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Power System Stability Enhancement using Static Synchronous Series Compensator Through FACTS

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***Abstract*--A power system is becoming more complex and heavily loaded day by day. Earlier electric power systems were small and localized. Thus, Real and reactive power compensation in transmission line is essential which will improve the stability of ac system. Flexible Alternating Current Transmission System (FACTS) technology provides new opportunity to control the power and enhancing the capacity of the present as well as new line sit is used to investigate the effect of this device in controlling active and reactive powers as well as damping power system oscillations in transient mode. A Transmission line needs controllable compensation for power flow control and voltage regulation. This can be achieved by FACTS controllers. The employed compensators are three-phase (IGBT) based, Pulse Width Modulation (PWM) operated Converter (VSC). The proposed control employ proportional-integral (PI) controller to generate a constant error.**

Static Synchronous Series Compensator (SSSC) is series reactive power compensation to a power system. The output of an SSSC is series injected voltage, which leads or lags line current by 90°, thus emulating a controllable inductive or capacitive reactance. SSSC can be used to reduce the line impedance and enhance the active power transfer capability of the line. With the parameters and control, the SSSC is found effective to regulate load voltage during sudden change of the loads. The SSSC also provides stable operation with dynamic induction motor load and mitigates the unstable and oscillating behaviour that is resulting during the operation of compensated Alternator with dynamic motor load.

The presented results prove that SSSC systems provide satisfactory performance The advantage of this approach is that it can handle the nonlinearities, at the same time it is faster than other conventional controllers and it improve the reactive power of the system. Simulation studies will be carried out in MATLAB/Simulink environment to evaluate the effectiveness of the proposed Static synchronous series compensator (SSSC). Results will show that the proposed SSSC based damping controllers improve the damping performance event of a major disturbance as well as Reactive power control.

Keywords*— Static Synchronous Series Compensator (SSSC), Pulse Width Modulation (PWM), Flexible Alternating Current Transmission System (FACTS), Voltage Source Converter(VSC).

I. INTRODUCTION

Nowadays, the need for flexible and fast power flow control in the transmission system is anticipated to increase in the future in view of utility deregulation and power wheeling requirement. The utilities need to operate their power transmission system much more effectively, increasing their utilization degree. Reducing the effective reactance of lines by series compensation is a direct approach to increase transmission capability. However power transfer capability of long transmission lines is limited by stability considerations. Because of the power electronic switching capabilities in terms of control and high speed, more advantages have been done in FACTS devices areas and presence of these devices in transient stability during transient faults resulting in improvement in power system stability

The power systems of today, by and large, are mechanically controlled. There is a widespread use of microelectronics, computers and high- speed communications for control and protection of present transmission systems; however, when operating signals are sent to the power circuits, where the final power control action is taken, the switching devices are mechanical and there is little high-speed control. Another problem with mechanical devices is that control cannot be initiated frequently, because these mechanical devices tend to wear out very quickly compared to static devices. In effect, from the point of view of both dynamic and steady-state operation, the system is really uncontrolled. Power system planners, operators, and engineers have learned to live with this limitation by using a variety of ingenious techniques to make the system work effectively, but at a price of providing greater operating margins and redundancies. These represent an asset that can be effectively utilized with prudent use of FACTS these represent an asset that can be effectively utilized with prudent use of FACTS The FACTS devices (Flexible AC Transmission Systems) could be a means to carry out this function without the drawbacks of the electromechanical devices such as slowness and wear.

FACTS can improve the stability of network, such as the transient and the small signal stability, and can reduce the flow of heavily loaded lines and support voltages by controlling their parameters including series impedance, shunt impedance, current, voltage and phase angle. Controlling the power flows in the network leads to reduce the flow of heavily loaded lines, increased system load ability, less system loss and improved security of the system.

The static synchronous series compensator (SSSC) FACTS controller is used to prove its performance in terms of stability

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improvement. A Static Synchronous Series Compensator (SSSC) is a member of F ACTS family which is connected in series with a power system. It consists of a solid state voltage source converter (VSC) which generates a controllable alternating current voltage at fundamental frequency. When the injected voltage is kept in quadrature with the line current, it can emulate as inductive or capacitive reactance so as to influence the power flow through the transmission line. While the primary purpose of a SSSC is to control power flow in steady state, it can also improve transient stability of a power system. Here PI controller is used to control the parameters of the power system.

II. STATIC SYNCHRONOUS SERIES COMPENSATOR

A Transmission line needs controllable compensation for power flow control and voltage regulation .This can be achieved by FACTS controllers. Static Synchronous Series Compensator (SSSC) is a series connected FACTS controller, which is capable of providing reactive power compensation to a power system. It injects an almost sinusoidal voltage with variable amplitude. It is equivalent to an inductive or a capacitive reactance in series with the transmission line.

The heart of SSSC is a VSI (voltage source inverter) that is supplied by a DC storage capacitor. With no external DC link, the injected voltage has two parts. The main part is in quadrature with the line current and emulates an inductive or capacitive reactance in series with the transmission line, and a small part of the injected voltage is in phase with the line current to cover the losses of the inverter. When the injected voltage is leading the line current, it will emulate a capacitive reactance in series with the line, causing the line current as well as power flow through the line to increase. When the injected voltage is lagging the line current, it will emulate an inductive reactance in series with the line, causing the line Current as well as power flow through the line to decrease.

