generator or a noteworthy transmission line can have the intensifying impact of diminishing the responsive supply and, in the meantime, reconfiguring streams with the end goal that the framework is expending extra receptive power.

At least a part of the receptive supply must be equipped for reacting rapidly to changing responsive power requests and to keep up satisfactory voltages all through the framework. In this manner, similarly as an electrical framework requires genuine power stores to react to possibilities, so too it must keep up receptive power holds.

Loads can likewise be both genuine and receptive. The receptive segment of the heap could be served from the transmission framework. Receptive burdens cause more voltage drop and responsive misfortunes in the transmission framework than do comparative size (MVA) genuine burdens. System task has three targets while overseeing responsive power and voltages.

First, it must keep up satisfactory voltages all through the transmission and dissemination framework for both current and possibility conditions.

Second, it looks to limit blockage of genuine power streams.

Third, it looks to limit genuine power misfortunes.

One waveform drives the other

- Phase point not equivalent to 0°
- Power factor not as much as solidarity
- Measured in volt-ampere responsive (VAR)

Produced when the present waveform drives voltage waveform (Leading force factor)

Vice refrain, expended when the present waveform slacks voltage (slacking power factor)

C. Reactive Power Limitations: Reactive power does not travel exceptionally far. Usually important to deliver it near the area where it is required

A provider/source near the area of the need is in a vastly improved position to give receptive power versus one that is situated a long way from the area of the need

Reactive power supplies are firmly attached to the capacity to convey genuine or dynamic power.

2. Generation:

An electric power generator's essential capacity is to change over fuel into electric power. Practically all generators additionally have impressive command over their terminal voltage and receptive power yield.

The capacity of generator to give responsive help relies upon its genuine power creation. Like most electric gear, generators are restricted by their flow conveying capacity. Close evaluated voltage, this ability turns into a MVA limit for the armature of the generator as opposed to a MW impediment.

Production of receptive power includes expanding the attractive field to raise the generator's terminal voltage. Expanding the attractive field requires expanding the current in the pivoting field winding. Ingestion of responsive power is restricted by the attractive motion design in the stator, which results in exorbitant warming of the stator-end press, the center end warming cutoff.

The synchronizing torque is additionally decreased while retaining a lot of responsive power, which can likewise constrain generator capacity to lessen the opportunity of losing synchronization with the framework.

The generator prime mover (e.g., the steam turbine) is normally structured with less limit than the electric generator, bringing about the prime-mover limit. The planners perceive that the generator will deliver responsive power and supporting framework voltage more often than not. Giving a prime mover equipped for conveying all the mechanical power the generator can change over to power when it is neither creating nor retaining receptive power would result in under use of the prime mover.

To deliver or ingest extra VARs past these cutoff points would require a decrease in the genuine power yield of the unit. Authority over the responsive yield and the terminal voltage of the generator is given by changing the DC current in the generator's turning field. Control can be programmed, constant, and quick.

The intrinsic qualities of the generator help keep up framework voltage. At some random field setting, the generator has a particular terminal voltage it is endeavoring to hold. In the event that the framework voltage decreases, the generator will infuse responsive power into the power framework, tending to raise framework voltage. In the event that the framework voltage rises, the responsive yield of the generator will drop, and at last receptive power will stream into the generator, tending to bring down framework voltage. The voltage controller will complement this conduct by driving the field current the proper way to acquire the ideal framework voltage.

The SVC comprises of the quantity of settled or exchanged frameworks of branches. A SVC ordinarily incorporates as mixes of TCR/FC or TCR/TSC/FC:-

a) Thyristor control reactor (TCR)

b) Thyrister Switched Capacitor (TSC)

c) Harmonic Filter (FC)

d) Mechanically exchanged capacitor back (MSC) or reactor bank (MSR)

In our paper we have utilized (FC-TCR) which is set at the less than desirable end . The terminating edge control circuit [is structured and the terminating edge are differed for different stacking conditions. Here in our undertaking we have utilized the Fuzzy rationale controller to accomplish better responsive power remuneration for the transmission line.

3. Fixed Capacitor Bank

Anyway when the settled capacitor becomes possibly the most important factor which has been intended for high productivity dependability and for a long conditions. Since concerning as load is differing the capacitor is exchanged with the heap for power factor rectification. It is appropriate to be utilized whose little numerous heaps requires receptive power pay. The settled capacitor thyristor controlled responsive sort VAR generator might be considered basically to comprises of a variable reactor (constrained by a terminating point) .

