IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

PRETEND DESIGN OF A 9-LEVEL & 27-LEVEL MLI-DSTATCOM FOR REACTIVE POWER COMPENSATION IN PS

T. Rakesh*, Dr. V. Madhusudhan, Dr. M. Sushama
* Research Scholar, JNTUH, Kukatpally, Hyderabad
Principal & Dean, KORMCE, Kadapa
Professor, JNTUCEH, Kukatpally, Hyderabad

ABSTRACT

This article deals with the look and implementation of a construction voltage supply convertor (VSC) primarily based Distribution static synchronous compensator (DSTATCOM) and using an efficient modulation management technique simulated in a very MATLAB/Simulink atmosphere for triggering the switches of the VSC (PWM). A MATLAB program has been developed to simulate the system operation and numerous simulation results area unit given below completely different conditions .The main objective of this project is to take care of the voltage stability by compensating the reactive power within the facility. Hence, a brand new economical methodology accustomed scale back the voltage fluctuations like sag and swell conditions and conjointly to isolate current and voltage harmonics within the gear mechanism. The construction DSTATCOM which might be used at the purpose of common coupling (PCC). The performance is compared by applying it to a hundred and ten potential unit conductor with and while not DSTATCOM. The system while not STATCOM technique during this project has the subsequent faults Voltage sag and voltage swell, Harmonics and interharmonics, Voltage fluctuations. So, during this project reactive power compensation is chosen to enhance the performance of the ac system. The compensation achieved by victimization 2 kinds of STATCOM: 9 levels STATCOM and twenty seven levels STATCOM. At the end, there's a comparative study between them. reckoning on the outputs; one in every of them are preferred for the load, that reckoning on what the profile of voltage, current, active and reactive power deliver to the load. The higher one is that delivered constant and stabile voltage to the destination space.

KEYWORDS: STATCOM, Reactive Power, VSC, SPWM, PCC, Voltage Sag and Swell.

INTRODUCTION

Electrical energy plays a vital role within the gift industrial society and has huge importance to a nation's welfare and development. Hydro, thermal and atomic power plants account for nearly all of the energy generated. Tons of this energy is employed for industrial, commercial, home, house and military applications with the applying of power physics. Power physics technology has advanced tons over the last 20 years and as a results of this the analysis of power physics applications has unfold to any or all voltage levels, ranging from EHV transmission to low voltage circuits within the user facilities. HVDC terminals, Static volt-ampere Compensation (SVC) systems, load transfer switches, static section shifters, active line acquisition, energy storage, isolation switches and fast backup power systems, renewable energy integration, and varied different applications area unit the unremarkably discovered power physics applications. In Associate in Nursing interconnected transmission network, power flow management could be a key drawback in planning and in operation. demand of interconnected networks, unforeseen increase of load demands, limitations on installation of station in applicable places and limitations on building new transmission lines area unit the factors that cause such issues.

The employment of FACTS devices in transmission lines becomes necessary attributable to reasons like over loaded transmission lines in special ways, power flow in unwanted ways, and non-optimal operation of line capability. Most if not all of the world's electrical power offer systems area unit wide interconnected, involving association utilities within own territories that reach bury-utility inter connections so to interregional and international connections. This is often in dire straits economic reasons, to cut back the value of electricity and to boost responsibility of power offer. However, the long change periods and distinct operation of the devices within the gift installation, cause issue in handling the oftentimes ever-changing masses swimmingly and damp out the transient oscillations quickly. During this project reactive power compensation is chosen good thanks to improve the performance of the ac system. Thence a structure STATCOM and a sway system ought to be designed for this purpose.

GENERAL VIEW OF REACTIVE POWER

"Power" refers to the energy-related quantities flowing within the transmission & distribution network. Power in an electrical circuit is that the rates of flow of energy pass a given purpose of the circuit. In electrical energy circuits, energy storage components equivalent to inductance and capacitance could lead to periodic reversals of the direction of energy flow. The portion of power that averaged over an entire cycle of the ac wave kind, leads to web transfer of energy in one direction is thought as real power. The portion of power thanks to hold on energy, which returns to the supply in every cycle, is thought as reactive power. In a flash Power, is that the product of voltage and current. Once voltage and current don't seem to be in part or in synch, there are a unit 3 idea as that shown in Fig. 1:

1. Real or active power is measured in Watts.
2. Reactive (sometimes said as imaginary) power is measured in Vars.
3. The mixture (vector product) is advanced Power or Apparent Power.