A) Principle of Operation:

A series capacitor compensates the transmission-line inductance by presenting a lagging quadrature voltage with respect to the transmission-line current. This voltage acts in opposition to the leading quadrature voltage appearing across the transmission line inductance, which has a net effect of reducing the line inductance. Similar is the operation of an SSSC that also injects a quadrature voltage, V_C proportion to the line current but is lagging in phase. The figure 1 below shows the schematic diagram of Static Synchronous Series Compensator.

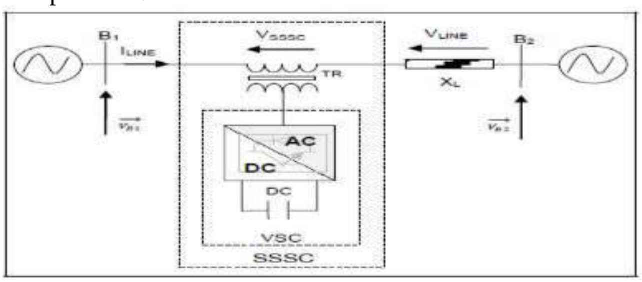

Fig.1 Static series synchronous compensator

B) Elementary two-machine system with an SSSC and the associated phasor Diagram:

An SSSC comprises a voltage source inverter and a coupling transformer that is used to insert the ac output voltage of the inverter in series with the transmission line.is shown in fig 2, the magnitude and phase of this inserted ac compensating voltage can be rapidly adjusted by the SSC controls. The SSSC injects the compensating voltage in series with the line irrespective of the line current. The transmitted power Pq, therefore becomes a parametric function of the injected voltage,

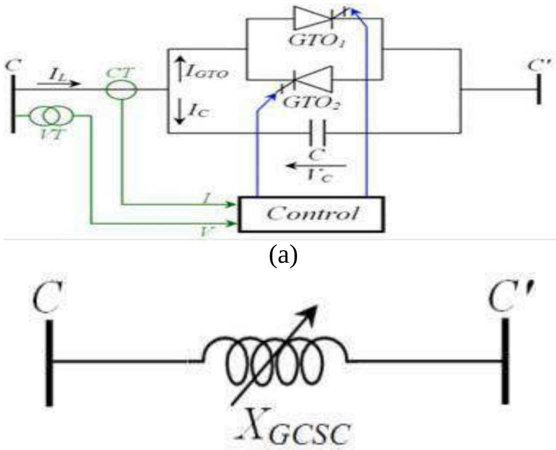

Fig.2 Transmission line in presence of GCSC system (a) Principle, (b) Apparent reactance

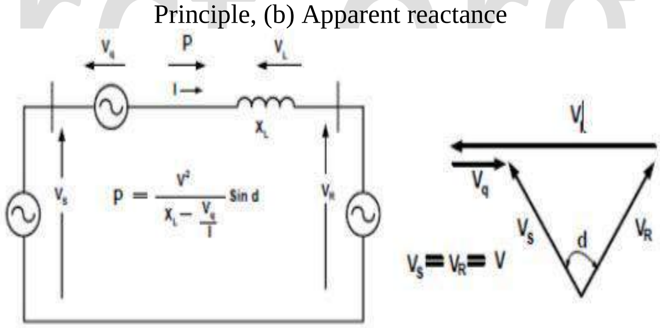

Fig.3 Elementary two-machine system with an SSSC and the associated phasor Diagram

The real and reactive power (P and Q) flow at the receiving end voltage source are given by the expressions

$$P = \frac{Vs\,Vr}{X_L}\sin\,(\delta_{s-}\ \delta_r) = \frac{V^2}{X_L}\sin\delta \qquad (1)$$

$$Q = \frac{Vs\,Vr}{X_L}(1\text{-}\cos(\delta_{s-}\ \delta_r)) = \frac{V^2}{X_L}(1\text{-}\cos\delta) \qquad (2)$$

Where V_S and Vr are the magnitudes and ∂s and ∂r are the phase angles of the voltage sources Vs and Vr respectively. For simplicity, the voltage magnitudes are chosen such those

$$\delta = (\delta_{s-}\ \delta_r) \qquad (3)$$

An SSSC, limited by its voltage and current ratings, is capable of emulating a compensating reactance Xq (both inductive and capacitive) in series with the transmission line inductive

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reactance X_L, Therefore, the expressions for power flow given in equation (l & 2) becomes

$$P_q = \frac{V^2}{X_{eff}} \sin\delta = \frac{V^2}{X_L(1-\frac{X_q}{X_L})} \sin\delta \quad (3)$$

$$Q_q = \frac{V^2}{X_{eff}}(1-\cos\delta) = \frac{V^2}{X_L(1-\frac{X_q}{X_L})} (1-\cos\delta) \quad (4)$$

Where X_{eff} is the effective reactance of the transmission line between its two ends, including the emulated variable reactance inserted by the injected voltage source of the Static Synchronous Series Compensator (SSSC). The compensating reactance X_q is defined to be negative when the SSSC is operated in an inductive mode and positive when the SSSC is operated in a capacitive mode.

