Voltage Quality Enhancement for Microgrids using D-STATCOM

Vidhyavati Suryawanshi[1], Prof. A K Jhala[2]

[1]Mtech Research Scholar , [2]Research Guide

Department of Electrical Engineering, RKDF College of Engineering, Bhopal

Abstract - The unbalanced are very common conditions for Low Voltage (L V) MGs, due to single phase loads and single phase inverters usage. The unbalanced conditions produce unbalanced currents circulating between main grid and MGs, which creates negative affects into grid and the MGs DGs. Asymmetry in current and voltage add negative effects throughout the process of power delivery. The negative sequence voltage introduce to increases heat and losses of induction motors. The negative sequence currents reduce the efficiency of system. The yield power of single phase DGs in LV MGs and residential loads are various and highly dependent on the surrounding conditions and the end-users behaviors. Therefore the unbalanced operations are more common to take place, especially for low voltage MGs with majority of single phase inverters and loads. To overcome the above issue this work proposed a model based on distributed compensation with D-STATCOM Scheme. Three distributed generator are used this individual grids will act as a microgid to enhance the performance of the system and quality of power supply.

Keywords – D-STATCOM, Microgrid (MG), DGs (Distribute generation system), Power Quality Control.

I. INTRODUCTION

The world is at the edge of a major shift in the paradigm of electrical energy generation, transmission, distribution and storage, by moving from existing, centralized generation towards DER. The new paradigm has the potential to result in higher stability margins and better reliability, reduction of transmission lines power loss, power quality increase, ability to shift peak loads, etc. smart grid technologies help utilities to operate, control, and maintain DER as well as interconnect them to the main grid. In the new paradigm of the grid, the complexity of technical tasks have changed from dealing with local SCADA data into a variety of massive field data collection, that allows a more comprehensive view of the power system status, energy flows, hierarchical control, asset management, equipment conditions etc. A Microgrid is a localized grouping of DER and loads that has the capability of islanding and operating independently from the grid as well as grid-connected mode of operation. Smart technologies bring about the possibility of a smart microgrid. A smart microgrid typically integrates the following components.

In many cases the energy sources in a microgrid are interfaced through power electronic converters. The controllability of prompt output current/voltage of power converters has made these converters be utilized as a part of various applications. Output current of the sources that incorporate interface converters can be controlled with more degrees of opportunity. So as to maintain a strategic distance from unsteadiness in the system and to build the effectiveness of the microgrid operation, the greater part of the converters in a microgrid ought to be controlled in a joint effort with each other.

Smaller energy sources in a microgrid are normally called Distributed Generation (DG) units, and frame some portion of the Distributed Energy Resources (DER), which can likewise incorporate any energy stockpiling systems. DG units are appraised up to 10 MW and can be specifically associated with the dispersion network through a power electronic converter to shape a microgrid situation. A microgrid is a current development, in little scale power era networks, that can speak to a correlative framework to the utility grid to help adapt to a quick increment of the load request [4]. Figure 1.1 classifies the normal sorts of DG units, and the accompanying subsections present their remarkable components.

(Increase in short circuit current: at the point when short out flaw happens, shortcoming current is supplied from the both power framework and distributed generation to the flaw point. In case the aggregate issue current outperforms the point of confinement of the feeder's electrical switch, the issue can't be detached out, in this way proceeds.(b) Deterioration of affectability of faults: dependent upon the range of the issue, the affectability of the hand off system is at hazard to break down. Defect current decreases on the feeder at the substation by providing imperfection current from conveyed era. Hence, the hand off system either will be notable recognize the inadequacy or might be move to remember it.