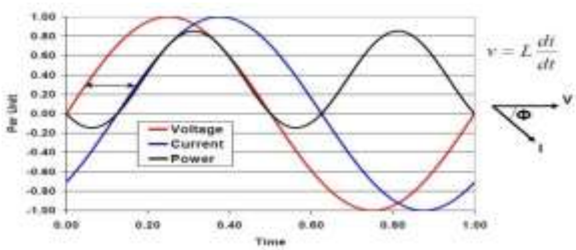

Fig.1 Ac Voltage and Current Phase Shift due to Inductance Current Lags Voltage

In a straightforward electrical energy (ac) circuit consisting of a supply and a linear load, each this and voltage square measure curved. If the load is only resistive, the two quantities reverse their polarity at identical time. At every instant the merchandise of voltage and current is positive indicating that the direction of energy flow doesn't reverse. In this case, solely real power is transferred. If the hundreds square measure purely reactive, then the voltage and Current Square measure ninety degrees out of section. For half every cycle, the merchandise of voltage and current is positive, however on the opposite half the cycle, the product is negative, indicating that on the average, exactly as much energy flows toward the load as flows back. There is no internet energy flow over one cycle. During this case, solely reactive energy flows—there is not any internet transfer of energy to the load. Practical masses have resistance, inductance, and capacitance, so each real and reactive power can flow to real masses. Power engineers live apparent power because the magnitude of the resultant of real and reactive power.

Apparent power is that the product of the root-mean square of voltage and current. Engineers care regarding apparent power, as a result of albeit this related to reactive power will not work on the load; it heats the wires, wasting energy. Conductors, transformers and generators must be sized to hold the whole current, not simply this that wills helpful work. Another consequence is that adding the apparent power for 2 masses won't accurately offer the total apparent power unless they need identical displacement between current and voltage (the same power factor). Conventionally, capacitors square measure thought of to generate reactive power and inductors to consume it. If a capacitor And an electrical device square measure placed in parallel, then the currents flowing through the electrical device and also the condenser tend to cancel instead of add. this is often the basic mechanism for dominant the ability consider electrical power transmission; capacitors (or inductors) square measure inserted in a circuit to partly cancel reactive power 'consumed' by the load.

A. Reactive Power Equation

Reactive power is that the power that provides the stored energy in reactive parts. Power, as we tend to mentioned above, consists of 2 elements, active and reactive power. The full total of active and reactive power is termed as apparent power. In ac circuits, energy is keep temporarily in inductive and electrical phenomenon parts, which results in the periodic reversal of the direction of flow of energy between the supply and therefore the load.

The average power when the completion of 1 whole cycle of the ac wave form is that the real power, and this can be the usable energy of the system and is employed to try and do work, whereas the portion of power flow that is briefly stored within the variety of magnetic or electrical fields and flows back and forth within the conductor because of inductive and capacitive network parts is understood as reactive power.

This is the unused power that the system must incur in order to transmit power. Inductors (reactors) square measure aforesaid to store or absorb reactive power, as a result of the store energy in the form of a field of force. Therefore, once a voltage is initially applied across a coil, a field of force builds up, and the current reaches the total worth when an explicit amount of time. This successively causes this to lag the voltage in phase. Capacitors square measure aforesaid to come up with reactive power, because they store energy within the variety of an electrical field.

Therefore once current passes through the electrical condenser, a charge is made up to provide the total voltage distinction over a certain amount of your time. Therefore in Associate in nursing ac network the voltage across the electrical condenser is often charging. Since, the electrical condenser tends to oppose this change; it causes the voltage to lag behind current in section. In Associate in nursing inductive circuit, we all know the instantaneous power to be:

$$p = \mathrm{VmaxImax}\cos\omega t\cos(\omega t - \theta) \qquad (1)$$

$$p = \frac{\mathrm{VmaxImax}}{2}\,\mathrm{cop} = \frac{\mathrm{VmaxImax}}{2}\cos\theta(1+\cos 2\omega t) + \frac{\mathrm{VmaxImax}}{2}\sin\theta\sin 2\omega t \qquad (2)$$

The instantaneous reactive power is given by:

$$\frac{\mathrm{VmaxImax}}{2}\sin\theta\sin 2\omega t \qquad (3)$$

Here:

p = instantaneous power.
Vmax = Peak value of the voltage waveform.
Imax = Peak value of the current waveform.
ω = Angular frequency.
= 2πf where f is the frequency of the waveform.
t = Time period.
θ = Angle by which the current lags the voltage in phase.

The zero average does not necessarily mean that no energy is flowing, but the actual amount that is flowing for half a cycle in one direction, is coming back in the next half cycle.

FLEXIBLE AC TRANSMISSION SYSTEM (FACTS)

The history of FACTS controllers are often copied back to Seventies once Hingorani given the thought of power electronic applications in installation compensation. From then on, varied researches were conducted on the application of high power semiconductors in transmission systems. The shunt-connected Static power unit compensator (SVC) victimization solid-state switches and therefore the series-connected controllers were planned in ac gear application. In 1988, Hingorani outlined the FACTS idea and represented the wide prospects of the applying. In nowadays, FACTS technology has shown robust potential.

Many samples of FACTS devices and controllers area unit in operation as given in FACTS and FACTS controllers are outlined in IEEE Terms and Definitions as:

1. Versatile AC gear (FACTS): Alternating current transmission systems incorporating power electronic-based and different static controllers to reinforce controllability and increase power transfer capability.
2. FACTS Controller: an influence electronic-based system and different static instrumentality that offer control of 1 or a lot of ac gear parameters.

As new technology for power gear, FACTS and FACTS controllers not solely offer an equivalent benefits as typical compensators with mechanically controlled switches in steady state however additionally improve the dynamic and transient performance of the ability system.