4. Fuzzy Logic Controller

Fluffy rationale controller is a vital idea of the constant applications. The beneath fig demonstrates the structure of the fluffy rationale controller (FIS-fluffy obstruction framework) in MATLAB. The MATLAB has the fluffy rationale tool stash which utilizes the two participation capacity of **-** . It utilizes two content qualities for the standard 1) MAMDENI 2) SUGENO

Load, Voltage and the heap current are taken as a contribution to the fluffy framework. To get the linearity triangular enrollment work is taken with half cover. The yield of the controller taken as the control flag and the beat generator gives synchronous terminating heartbeats to thyristor

Power factor not as much as solidarity

Measured in volt-ampere responsive (VAR)

Produced when the present waveform drives voltage waveform (Leading force factor)

Vice section, devoured when the present waveform slacks voltage (slacking power factor).

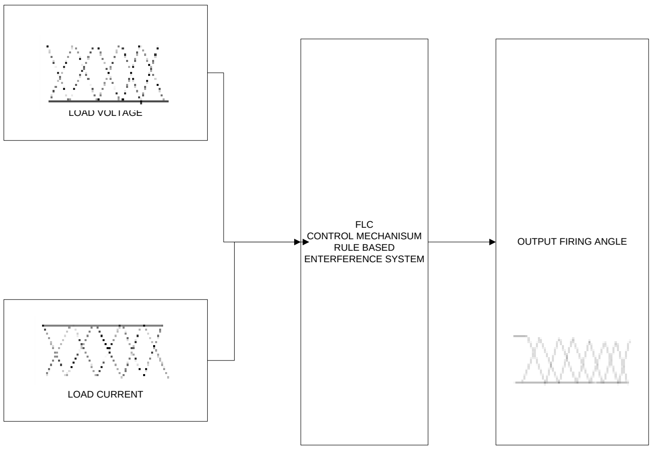


Fig (I) Structure of Fuzzy Logic Controller

5. Methodlogy:-

The venture exhibits the fluffy rationale control of a static var compensator for power framework upgrade. The single machine boundless bulbar SMIB hypothesis and model were utilized for power framework arrangement and the recreations and exploratory outcomes were acquired utilizing Matlab-Simulink programming. SVC's are FACTS gadgets in shunt associations used to enhance transmission line financial aspects and framework misfortunes by settling dynamic voltage issues and responsive influence control. Along these lines, a kind of SVC was researched in this paper to give critical damping amid transient conditions on power framework.

The TCR-FC (thyristor controlled reactor TCR and settled capacitor FC) was situated on the generator busbar and the conduct of the power framework was examined after the 3 stage hamper happens close to the boundless busbar.

This kind of SVC can be viewed as a movable reactance that can perform both inductive and capacitive remuneration to enhance the nature of the power framework. We proposed in this paper a SVC fluffy control chart which utilize an ordinary SVC circle with an assistant flag figured by the fluffy rationale controller.

The fuzzy rationale controller has as sources of info the speed deviation and the speed deviation rate. The yield of the fluffy controller is the strengthening voltage. The primary objective of acquainting the assistant circle is with soggy the motions of the rotor point after the blame. Near outcomes made after the recreations with the fluffy rationale controller helper circle accentuate a shorter settling time and a superior damping of the power framework motions

The STATCOM is a strong state shunt gadget that produces or retains responsive power and is one individual from a group of gadgets known as adaptable AC transmission framework.

The STATCOM is like the SVC accordingly speed, control abilities, and the utilization of intensity gadgets. As opposed to utilizing traditional capacitors and inductors joined with quick switches, be that as it may, the STATCOM utilizes control gadgets to combine the responsive power yield. Thus, yield ability is commonly symmetric, giving as much capacity to creation as retention.

The strong state nature of the STATCOM implies that, like the SVC, the controls can be intended to give quick and viable voltage control. While not having the momentary over-burden ability of generators and synchronous condensers, STATCOM limit does not endure as truly as SVCs and capacitors do from corrupted voltage.

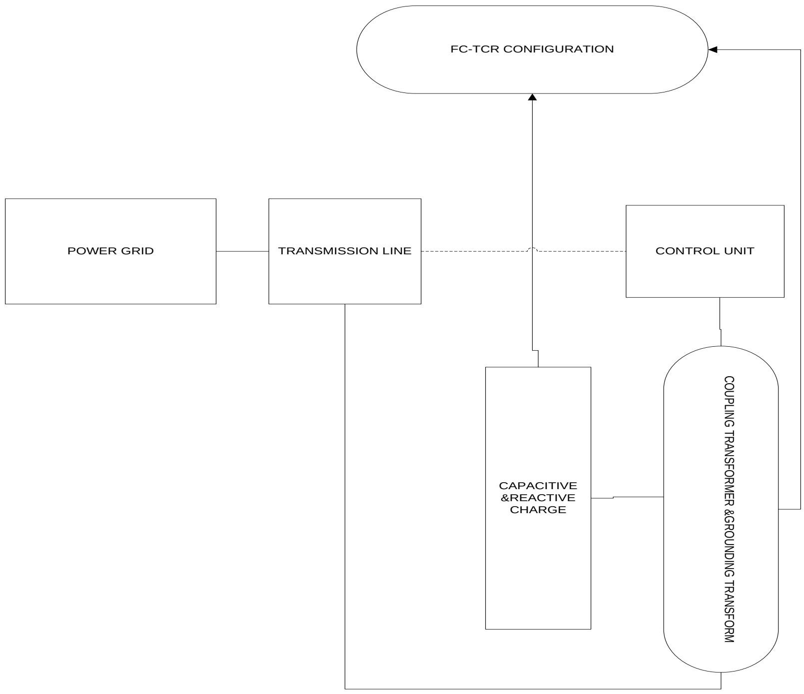
STATCOMs are current restricted so their MVAR ability reacts directly to voltage instead of the voltage squared relationship of SVCs and capacitors. This trait enormously builds the helpfulness of STATCOMs in avoiding voltage fall.