Distributed generators could have a positive effect on dissemination framework unwavering quality on the off chance that they are accurately facilitated with whatever remains of the system. A typical sample of distributed generators utilization is as era reinforcement, in which the unit works on account of fundamental supply interference. A distributed generator application that is picking up fame is the infusion of force into the system when the distributed generator limit is higher than its neighbourhood loads. A common illustration is a cogeneration plant, where the distributed generator proprietor is changed just for the distinction between the vitality depleted from the conveyance utility and the sum infused into the system. At the point when the distributed generator is working in parallel with the framework, new contemplations are presented in the system operation and arranging techniques. A basic distinct option for model distributed generators is as consistent dynamic and receptive force infusions free of the framework voltage at the unit terminal transport. The distributed generator model of negative burden can have a positive effect in framework dependability if the dependability assessment model considers limit imperatives amid framework rebuilding after a flaw. Another option is to model distributed generator units as controlled voltage sources in which the terminal voltage kept up at steady esteem by receptive power infusion. Under this condition, it ought to be kept away from to regard all distributed generation sources as accessible for dispatch by the utility at whatever point vital, since the distributed generator s are not so much property of the dissemination utility. This issue can be understood by displaying greatest measure of the dynamic force dispatch able by the unit and the periods when it will be accessible.

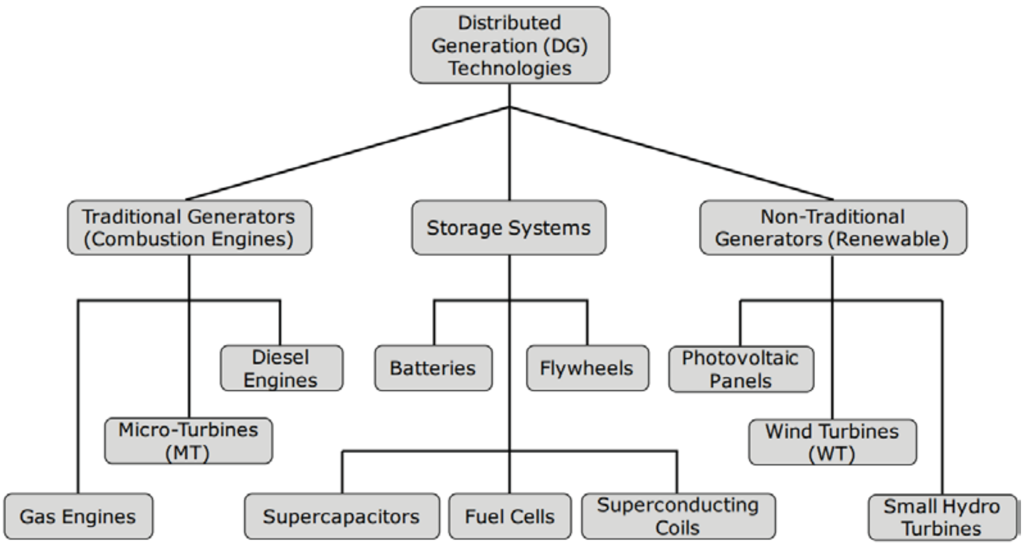

Figure 3.1 Types and technologies of the DG units.

II. PROPOSED WORK

Proposed model is based on distributed compensation with D-STATCOM Scheme. Schematic of proposed work is demonstrated in figure 2.1. There are three different distributed generator are used i.e. DG1, DG2 and DG3 which is on more than the base work. There individual grids will act as a microgid in the proposed model to enhance the performance of the system quality of power supply.