III. CONTROL SYSTEM OF STATIC SYNCHRONOUS SERIES COMPENSATOR

Depending upon the system conditions and the loads entering/getting out, the injected voltage and current to the circuit are changed so in this way SSSC resembles variable reactance. The series converter of SSSC is shown in fig (4) which is used by SSSC in order to respond to the dynamic and transient changes created in system. The system consists of two generating machines along with transmission line and load as shown in figure. The compensator is provided with a DC voltage source which helps in feeding or absorbing the active and reactive power from the system.

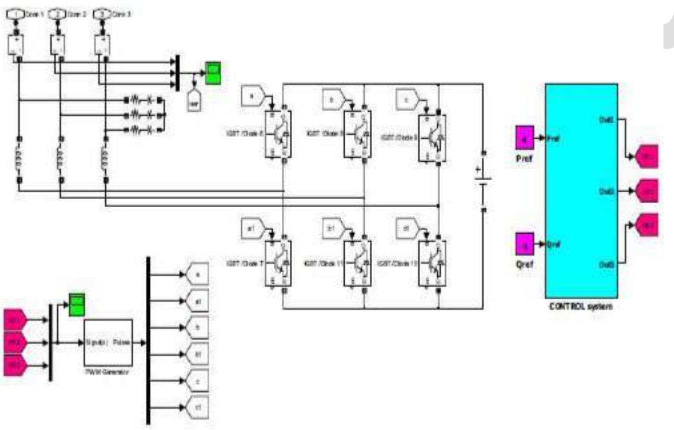

Fig.4 The convertor of SSSC

The control circuit in which the two sides of the converter are connected to AC system on one side and capacitor & battery on the other side. The battery we assumed here is a DC source. If any dynamic change occurs in the system the SSSC circuit works in accordance with the control circuit. The converter converts the energy of battery to the ac form and on injecting this voltage to the circuit the changes will be damped appropriately.

The control circuit is used to control the active and reactive powers of bus-2. For controlling the powers, first, sampling from the voltage and current is done and transformed to the dq0 values. Using the voltage and current in dq0 references the active and reactive powers of bus-2 are calculated and compared with the determined reference. The error signal produced is given to the PI controllers. We can try to achieve the zero signal error by adjusting the parameters of the PI controllers such that powers can follow the reference powers precisely. Then, the output of the controllers is transformed to the abc reference and is given to the PWM.

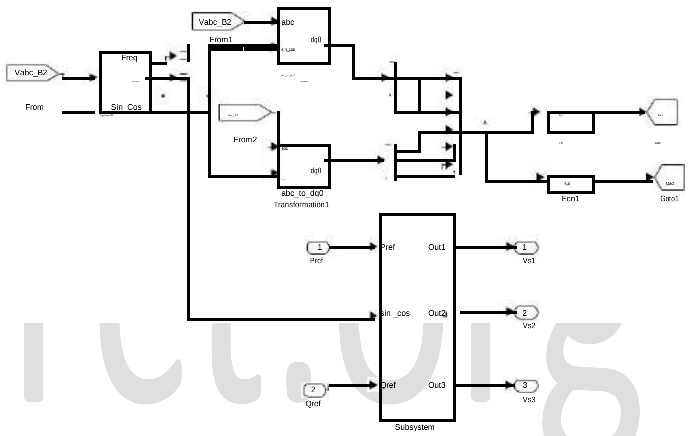

Fig.5 Simulated control circuit of SSSC

Two Machine Power System Modeling:

The performance of SSSC is presented by voltage and current waveforms in the two machine power system. The system shown in Fig (6) has been obtained by using MATLAB software. In the simulation one SSSC has been utilized to control the power flow in the 500 KV transmission systems. This system which has been made in ring mode consists of 4 buses (B1 to B4) connected to each other through three phase transmission lines L1, L2-1, L2-2 and L3 with the length of 280, 150, 150 and 50 km respectively. Two power plants supplies the system with the phase-to-phase voltage equal to 13.8 kv. Active and reactive powers injected by power plants 1 and 2 to the power system are presented by using base parameters Sb=100MVA and Vb=500KV, which are (24-j3.8) and (15.6-j0.5) per unit, respectively. Measured value and reference value of active and reactive power are compared and error signal is given by PI controller. The output of the controllers is transformed to abc value.

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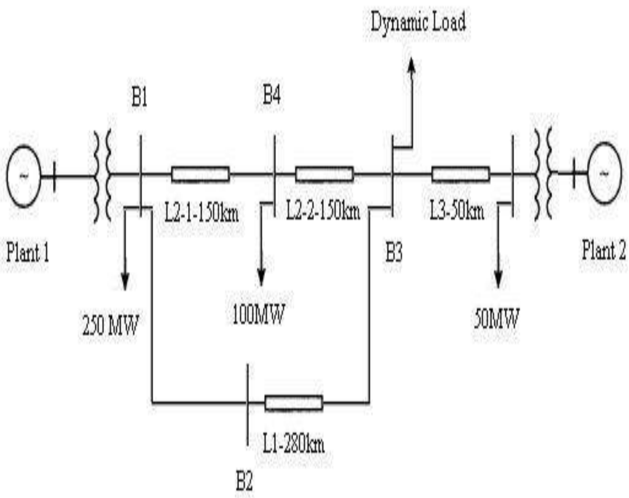