6. Block diagram:

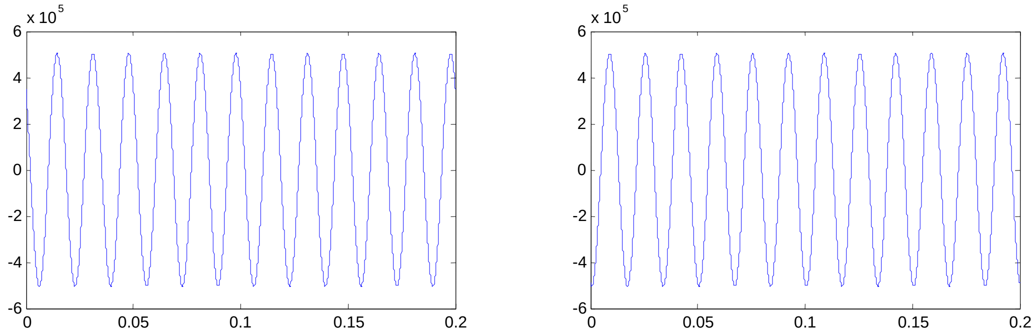
In an electric power transmission framework, a thyristor-controlled reactor (TCR) is a reactance associated in arrangement with a bidirectional thyristor valve. The thyristor valve is stage controlled, which permits the estimation of conveyed responsive capacity to be changed in accordance with meet shifting framework conditions. Thyristor-controlled reactors can be utilized for constraining voltage ascends on softly stacked transmission lines. Another gadget which used to be utilized for this reason for existing is an attractively controlled reactor (MCR), a sort of attractive speaker also called a transductor.

In parallel with arrangement associated reactance and thyristor valve, there may likewise be a capacitor bank, which might be for all time associated or which may utilize mechanical or thyristor exchanging. The mix is known as a static VAR compensator.

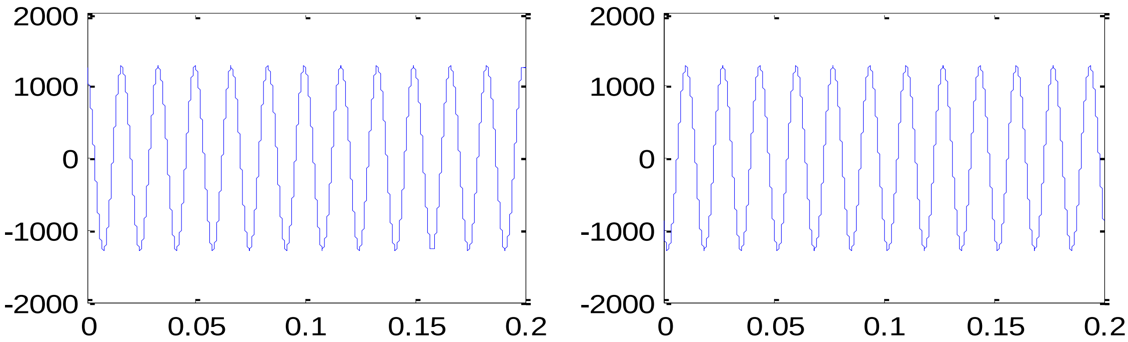
In transmission applications, the SVC is utilized to direct the network voltage. In the event that the power framework's responsive load is capacitive (driving), the SVC will utilize thyristor controlled reactors to devour VARs from the framework, bringing down the framework voltage. Under inductive (slacking) conditions, the capacitor banks are naturally exchanged in, hence giving a higher framework voltage. By associating the thyristor-controlled reactor, which is ceaselessly factor, alongside a capacitor bank step, the net outcome is constantly factor driving or slacking power.



