Power Quality Improvement in Distribution Network Using DSTATCOM

[1]Faiz Mohd Ansari, [2]Ameen Uddin Ahmad

[1]M.Tech Al Falah University Faridabad India, [2]Assistant Professor Department of EEE Al Falah University Faridabad India

Abstract **:** Power quality is one among the foremost important concerned for residential customer & it's a really sensitive issue for industrial consumer. A PQ problem occurred because of the non standard voltage current & frequency which result the failure or mis operation of customer equipments. PQ problem aren't a brand new issue in electrical wattage system, every users want to attenuate their effect to get the very best quality of power at end users.
This paper present to boost the standard of power by minimizing voltage Sag/Swell, distortion & low power factor using DSTATCOM. The model is predicated on the identical principle as of Voltage Source Converter. A DSTATCOM inject a current into the system to curtail voltage sag/swell, distortion & power factor. The model analyze in MATLAB/SIMULINK for required result.

Key words **- DSTATCOM, Shunt compensation device, VSC, Custom power devices.**

1. INTRODUCTION

Power quality defines as "The concept of powering & grounding of sensitive electronics equipments in an exceedingly manner suitable for the equipments. India could be a developing country where because of increase of population day by day the energy demand also increases. Because the energy demand increases among commercial & industrial customer become more, insufficient power quality may be caused by failure & switching operation in transmission & distribution network which mainly end in voltage sag, interruption & disturbances within the network. From the load side disturbances caused end in flicker, harmonic, phase imbalance.
One of the foremost power problems in recent days is voltage Sag/Swell. It's generally set by two parameter- magnitude & time duration. The voltage Sag/swell magnitude is generally ranged from 10% to 90% of nominal voltage & with time duration of half cycle to at least one minute. Based on the record by TNB (Tenagee Nasional Berhad- Malaysian Electricity Company) 80% of power quality complaint within the world by voltage sag. Sensitive electrical equipments like process controller, PLC & robotics becoming more sensitive to voltage sag. These sensitive equipments suffered from high loss because of voltage sag.
There are various custom power devices are accustomed to enhance the power quality problem in transmission & distribution system, among those DSTATCOM one among the foremost effective device because DSTATCOM aren't only improve voltage sag but also flicker, voltage swell, harmonic distortion & low power factor.

2. VOLTAGE SOURCE CONVERTER (VSC)

A voltage source converter could be a power electronic device, which might generate a sinusoidal voltage with any required magnitude, frequency and phase angle. Voltage source converter is widely utilized in adjustable speed drives, but may also be accustomed to mitigate voltage dips. The VSC is employed to either completely replace the voltage or to inject the 'missing voltage'. The 'missing voltage' is that the difference between the nominal voltage and also the actual. The converter is often supported some kind of energy storage, which is able to supply the converter with a DC voltage. The solid state electronics within the converter is then switched to induce the required output voltage. Normally the VSC is not only used for voltage sag/swell mitigation, but also for the opposite power quality issues, e.g. flicker and harmonics.

3. ENERGY STORAGE CIRCUIT

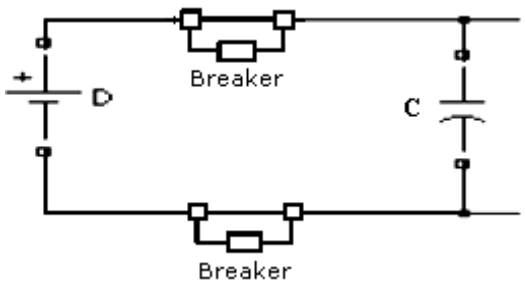


Fig.3.1.Circuit Diagram of DC Storage

From fig 3.1 DC source is connected in parallel with the DC capacitor. It carries the ripple current of the converter and it's the most reactive energy storage element. This DC capacitor might be charged by a electric battery source or might be recharged by the converter itself.

4. CONTROLLER

The aim of the control scheme is to keep up constant voltage magnitude at the purpose where a sensitive load is connected, under system disturbances. The system only measures the r.m.s voltage at the load point, i.e. no reactive power measurements are required. The VSC switching strategy is predicted on a sinusoidal PWM techniques which supply simplicity and good response. Since custom power is a relatively low power application, PWM method offers a more flexible option than the basic frequency switching methods favored in

FACTS applications. Besides, high switching frequencies may be accustomed to improve on the efficiency of the converter, without incurring significant switching losses. The controller input is an error signal obtained from the reference voltage and also the r.m.s of terminal voltage measured. Such error is processed by a PI controller the output is that the angle δ, which is provided to the PWM signal generator. It's important to note that during this case, indirectly controlled converter, there's a active and reactive power exchange with the network simultaneously an miscalculation signal is obtained by comparing the reference voltage with the r.m.s voltage measured at the load point. The PI controller process the error signal generates the specified angle to drive the error zero, i.e. the load r.m.s voltage is brought back to the reference voltage.