The power electronics-based switches within the purposeful blocks of FACTS will sometimes be operated repeatedly and therefore the switching time could be a portion of a periodic cycle, which is much shorter than the traditional mechanical switches. The advance of semiconductors will increase the change frequency and voltage-ampere ratings of the solid switches and facilitates the applications. maybe, the change frequencies of Insulated Gate Bipolar Transistors (IGBTs) are from three kilohertz to ten kilohertz that is many hundred times the utility frequency of installation (50~60Hz). Gate turnoff thyristors (GTOs) have a change frequency not up to 1 kHz; however the voltage and current rating will reach 5-8 potential units and six Ka severally.

FACTS controllers have several configurations. In general, they'll be categorized into shunt-connected controllers, series-connected controllers and their combinations. Shunt-connecter FACTS controllers are often impedance kind, supported thyristors while not gate turn-off capability, that area unit known as Static power unit Compensator (SVC) for shunt-connected application. Another style of FACTS controllers is converter-based that is typically within the type of a Static Synchronous Compensator (STATCOM).

SHUNT -CONNECTED CONTROLLER

The shunt compensator another name for the shunt connected controller, particularly shunt reactive compensation has been wide employed in gear mechanism to regulate the voltage magnitude, improve the voltage quality, and enhance the system stability. Shunt-connected reactors area unit won't to cut back the road over-voltages by consuming the reactive power, whereas shunt-connected capacitors area unit won't to maintain the voltage levels by compensating the reactive power to cable. A simplified model of a gear mechanism with shunt compensation is shown in Fig.2. The voltage magnitudes of the two buses area unit assumed equal as V, and therefore the point between them is δ. The cable is assumed lossless and drawn by the electrical phenomenon XL. At the point of the transmission line, a controlled capacitance C is shunt connected. The voltage magnitude at the affiliation purpose is maintained as V.

The active powers at bus 1 and bus 2 are equal.

$$P_1 = P_2 = 2\frac{V^2}{X_L}\sin\frac{\delta}{2} \qquad \textbf{(5)}$$

The injected reactive power by the capacitor to regulate the voltage at the mid-point of the transmission line is calculated as:

$$Q_C = 4\frac{V^2}{X_L}\left(1-\cos\frac{\delta}{2}\right) \qquad \textbf{(6)}$$

The transmitted power are often considerably increased, and therefore the peak purpose shifts from δ=90 δ=180.The operation margin and therefore the system stability area unit increased by the shunt compensation. The voltage support function of the centre compensation will simply be extended to the voltage support at the tip of the radial transmission, which is able to be well-tried by the system simplification analysis in a very later section.

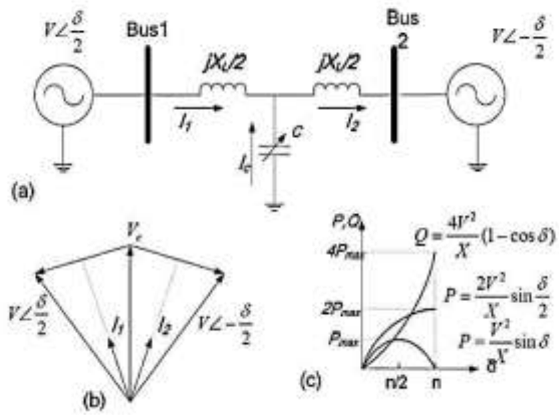

Fig. 2 Transmission System with Shunt Compensation: (a) Simplified Model; (b) Phase Diagram; (c) Power-Angle Curve.

The reactive power compensation at the tip of the radial line is particularly effective in enhancing voltage stability. Today's important producing processes need a stable flow of electricity. Sags, swells, harmonics and flickers square measure the most power quality issues. Although static shunt compensators in each transmission systems and distribution systems have identical structure, their objectives square measure totally different because of their considerations on the facility quality problems. The objectives of shunt compensators in an exceedingly transmission system square measure as given below so as to extend the transmitted power within the transmission lines:

1. Center voltage regulation for line segmentation so as to extend infectious power within the gear mechanism.
2. Finish of line voltage support needs the compensation of hundreds having poor power factor. This will increase the utmost power transmission capability of the line while raising the voltage instability limits.
3. Improvement of transient stability margin by increasing the utmost infectious power in the line.

WORKING PRINCIPLE OF DSTATCOM

One of the numerous devices beneath the FACTS family, a DSTATCOM may be a control device which may be accustomed regulate the flow of reactive power within the system independent of alternative system parameters. DSTATCOM has no long term energy support on the dc aspect and it cannot exchange real power with the ac system. Within the transmission systems, DSTATCOMs primarily handle solely basic reactive power exchange and supply voltage support to buses by modulating bus voltages throughout dynamic disturbances so as to supply higher transient characteristics, improve the transient stability margins and to damp out the system oscillations thanks to these disturbances.