Fig.6 Two machine power system

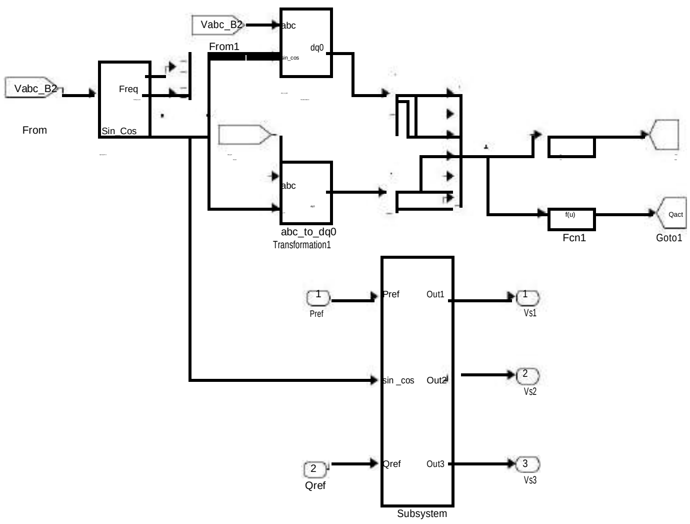

Fig.7 Simulation model of sssc controller

Table1 Specification and Parameters of Model

Specifications	System parameters
Generator G1 or Machine M1	2100 MVA, 13.8 KV
Generator G2 or Machine M2	1400 MVA, 13.8 KV
Transformer (TR1)	2100 MVA, 13.8 KV / 500 KV
Transformer (TR2)	1400 MVA, 13.8 KV / 500 KV
System phase to phase Voltage	13.8 KV
Transmission line	500 KV
Load	2000 MVA
Base Parameters	(MVA)base = 100 MVA
Line length	L1 = 280km, L2 = 150km, L3 = 150km, L4 =50km

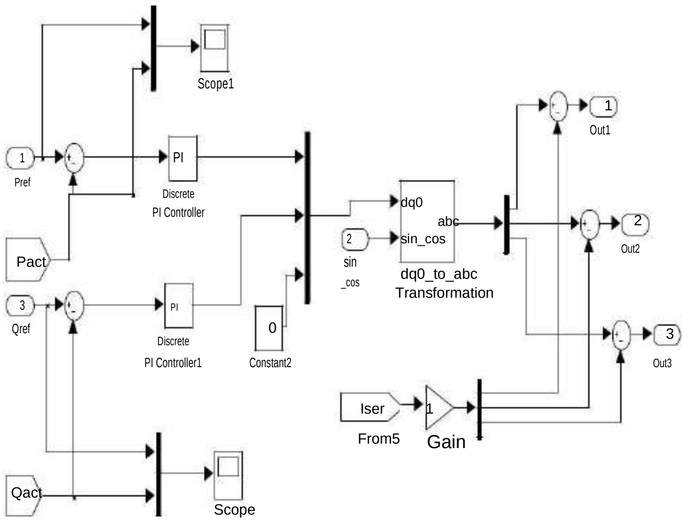

Fig.8 Internal design of SSSC controller

IV. RESULTS AND DISCUSSIONS

Simulation diagram of SSSC Controller:

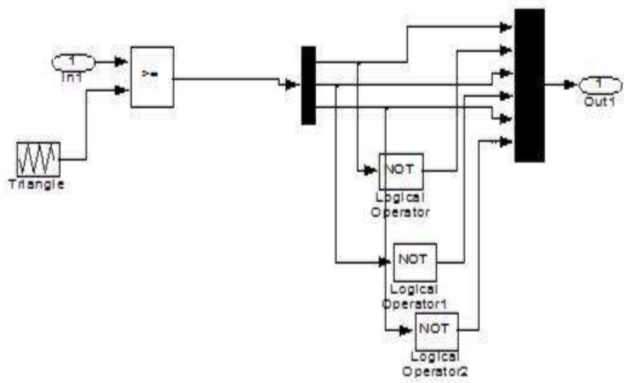

Fig.9 PWM Generation

In this control scheme, (Refer the fig 8) P_{ref} is taken as 4pu and Q_{ref} is taken as -1 pu is taken. The instantaneous power is obtained in terms of d-q quantities of voltages and currents as below,

$$P_{act} = V_d.\, Id + V_q.\, I_q \qquad (5)$$

$$Q_{act} = V_q.\, Id + V_d.\, I_q \qquad (6)$$

The voltage and current of bus-2 in dq0 references are used to find out active and reactive powers of bus-2 and are compared with the determined reference values and thus error signal is produced which is further given to the PI controllers. By adjusting parameters of the PI controllers, our goal is to achieve the zero signal error. Then, the output of the controllers are converted to the abc frame of reference and given to the SPWM. In SPWM, the reference wave is sinusoidal wave and carrier wave is triangular wave in fig (9)

Simulation schematic diagram with static synchronous series compensator (SSSC):