5. DISTRIBUTION STATIC COMPENSATOR (D-STATCOM)

A D-STATCOM is schematically depicted in figure 5.1, accommodates two level Voltage Source Converter (VSC), a DC energy storage device, a coupling transformer connected in shunt to the distribution network through a coupling transformer. The VSC converts the DC voltage across the storage device into a group of three phase AC output voltages. These voltages are in phase and matched with the AC system through the reactance of the coupling transformer. Suitable adjustment of the phase and magnitude of the D-STATCOM output voltage allow effective control of active and reactive power exchanges between the D-STATCOM and also the AC system. Such configuration allows the device to soak up or generate controllable active and reactive power. The VSC connected in shunt with the AC system provides a multifunctional topology which might be used for up to three quite distinct purposes.

1. Voltage regulation and compensation of reactive power.
2. Correction of power factor
3. Elimination of current harmonics

The value of I_{sh} can be controlled by adjusting the output voltage of the converter. The shunt injected current I_{sh} can be written as:

$$I_{sh} = I_L - I_s = I_L (V_{th} - V_L) / Z_{th} \quad \text{.....(5.1)}$$

$$I_{sh}\text{^}\eta = I_L\text{^}\theta - (V_{th} / Z_{th})\text{^}(\delta-\beta)+ ((V_{th} / Z_{th})\text{^}-\beta \quad \text{.....(5.2)}$$

I_{out} = output current
I_s = source current
I_L = load current
V_L = load voltage
V_{th} = thevenin voltage
Z_{th} = impedance

Referring to the equation 5.2 output current will correct the voltage sags by adjusting the voltage drop across the system impedance, (Zth = R+jX)

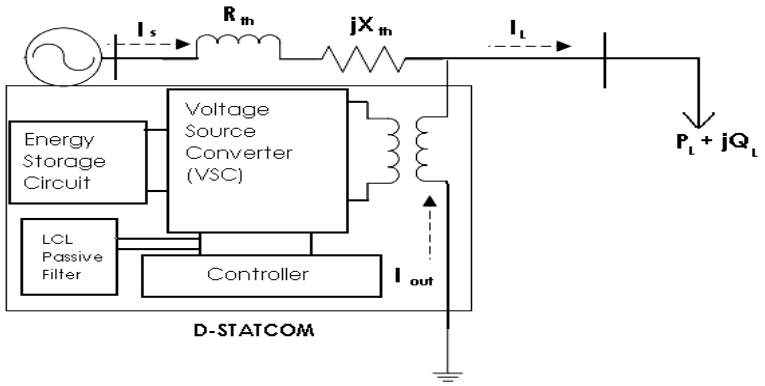
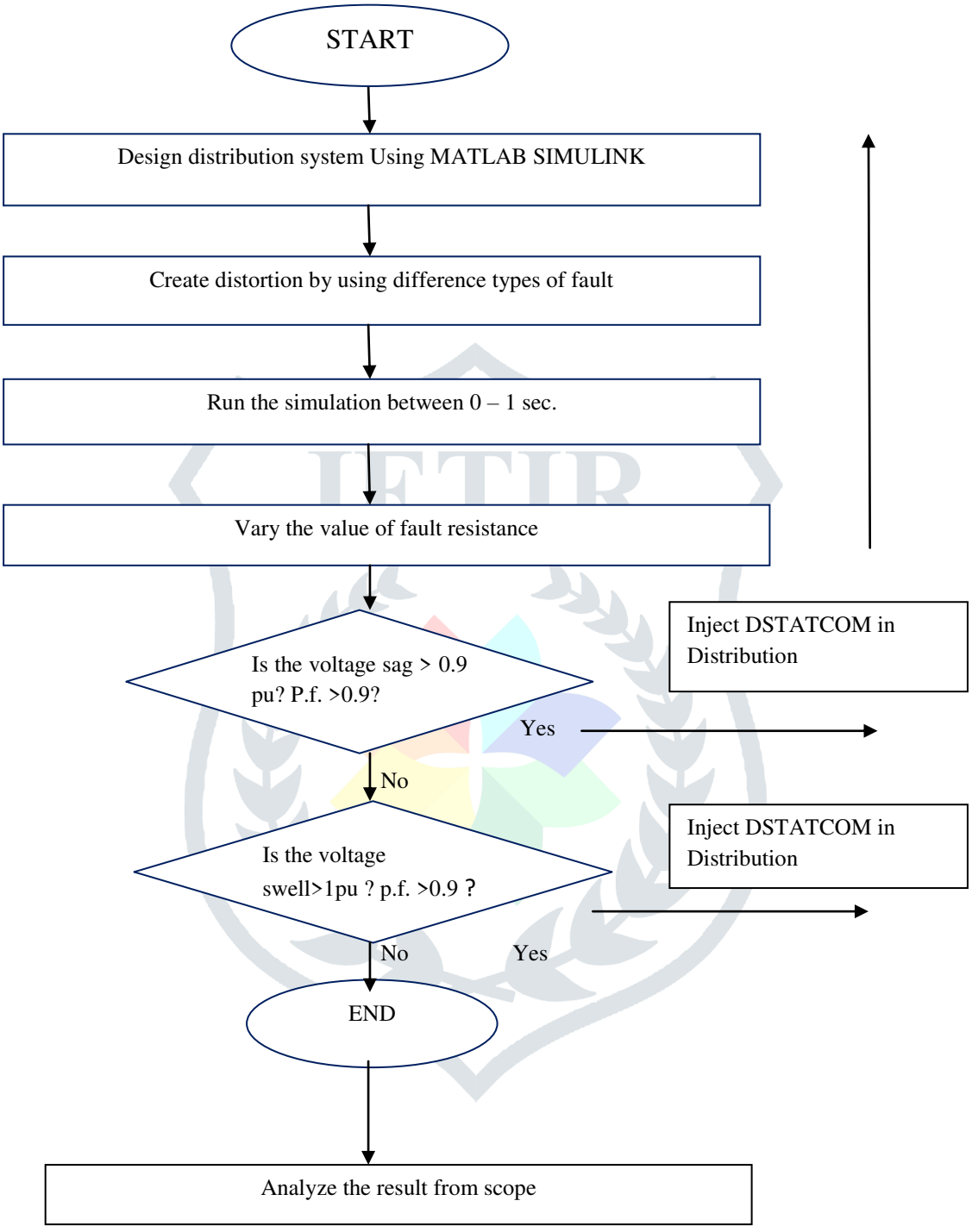