As it clear from Fig. 3, DSTATCOM consists of a three part electrical converter (generally a PWM inverter) mistreatment SCRs, MOSFETs or IGBTs, a dc capacitance that provides the dc voltage for the electrical converter, a link reactor that links the inverter output to the ac offer aspect, filter parts to filter out the high frequency parts thanks to the PWM inverter. From the dc aspect capacitance, a 3 part voltage is generated by the electrical converter. This is often synchronous with the ac supply. The link inductance links this voltage to the ac offer side. This is often the essential principle of operation of DSTATCOM.

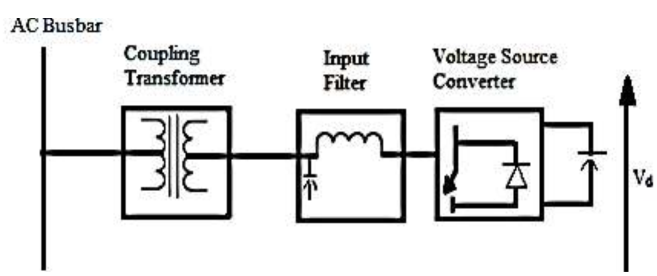

Fig. 3 DSTATCOM Components

For two ac sources that have constant frequency and are connected through a series inductance, the active power flows from the leading supply to the insulating material supply and the reactive power flows from the upper voltage magnitude supply to the lower voltage magnitude supply. The phase distinction between the sources determines the active power flow and therefore the voltage magnitude distinction between the sources determines the reactive power flow. Thus, a DSTATCOM will be accustomed regulate the reactive power flow by dynamic the magnitude of the VSC voltage with relevancy supply bus voltage. It's long been recognized that the steady-state contractible power will be increased and therefore the voltage profile on the road controlled by appropriate reactive shunt compensation. The purpose of this reactive compensation is to change the natural electrical characteristics of the transmission line to create it additional compatible with the prevailing load demand. Thus, shunt connected, fixed or mechanically switched reactors are applied to attenuate line overvoltage below light-weight load conditions, and shunt connected, fastened or automatically switched capacitors are applied to take care of voltage levels below serious load conditions. During this section, basic issues to extend the contractible power by ideal shunt-connected power unit compensation are going to be reviewed so as to produce a foundation for power electronics-based compensation and control techniques to satisfy specific compensation objectives.

The ultimate objective of applying reactive shunt compensation in a very gear mechanism is to extend the transmittable power. This might be needed to enhance the steady-state transmission characteristics furthermore because the stability of the system. Power unit compensation is so used for voltage regulation at the center (or some intermediate) to segment the line and at the top of the (radial) line to stop voltage instability, furthermore as for dynamic voltage management to extend.

DSTATCOM may be a primary shunt device of the FACTS family that uses power natural philosophy to regulate power flow and improve transient stability on power grids. The DSTATCOM regulates voltage at its terminals by controlling the quantity of reactive power injected into or absorbed from the facility system. For strictly reactive power flow the 3 part voltages of the DSTATCOM should be maintained in part with the system voltages. The variation of reactive power is performed by means that of a VSC connected through a coupling electrical device. The VSC uses forced commutated power natural philosophy devices (GTO's or IGBT's) to synthesize the voltage from a dc voltage supply.

The in operation principle of DSTATACOM is explained in Fig. 3.20. It is seen that if V2>V1 then the reactive current flows from the convertor to the ac system through the coupling electrical device by injecting reactive power to the ac system. On the opposite hand, if V2<V1 then current flows from ac system to the convertor by engrossing reactive power from the system. Finally, if V2=V1 then there's no exchange of reactive power. The quantity of reactive power exchange is given by:

$$Q = \frac{v_1(v_1 - v_2)}{x_s} \qquad (7)$$

Where:
V1=Magnitude of System Voltage
V2=Magnitude of DSTATCOM Output Voltage
Xn= Equivalent impedance between DSTATCOM and the system
A capacitor connected on the dc side of the VSC acts as a dc voltage source.

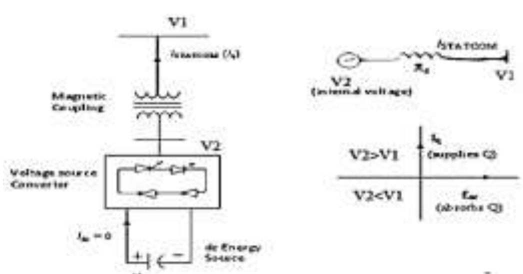

Fig. 4 The Operating Principle of STATACOM

CASCADED MULTILEVEL DSTATCOM CIRCUIT

A cascaded multi-level device circuit is shown in Fig. 5. It's 3|a 3} part VSC that h includes of three single parts and every phase consists of H-bridges connected asynchronous. The 3 phases within the device area unit star connected. Every single part H-bridge device has two arms consisting of 2 pairs of GTO and diode connected in anti-parallel. Every H-bridge has its own capacitor, acting as a voltage supply. Individual capacitors of same capacitance area unit selected to fulfill the economic and harmonic criteria. The height output voltage of DSTATCOM is N-times thereto of the capacitance voltage, wherever N is that the number of H-bridges in every part. Every H-bridge generates 3 voltage levels +Vdc, 0 and –Vdc and also the total output voltage of every part is that the combination of individual H-bridge voltages. A DSTATCOM with converters per part will synthesize 2N+1 voltage levels. Cascade structure inverters are developed for electric utility applications. A cascade M-level electrical converter consists of (M-1)/2 H-bridges within which every bridge's dc voltage is supported by its own dc capacitance. The new inverter can:

1. Generate virtually curved wave voltage while solely switch only once per basic cycle.
2. Dispense with multi-pulse inverters' transformers employed in standard utility interfaces and static volt-ampere compensators.
3. Allows direct parallel or series transformer-less connection to medium- and high-voltage power systems.