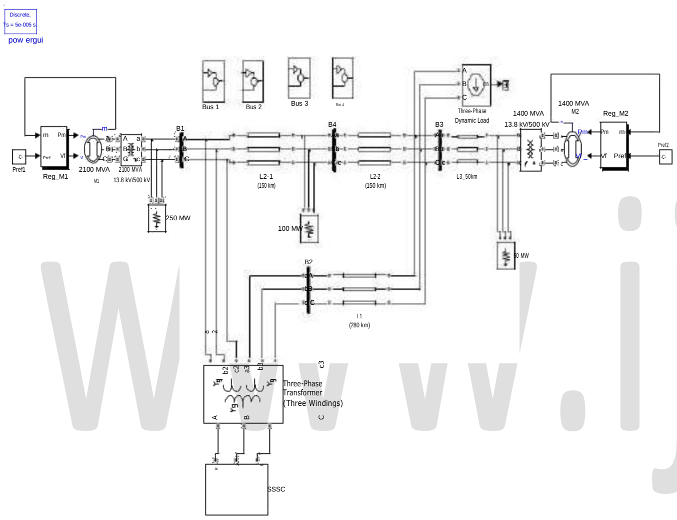

Fig.10 Simulation Diagram with sssc

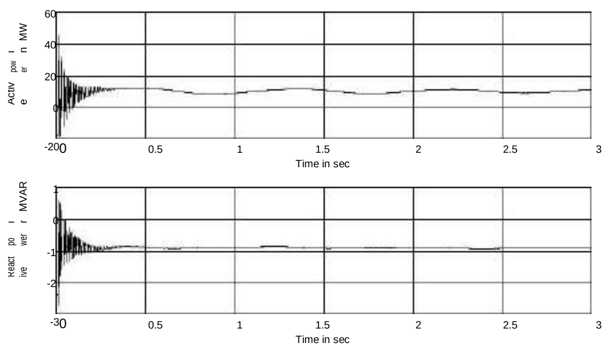

Fig.11 Active and reactive power waveform with SSSC

Active and Reactive power at bus 2 when SSSC is connected. Whenever SSSC is connected to the system, active power damping time will get reduced than that of the mode without SSSC. In case of without SSSC damping time was near about 3 cycle or sec. whereas in case of SSSC mode, time is 2 to 2.5 cycles. After connecting SSSC, controlling the power flow at bus-2, we want to keep the constant voltage 1 pu. Active power also increases to 10.55 and Reactive power is -1 while connecting of SSSC.

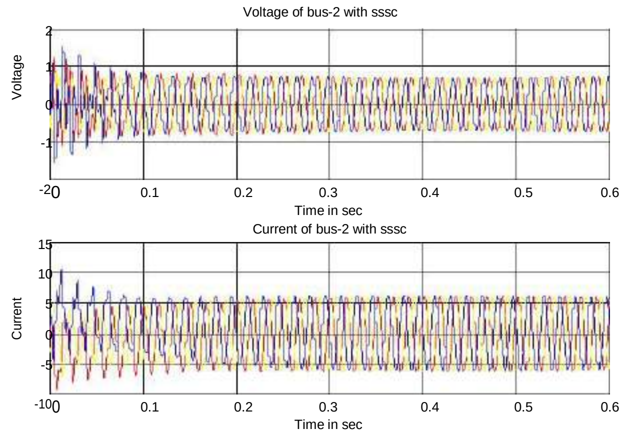

Fig.12 Voltage and current waveform with SSSC

Voltage and Current Waveform are shown in fig (12) which are relatively same as that of sinusoidal waveforms. The voltage amplitude is near to 1 p.u and current amplitude is near about 6.20 p.u.

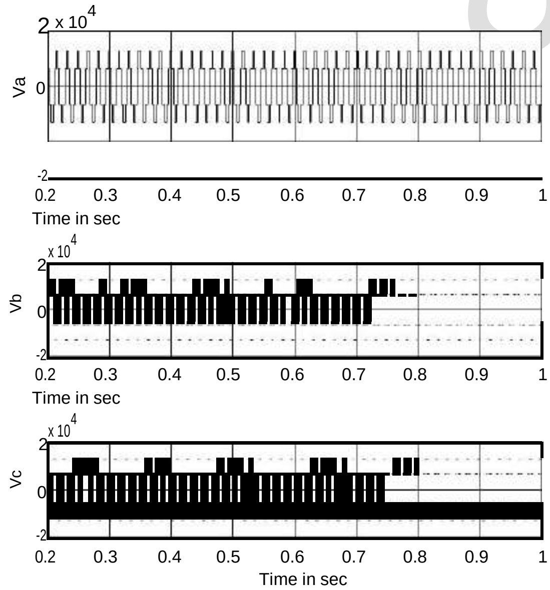

Fig.13 Inverter output voltage

The above shows the inverter output voltage it nearly $1.6*10^4$ voltage is injected to the system.