Fig.5.1. Schematic Diagram of D-STATCOM

6. METHODOLOGY

The proposed methodology is based on the following algorithm



7. SIMULINK MODEL FOR THE TEST SYSTEM

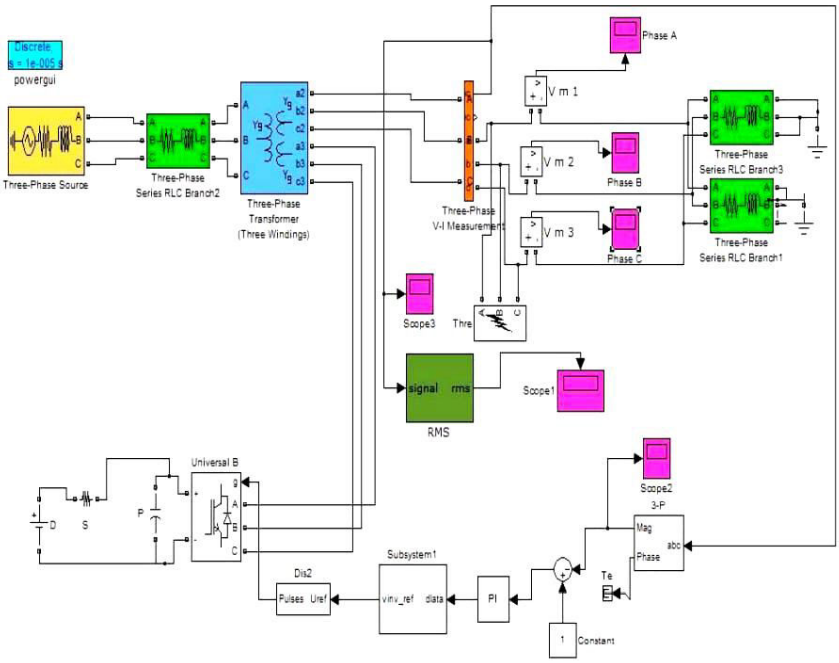


Fig.7. Simulink model of D-STATCOM

8. CONCLUSION

In this paper by analyzing the various management techniques for coming up with the DSTATCOM and implementing the formula that facilitate in to style, the model & operating of DSTATCOM in MATLAB/simulink for the desired result. By coming up with the DSTATCOM using MATLAB simulink probable result having low proportion of voltage sag & swell ought to be obtained.

9. REFERENCES

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