In short, the cascade electrical converter is far a lot of efficient and appropriate for utility applications than ancient multi-pulse and pulse dimension modulation (PWM) inverters. The superiority of the new electrical converter is seem in power supply, (hybrid) electrical vehicle (EV) motor drive, reactive power (Var) and harmonic compensation. This project summarizes the options, practicableness, and management schemes of the cascade electrical converter for utility applications together with utility interface of renewable energy, voltage regulation, Var compensation, and harmonic filtering in power systems. Analytical, simulated, and experimental results demonstrated the prevalence of the new inverters.

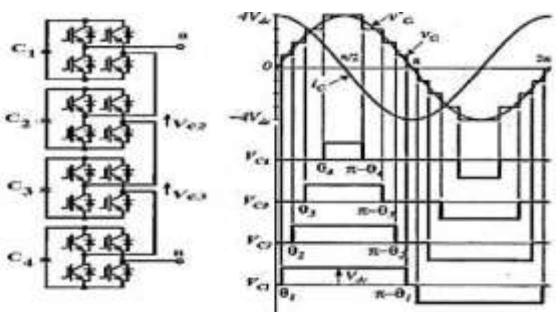

Fig. 5 Cascaded Multi-Level Converter Circuit

The output voltage wave shape of the cascaded N-Level DSTATCOM depends on the shift pattern, which is controlled by the shift angles of the converters. These shift angles may be severally selected, but appropriate shift angles are needed to attain smart quality of the output voltage wave shape. By using SHEM (Selective Harmonic Elimination Modulation), lower order harmonics may be eliminated within the output wave shape. The amplitude of the odd harmonic order of the output voltage with 2N+1 level may be portrayed exploitation Fourier's series methodology as,

$$V_n = \frac{4V_{dc}}{n\pi}\sum_{K=1}^{N}\cos(n\theta_K) \qquad (8)$$

Where

Vn is the amplitude of voltage harmonic of nth order

Vdc is the dc voltage across the capacitor

N is the number of the bridges in each phase

N is the odd harmonic order

θk is the switching angle of the single phase bridge

A 9 level cascaded construction convertor is designed and is simulated in MATLAB Simulink environment. The firing angles of the bridges within the converter are thus chosen such fifth, 7th, eleventh and thirteenth harmonics are eliminated and therefore the THD of part voltage is minimized. For the best values of firing angles the following equations should be resolved (considering the modulation index M = 1).

$$\cos(5\theta_1) + \cos(5\theta_2) + \cos(5\theta_3) + \cos(5\theta_4) = 0$$
$$\cos(7\theta_1) + \cos(7\theta_2) + \cos(7\theta_3) + \cos(7\theta_4) = 0$$
$$\cos(11\theta_1) + \cos(11\theta_2) + \cos(11\theta_3) + \cos(11\theta_4) = 0$$
$$\cos(13\theta_1) + \cos(13\theta_2) + \cos(13\theta_3) + \cos(13\theta_4) = 0$$
$$\cos(\theta_1) + \cos(\theta_2) + \cos(\theta_3) + \cos(\theta_4) = (m-1)M$$

This set of nonlinear transcendental equations (9 to 13) can be solved by iterative methods such as the Newton-Raphson method. We get,

$$\theta_1 = 6.57^\circ, \theta_2 = 18.94^\circ$$
$$\theta_3 = 27.18^\circ, \theta_4 = 45.15^\circ$$

Thus, if the H-bridges are symmetrically switched during the positive half-cycle of the fundamental voltage to +Vdc at 6.57°, +2Vdc at 18.94°, +3Vdc at 27.18° and +4Vdc at 45.l5° and similarly ill the negative half-cycle to –Vdc at 186.57°, −2Vdc at 198.94°,−3Vdc at 207.18° and −4Vdc at 255.15° to eliminate 5th, 7th ,11th and 13th harmonics [5].

SIMULATION & RESULTS ANALYSIS

This paper deals with the planning and implementation of a nine and twenty seven levels voltage supply converter based mostly distribution static synchronous compensator (DSTATCOM),employing a good modulation management technique (sinusoidal pulse breadth modulation) (SPWM) simulated during a MATLAB Simulink surroundings. The main objective of this project is to take care of the voltage stability by compensating the reactive power within the installation. Hence, a replacement economical strategy is planned, so as to reduce the voltage fluctuations like sag and swell conditions and additionally to isolate current and voltage harmonics within the transmission system. The structure DSTATCOM which may be used at the purpose of common coupling (PCC), for improving power quality is sculptured and simulated exploitation proposed management strategy and also the performance is compared by applying it to a110 kV line with and while not DSTATCOM.