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Two machine power system model in MATLAB (Without SSSC and with fault):

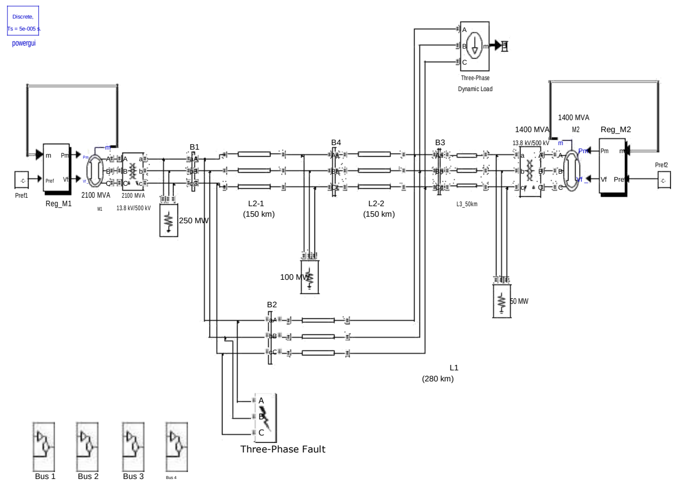

Fig.14 Simulation model without SSSC with Fault

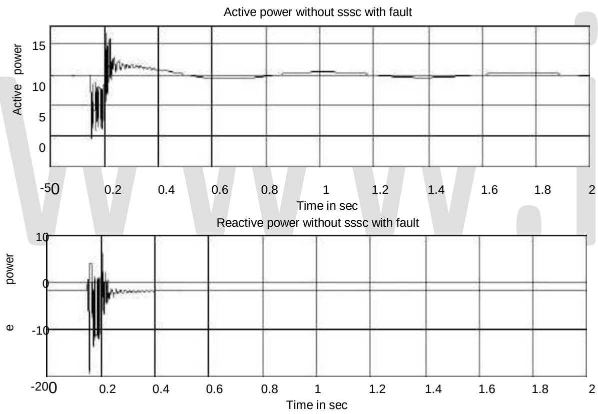

Fig.15 Active and reactive power waveform with (L-G) fault without SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-G fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig.15 shows Active and reactive power at bus 2 without SSSC but with fault.L-G fault has been occurred on transmission system. Fault can make disturbance in the system for a greater time. Fault occur at 0.15 to 0.2 cycles.in figure during the period of occurance of fault, Active power drastically reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out nearly 1.8 to 2 cycles. During fault,reactive power reduces to negative value. The time required to damped out oscillation near about 1 to 1.2 sec. and also avg Active power is 9.847 and Reactive power is -1.829 without connecting of SSSC.

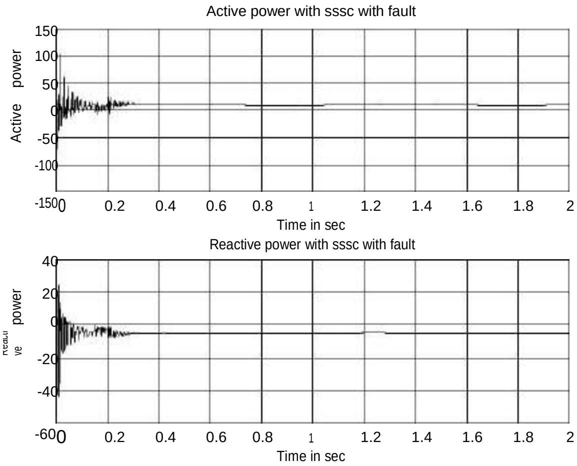

Fig.16 Active and reactive power waveform with (L-G) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-G fault is occur at bus 2 and system performance is checked with SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig.16 shows Active and reactive power at bus 2 with SSSC but with fault. L-G fault has been occurred on transmission system. Fault can make disturbance in the system for a greater time. Fault occur at 0.15 to 0.2 cycles.in figure during the period of occurance of fault, Active power nearly reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out nearly 1.2 to 1.4 cycles. During fault,reactive power reduces to negative value. The time required to damped out oscillation near about 0.3 to 0.4 sec. and also avg Active power is 10.03 and Reactive power is -5.06 with connecting of SSSC.

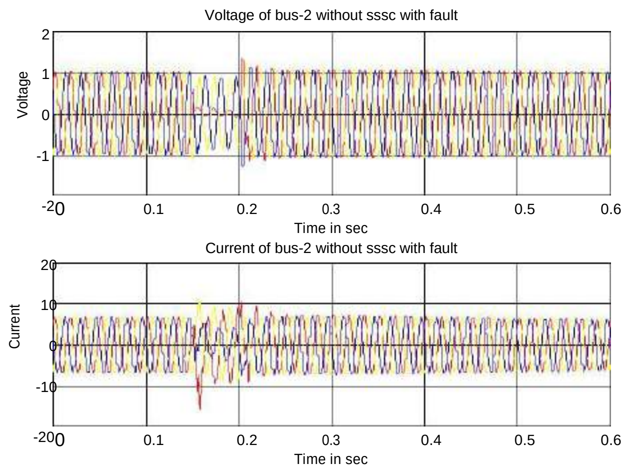

Fig.17 Voltage and Current waveform with (L-G) fault without SSSC with A ground R.of=1.66 and Fault Resistance of = 1 o

Here, a L-G fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig 6.13 shows Voltage and Current at bus 2 without SSSC but with fault. During a L-G fault voltage is reduced to zero. At the same time magnitude of current is high as compared to healhy phases.