7. Results: Scope 1



Source Voltage & Source Current



Load Voltage & Load Current

From Scope 1 we can see that in the event that we keep capacitor esteem as consistent and differ the estimation of inductor then responsive power is expanding and from scope2 we can reason that if increment terminating point current through TCR diminishes with increment of terminating edge in this manner expanding the Reactive Power yield. This demonstrates responsive power is redressed and thus steadiness of intensity framework is moved forward. Henceforth it is inferred that FC-TCR will receptive power is smoother by utilizing FC-TCR framework. From the outcomes we can reason that on the off chance that capacitor esteem is consistent and shift the estimation of inductor, responsive power is expanding and we can likewise presume that in the event that we increment terminating point current through TCR diminishes with increment of terminating edge along these lines expanding the Reactive Power yield. This demonstrates responsive power is redressed and that enhance control framework security.

8. CONCLUSION

This paper presents a unique scheme for the control of the reactive power in the transmission line us e of the SVC (FC- TCR) provides an effective means for reactive power control irrespective of the load variation transmission lines without any compensation was not satisfying the essential condition of maintaining the voltage within the Condition.

9. REFERENCES

[1] **Al-Kandari AM, Soliman SA and Alammari RA (2006).** Power quality analysis based on fuzzy estimation algorithm: voltage flicker measurements. *International Journal of Electrical Power & EnergySystem* **28**(10) 723–8.

[2] **]Eminog˘lu U, Yalcınoz T and Herdem S (2003).** Analysis of FACTS devices for dynamic loads using matlab. *In: 38th International Universities Power Engineering Conference* **2** 377–80.

[3] **Joshi NN and Mohan N (2006).** Application of TCSC in wind farm application. *IEEE PowerElectronics, Electric Drives, Automation and Motion*, SPEEDAM 1196–200.

[4] **Jowder FAL (2007).** Application of SSSC to wind farm. *Power Engineering Conference IPEC* 544-9.

[5] **Molinas M, Suul JA and Undeland T (2008).** Low voltage ride through of wind farms with cage generators: STATCOM versus SVC. *IEEE Trans Power Electron* **23**(3) 1104–17.

[6] **Mohammadi M, Hosseinian SH and Gharehpetian GB (2012),** Optimization of hybrid solar energysources/wind turbine systems integrated to utility grids as microgrid (MG) under pool/bilateral/hybrid electricity market using PSO, *Solar Energy* **86** 112–125.

[7] **Paulo Fischer de Toledo and Hailian Xie (2005).** Wind farm in weak grids compensated with STATCOM. *Nordic PhD course on wind power.*

[8] **Papantoniou A and Coonick A (1997).** Simulation of FACTS for wind farm application. *IEEE PowerElectron Renew Energy* 1–5.

[9] **Qiao Wei, Venayagomoorthy GK and Harley RG (2009).** Real time implementation of a wind farm equipped with double feed induction generator. *IEEE Transactions on Industry Applications* **45** 98–107.

[10] **Qi L, Langston J and Steurer M (2008).** Applying a STATCOM for stability improvement an existing wind farm with fixed speed induction generator. *In: IEEE power and energy society general meeting –conversion and delivery of electric energy in the 21st century* 1–6.

[11] **Qiao Wei, Ronald G Harley and Ganesh K Venayagomoorthy (2006).** Effect of FACTS devices on apower systems which includes a large wind farm. *In: IEEE power system conference and exposition*2070–76.

[12] **Suul Jon Are and Undeland Tore (2008).** Low voltage ride through of wind farms with cage generators:STATCOM versus SVC. *IEEE Trans Power Electron* **23** 1104–17.

[14] **PSCAD/EMTDC, User's Guide, ManitobaHVDC** Research Centre. Winnipeg, MB, Canada, Jan. 2003.

[15 **] Padiyar K.R.'HVDC Power Transmission System**.' Wiley Eastern, New Delhi, 1993).

[16] Rudervall Roberto, Johansson Jan, "Interconexion de sistemas eléctricos con HVDC". Seminario internacional de interconexiones regionales CIGRE, Santiago de Chile, Noviembre 2003.

[17] **Stella M., Dash P. K., and Basu K. P.** "A neurosliding mode controller for STATCOM," Elect. Power Compon. Syst., vol. 32, pp. 131–147, Feb. 2004.

[18] **Litzenberger Wayne H., (ed.),** An Annotated Bibliography of High-Voltage Direct-Current Transmission and Flexible AC Transmission (FACTS) Devices, 1991-1993. Portland, OR, USA: Bonneville Power Administration and Western Area Power Administration, 1994.

[19] **Padiyar K. R., Pai M. A., and Radhakrishna** C., "Analysis of D.C. link control for system

[20] **PSCAD/EMTDC,** User's Guide, ManitobaHVDC Research Centre. Winnipeg, MB, Canada, Jan. 2003.