The twenty seven levels DSTATCOM is associate improvement step to the nine levels that manufacture by the structure supply voltage converter based mostly DSTATCOM. The DSTATCOM regulates voltage at its terminals by dominant the number of reactive power injected into or absorbed from the ability system. For purely reactive power flow the 3 section voltages of the DSTATCOM should be maintained in section with the system voltages. The variation of reactive power is performed by means of a VSC. The VSC uses forced commutated power electronics devices (GTO's or IGBT's) to synthesize the voltage from a dc voltage supply.

The Fig. 6 showed the electric power distribution system without DSTATCOM.

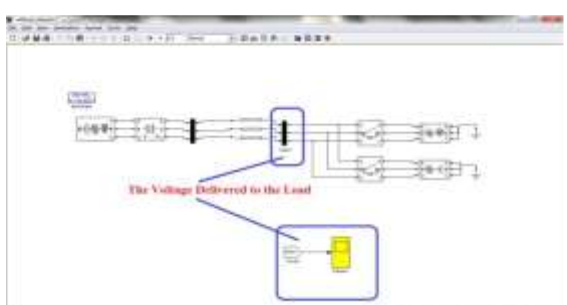

Fig. 6 the Load without DSTATCOM

The Fig. 7 has shown the Simulink model of the 9-LEVELS DSTATCOM.

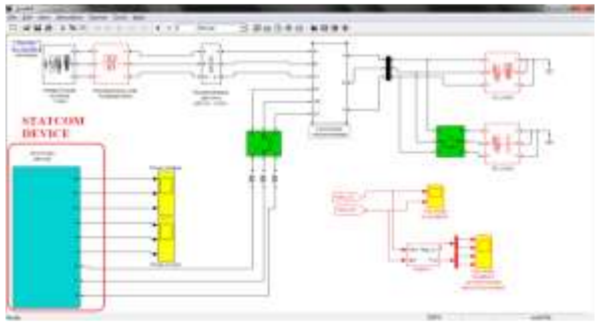

Fig.7 Simulink Model of the Nine Levels DTATCOM

The generation supply for this model may be a 3 phase supply (110 potential unit and fifty Hz). The conductor is expanded for (300 Km) to succeed in the destination space. There are 2 mounted hundreds connected to the transmission lines: fix inductive load (R= three hundred ohm and L= one.537*10-3H) and glued capacitive load (R= fifty ohm and C= one.0 F). In the nine levels construction STATCOM there was four dc Sources to attain the nine levels output in every section and for conversion method I used with every dc supply four IGBT/Diode. Thus in one phase I clinical trial used sixteen IGBT/Diode because I actually have four dc sources and therefore the total IGBT/Diode for three phases is forty eight switches. this is often a large variety of switches and therefore the model are going to be complicated and after all the losses are going to be additional and therefore the management style are going to be dangerous to control on this variety of switches in correct manner. All that and that simply name nine levels thus what's the situation once I got to improve that model from 9levels to twenty seven levels. initial to come up with that twenty seven level we want to 13dc supplies and every dc source has four IGBT/Diode so in one phase I clinical trial have fifty two switches and for 3 phases we need to use 156 switches. This is often a large variety of switches and therefore the model are going to be thus complicated and that we would like numerous pulse generators to manage the gate triggering for all the switches and in correct manner additionally for that, the installation area is massive and expensive. Rather than that I used here new kind of construction electrical converter with scale back variety of switches as well as dc sources fed for STATCOM.

THE 27 LEVELS STATCOM SIMULATION

The simulation of the twenty seven level is shown in Fig. 8 and there's no 2 a lot of distinction between this model and the model in of the 9 levels within the main blocks however the difference within the DSTATCOM controller. The twenty seven level model consist of the (Three-Phase supply, Three-Phase Series RLC Branch, Three-Phase electrical device (Two Windings) ,Three-Phase V-I measuring ,Three-Phase Breaker and there are the hundreds.

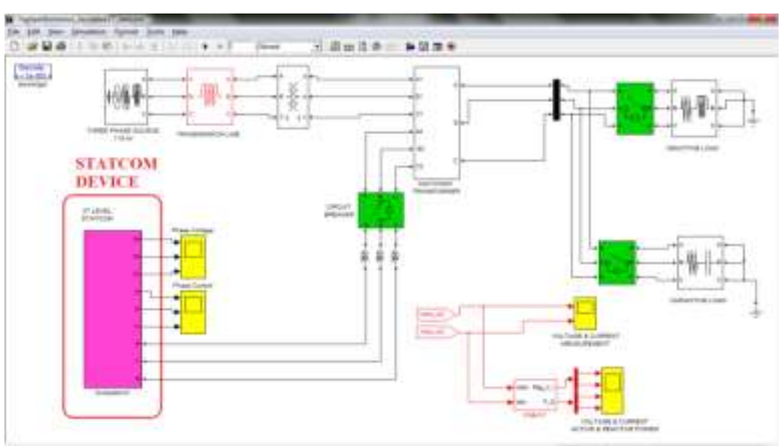

Fig. 8 The Simulation of Electrical Network with 27 Levels DSTATCOM

RESULT ANALYSIS

The Load without STATCOM

If the simulation of that system in achieved, and the scope in the Fig. 4 is explored we can see the sag, swell, harmonic and voltage fluctuations appear clearly as it illustrated in Fig. 9