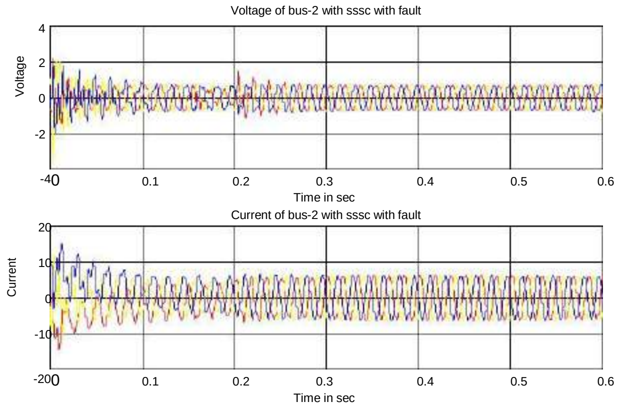

Fig.18 Voltage and Current waveform with (L-G) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-G fault is occur at bus 2 and system performance is checked with SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig 6.14 shows Voltage and Current at bus 2 with SSSC but with fault. During a L-G fault voltage is injected to the line. At the same time magnitude of current is constant.

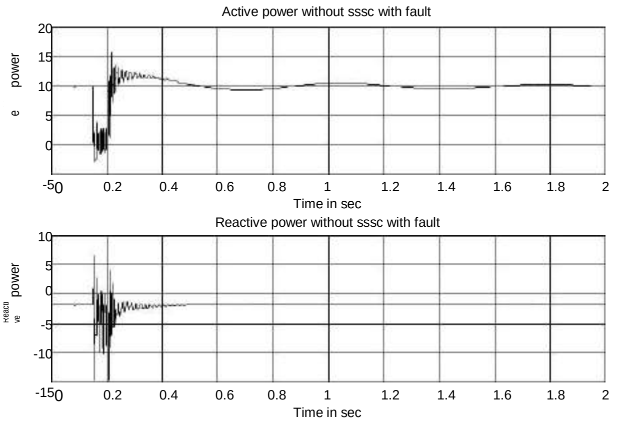

Fig.19 Active and reactive power waveform with (L -L-G) fault without SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-L-G fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig.19 shows Active and reactive power at bus 2 without SSSC but with fault.L-G-G fault has been occurred on transmission system. Fault can make disturbance in the system for a greater time. Fault occur at 0.15 to 0.2 cycles.in figure during the period of occurance of fault, Active power drastically reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out nearly 1.8 to 2 cycles. During fault,reactive power reduces to negative value. The time required to damped out oscillation near about 0.6 to 0.8 sec. and also avg Active power is 9.902 and Reactive power is -1.818 without connecting of SSSC.

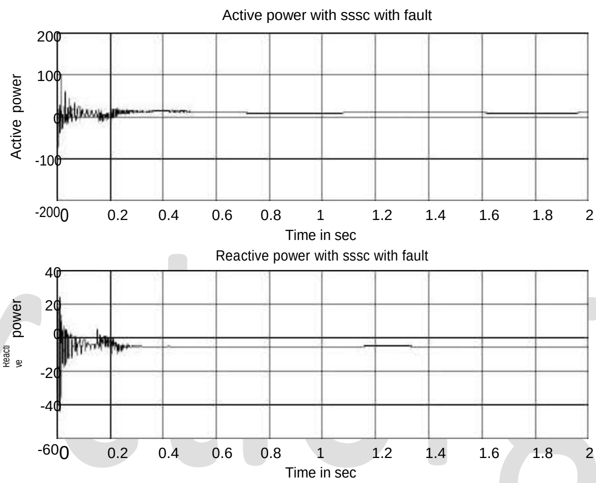

Fig.20 Active and reactive power waveform with (L-L-G) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-L-G fault is occur at bus 2 and system performance is checked with SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig.20 shows Active and reactive power at bus 2 with SSSC but with fault. L-L-G fault has been occurred on Transmission system. Figure 6.16 shows during the period of occurance of fault, Active power nearly reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out nearly 0.6 to 0.8 cycles. During fault,reactive power reduces to negative value. The time required to damped out oscillation near about 0.25 to 0.4 sec. and also avg Active power is 9.996 and Reactive power is -5.05 with connecting of SSSC.

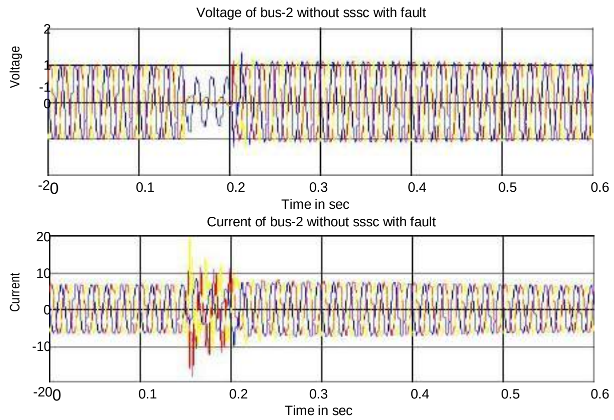

Fig.21 Voltage and Current waveform with (L-L-G) fault without SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-LG fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transition time of [0.15 0.2]. Fig.21 shows Voltage and Current at bus 2 without SSSC but with fault. During a L-L -G fault voltage is drop to zero. At the same time magnitude of current is high as compared to healhy phase.