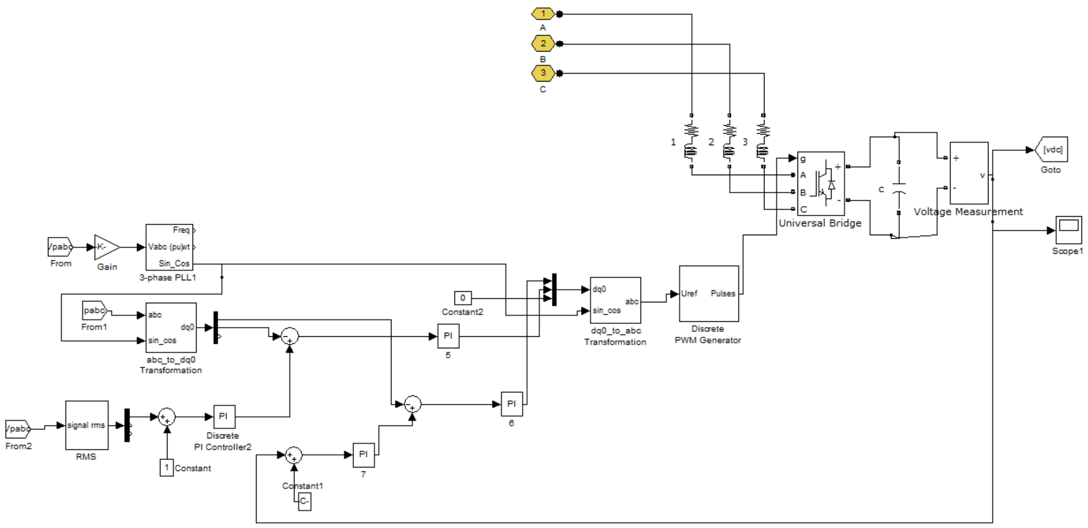

Figure 3.1 Proposed DSTATCOM Scheme.

Parallel D-STATCOM is connected with non linear load for reactive power compensation. Static Synchronous Compensator is one of the static component device and comes under the family of FACTS devices. It can absorb or supply reactive power in the single or three phase AC systems. A transmission network reactive power can be compensated using Static Synchronous Compensator. It also helps in preventing fluctuations in the transmission system like sudden voltage increase (voltage sag), sudden voltage decrease (voltage sag), transients etc.

A STATCOM comprises of a three phase inverter utilizing SCRs, MOSFETs or IGBTs, a DC capacitor (which when charging will absorb reactive power and while discharging will supply reactive power), a connection reactor whose purpose is to link the inverter output to the AC supply side, channel parts to channel out the high recurrence segments because of the PWM inverter. From the DC side capacitor, a three stage voltage is produced by the inverter. This is synchronized with the AC supply. The connection inductor interfaces this voltage to the AC supply side. This is the essential standard of operation of STATCOM. Simulation model of proposed work is demonstrated in figure 2.2 the major component of the proposed system are as discussed below illustrated in figure 2.2.

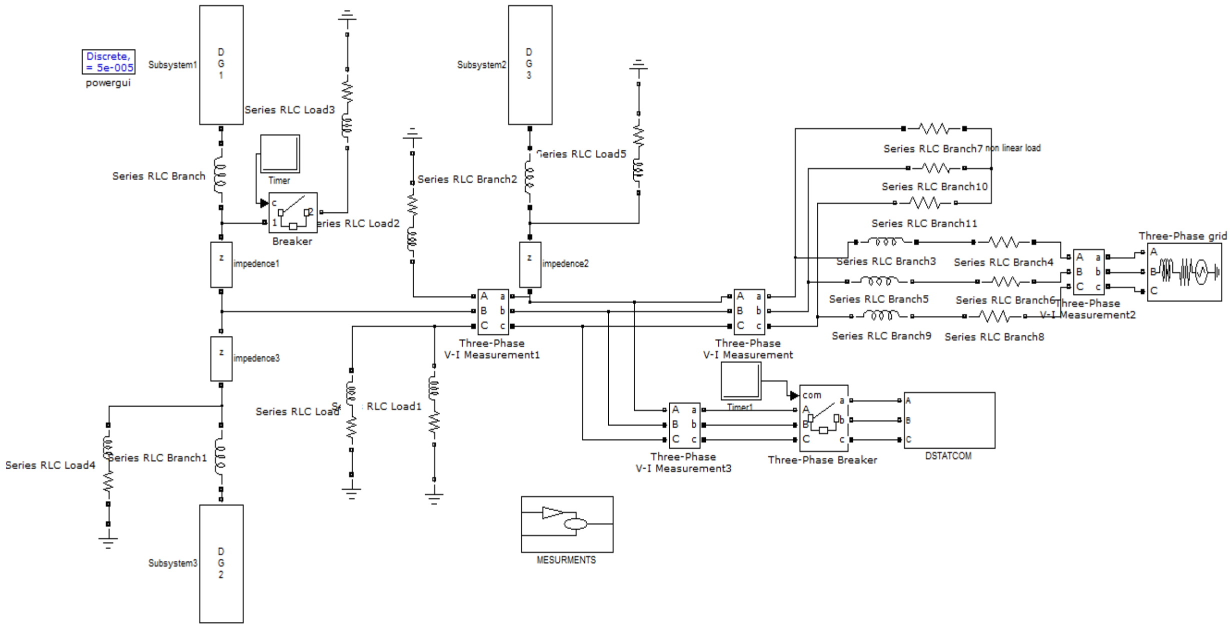

Figure 4.2 Simulation Diagram with proposed scheme.