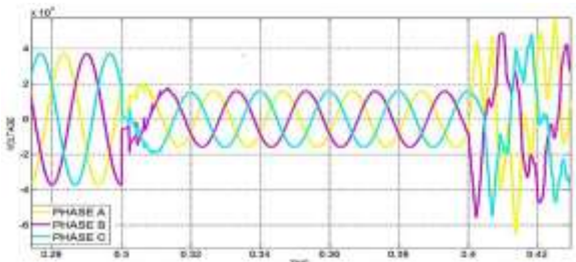

Fig. 9 The Load in the Voltage Delivered to the Load.

The Load with 9 Levels DSTATCOM

The figure 10 showed the state of the voltage profile and the current after the simulation

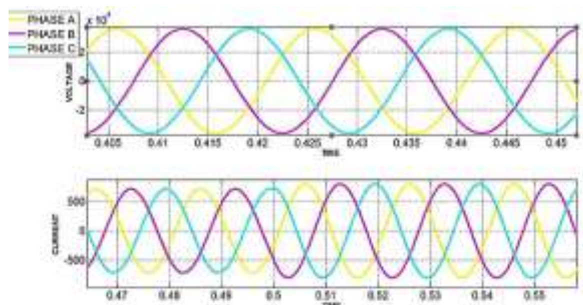

Fig.10. The voltage and Current Waveforms after Compensation.

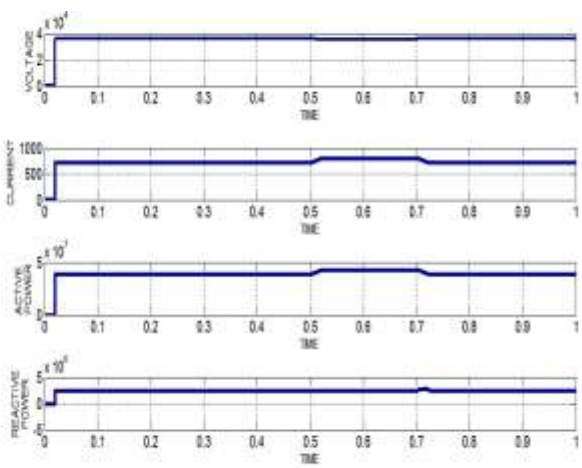

Fig.11 The Voltage, Current, Active power & Reactive Power Simulation.

The Load with 27 Levels DSTATCOM

Referring to the two scopes in the Fig. 6, the first one simulate the voltage and current. The Fig. 10 shown the voltage and current delivered to the load; it's the result obtained from first scope.

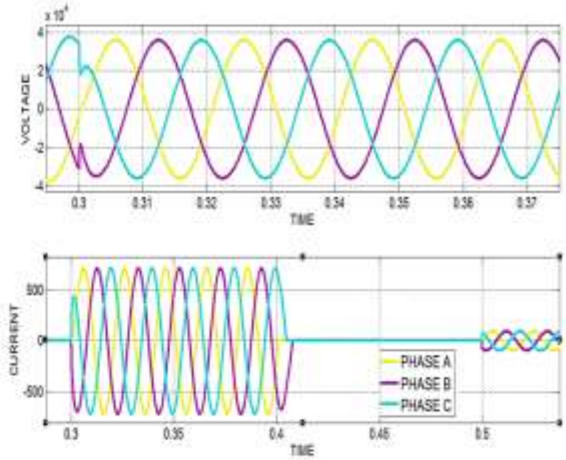

Fig. 12 The Voltage and Current after Compensation

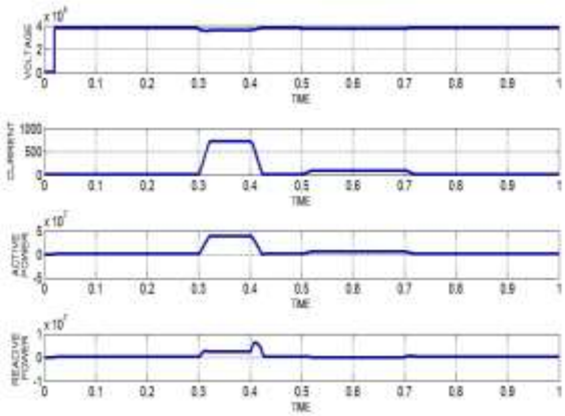

Fig.13 The Voltage, Current, Active Power & Reactive Power Simulation.

THE COMPARISON BETWEEN THE TWO MODELS

The optimal values for the load is (voltage = 37 Kv, current = 715 A, active power 38 MW, reactive power = 2.4 MVar), to achieve the better and constant operation of that loads..The TABLE 1 shown the disturbances in the voltage and current

TABLE1: The disturbances in the Destination Area without compensation

	THE EVENTS	TIME PERIODE (s)	MAGNITUDE (Kv)
VOLTAGE	HARMONIC AND SAG	0.3-0.32	37 - 20 = 17
	SAG	0.32 - 0.4	37 - 16 = 21
	SWELL	0.4-0.5	44 - 37 = 7 57 -37 = 20
	FLUCTUATIONS	0.6 - 0.8	44 - 37 = 7 (swell) 43-37 = 7 (swell) 38- 37=1 (swell)

TABLE2: The Quantities Reached Load after Compensation of 9 Levels SDTATCOM

	THE EVENTS	TIME PERIODE(s)	MAGNITUDE(Kv)
VOLTAGE	HARMONIC	NONE	
	SAG		
	SWELL		
	FLUCTUATIONS		

	THE EVENTS	TIME PERIODE(S)	MAGNITUDE (A)
CURRENT	SWELL	0.5 - 0.7	600 - 517 = 85

	THE EVENTS	TIME PERIODE(s)	MAGNITUDE (MW)
ACTIVE POWER	SWELL	0.5 - 0.7	42 - 38 = 4

	THE EVENTS	TIME PERIODE(s)	MAGNITUDE(Mvar)
REACTIVE POWER	SWELL	0.7 - 0.73	2.8 - 2.4 = 0.4

It is represent the overall looking to what happen after the compensation process by 27 levels STATCOM and what is the voltage, current, active power delivered to the load.

TABLE3: The Quantities Reached Load after Compensation of 27 Levels STATCOM

	THE EVENTS	TIME PERIODE(S)	MAGNITUDE(Kv)
VOLTAGE	SAG	0.3-0.42	37-35=2

	THE EVENTS	TIME PERIODE(S)	MAGNITUDE(A)
CURRENT	HUGE SAG	0-0.3 0.4-0.5 0.7-1	JUST 0.076
	SAG	0.5-0.7	JUST 93

	THE EVENTS	TIME PERIODE(s)	MAGNITUDE(MW)
ACTIVE POWER	HUGE SAG	0-0.3, 0.428-0.5, 0.725-1	only 4000w
	SAG	0.5-0.752	JUST 5.28

	THE EVENTS	TIME PERIODE(s)	MAGNITUDE(Mvar)
REACTIVE POWER	HUGE SAG	0-0.3, 0.428-0.7, 0.725-1	NEARLY ZERO
	SAG	0.7-0.725	ONLY 0.5
	SWELL	0.4-0.426	6.5-2.4= 4.1

From the table three we will see the subsequent

1. Within the voltage profile there are a unit sag happens within the period (0.3 – 0.42s). The voltage decrease to succeed in the thirty five kilovolt in throughout this era, that's mean there area unit decreasing within the voltage by two kilovolt.

2. Within the current there are a unit Brobdingnagian deceasing within the current within the durations (0- zero.3s), (0.4 – 0.5) and (0.7 -1s), this there's simply zero.076A no a lot of. This can be terribly Brobdingnagian sink within the current which create huge downside within the load facet. Within the period (0.5 – 0.752s) this increasing however not an excessive amount of which additionally represent a giant sag, this price not exceed 93A.
3. Within the active power the situation not far better than this. There are a unit hug sag within the active power reached to the load within the durations (0-0.3s), (0.428- 0.5s) and (0.725-1) it's no more than 4000W. Within the period (0.5- 0.752s) the active power in exaggerated very little to succeed in to five.28 MW only, the load have to be compelled to thirty eight Mw to satisfy it.
4. The reactive power compensation isn't well ever, it have several distortion events. From Table four.3 we will see that the reactive power is sort of zero within the durations (0- zero.3s), (0.428- 0.7) and (0.725- 1). this can be dangerous event, that mean there's no compensation all told that durations which cause disturbance within the voltage and within the current as we tend to see from purpose one and a pair of on top of. Not simply that, there's another sag within the reactive power within the period (0.7- 0.752) and therefore the reactive power exaggerated to succeed in solely zero.5 MVar. The period (0.4 – 0.426) witness associate increasing within the reactive power to succeed in to six.5 MVar, that mean there are a unit increase by four.1 MVar throughout this era. The load desires no more two.4 MVar reactive powers to receive a pure thirty seven kilovolt voltage with none swell or sag.

CONCLUSION

The necessary issue within the finish of this paper is that the selecting of the 9 levels STATCOM device to realize the compensation, overcome on all the disturbances and deliver a pure voltage, current, active power and reactive power to the destination space (the Load) through the (110 Kv) line. Those coming back from study all the STATCOM devices between the nine levels and therefore the twenty seven levels. the selection was the selecting the later models as a result of they're the higher within the compensation method and maintain the voltage stabile for the load. the ultimate issue was selecting only 1 model from them and counting on the simulation results, the 9 level STATCOM was the model it a lot of capable to try and do the task in good manner, simpler style, less losses and fewer triggering circuit.

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