A power GUI a graphical user interface (GUI) that act as a display unit to observe steady-state values of current and voltages measured as well as all state variables (inductor currents and capacitor voltages). The Powergui block allows modifying the initial states in order to start the simulation from any initial conditions. UGI is most essential component to display graphically various parameters discussed.

Subsystem there are three sub systems are used having three individual distributed generators DG1, DG2,DG3 in subsystem Subsystem1 subsystem2 and subsystem3 respectively.

Serial RLC load connected in parallel of proposed work three phase grid three phase measurement a three phase measurement unit three phase V-I measurement 1 and three phase V-I measurement2 are connected with three phase grid and three phase non linear load to measure voltage and current simultaneously.

III. SIMULATION RESULT

Simulation of proposed work has done in Matlab using Simulink Matlab Simulator the waveform of proposed system has given in figure 3.1, figure 3.2, and figure 3.3. Active and reactive waveform of proposed DG system has illustrated in figure 3.1. Both waveforms are visible in two different colors yellow and red.

Reactive and active power of DG units along with current and phase has illustrated in figure 3.2. positive sequence for active and reactive power DG1 DG2 and DG3 are respectively illustrated from to bottom in figure 3.2.

negative and zero sequence output current of DG1, and phase output current of DG1 are illustrated in bottom of figure 3.2.

Voltage and current before and after compensation are shown in figure 3.3. Bus voltage after voltage compensation bus current before voltage compensation bus current before voltage compensation. bus current after voltage compensation bus voltage before voltage compensation are shown in figure 3.3.

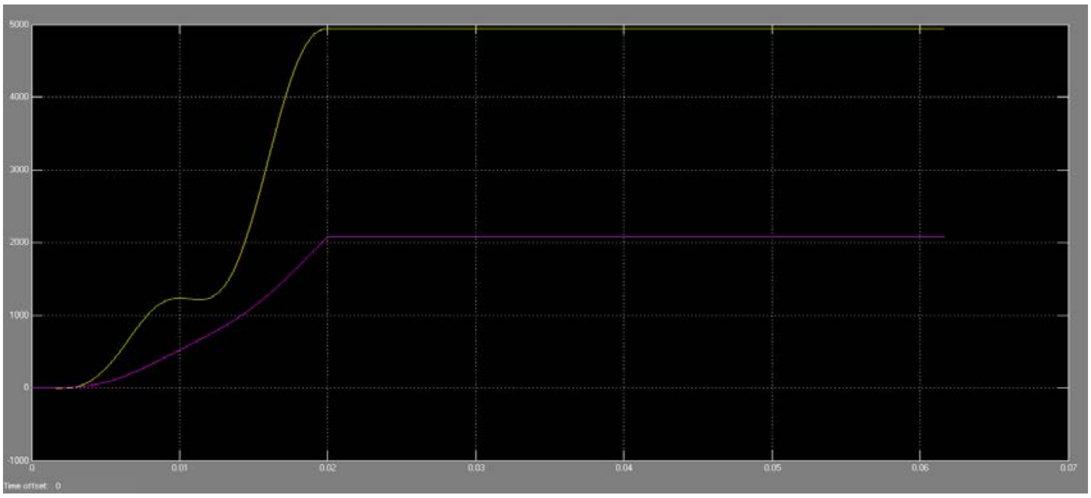

Figure 3.1 Active and Reactive Power of DG unit.

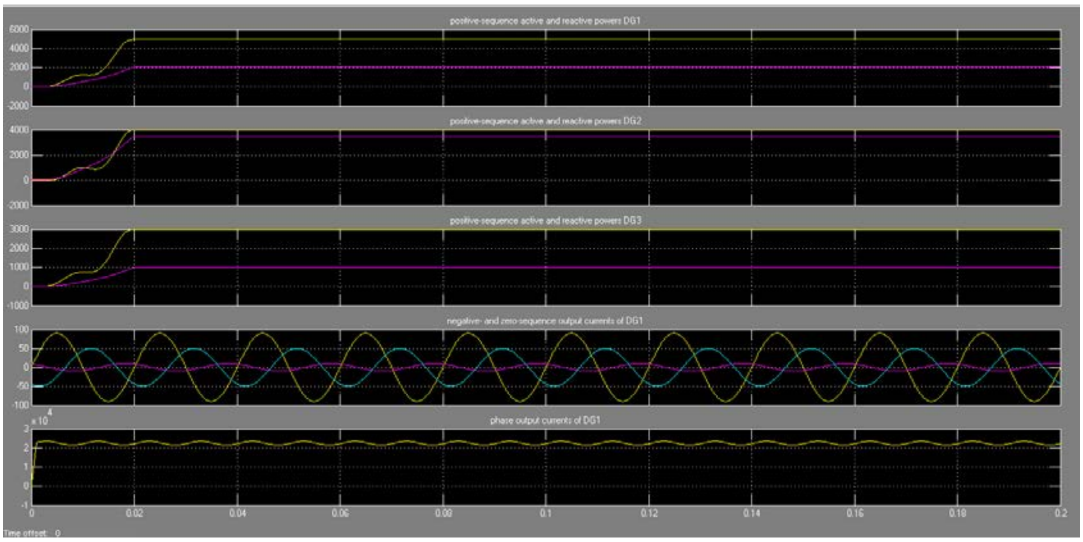

Figure 3.2 Active and Reactive Power of DG units along with Currents and Phase.

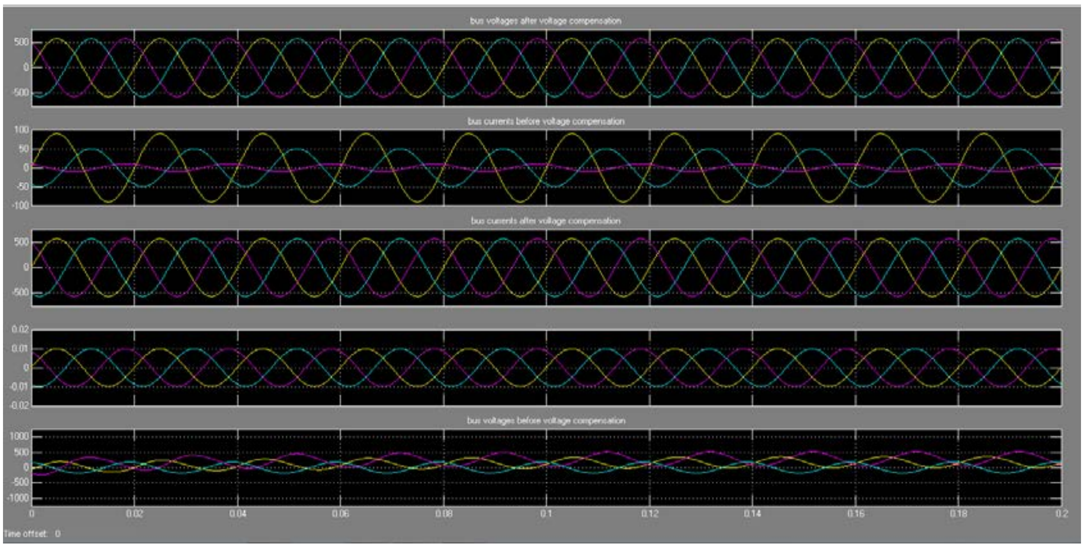

Figure 3.3 Voltage and Current Before and After Compensation.

IV. CONCLUSION

This work presented a power control scheme with parallel non linear load connected with D-STATCOM. A brief introduction could help to understand different issues related to this kind of systems, discussing in general the, DG, MGs, and the imbalance with symmetrical components. This venture the investigation of the essential standards of the STATCOM is done and in addition the fundamentals of reactive power compensation utilizing a STATCOM. This undertaking has displayed the power quality issues, for example, voltage sags and swells. Compensation strategies of custom power electronic gadget D-STATCOM were exhibited. Also the study of reactive power compensation of three phase AC transmission line is also carried by connecting 3-phase STATCOM to transmission line and required analysis is done through Matlab Simulink.

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