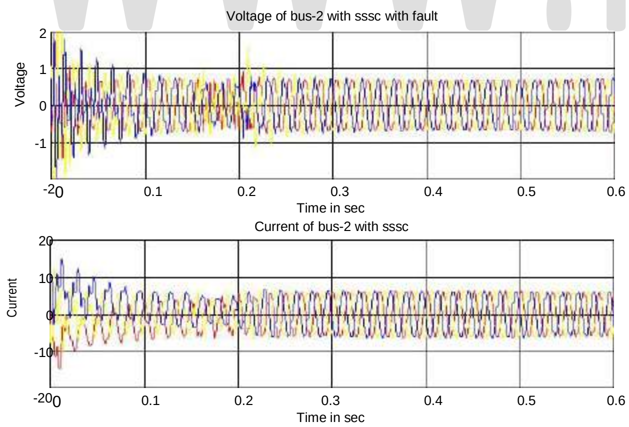

Fig.22 Voltage and Current waveform with (L-L-G) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

When a L- LG fault is occur at bus 2 and system performance is checked with SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig 6.18 shows Voltage and Current at bus 2 with SSSC with fault. During a L-L-G fault voltage is injected to the line. At the same time magnitude of current is constant

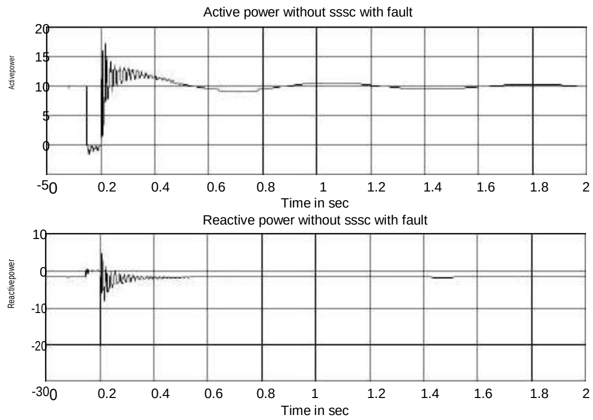

Fig.23 Active and reactive power waveform with (L- L-L-G) fault without SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-L-G fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transition time of [0.15 0.2]. Fig.23 shows Active and reactive power at bus 2 without SSSC but with fault.L-L- L-G fault has been occurred on transmission system. During the period of occurance of fault, Active power drastically reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out nearly 1.8 to 2 cycles. During fault,reactive power reduces to negative value. The time required to damped out oscillation near about 0.4 to 0.6 sec. and also avg Active power is 9.928 and Reactive power is -1.813 without connecting of SSSC.

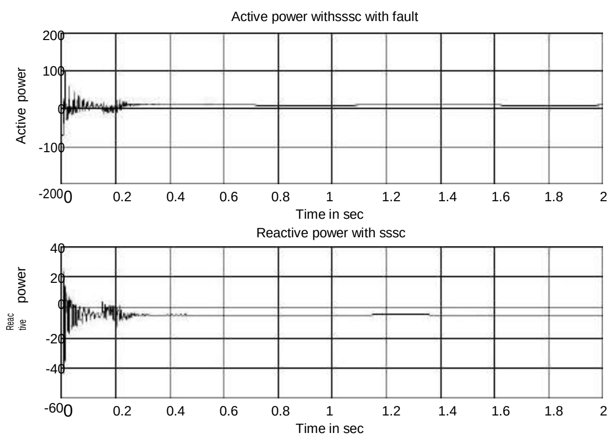

Fig.24 Active and reactive power waveform with (L -L-L-G) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

During the period of occurance of fault, Active power nearly reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out neary 0.3 to 0.4 cycles. During fault,reactive power reduces to negative value. The time required to damped out oscillation near about 0.25 to 0.4 sec. and also avg Active power is 9.782 and Reactive power is -5.051 with connecting of SSSC.

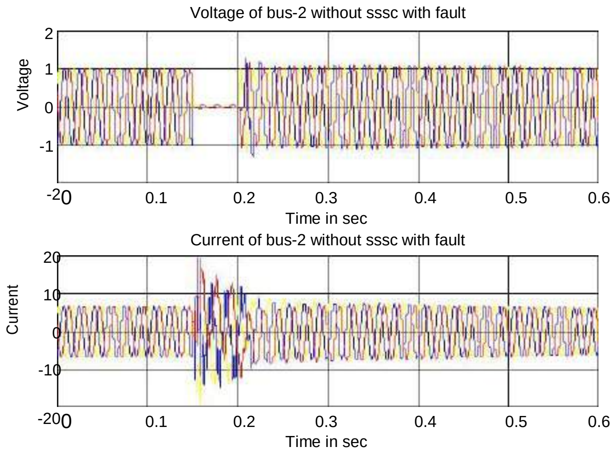

Fig.25 Voltage and Current waveform with (L-L-L-G) fault without SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a Three phase L-L-L-G fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transition time of [0.15 0.2]. Fig.25 shows Voltage and Current at bus 2 without SSSC but with fault. During a L-L-L-G fault voltage is drop to zero during a Fault period At the same time magnitude of current is high as compared to healhy condition.

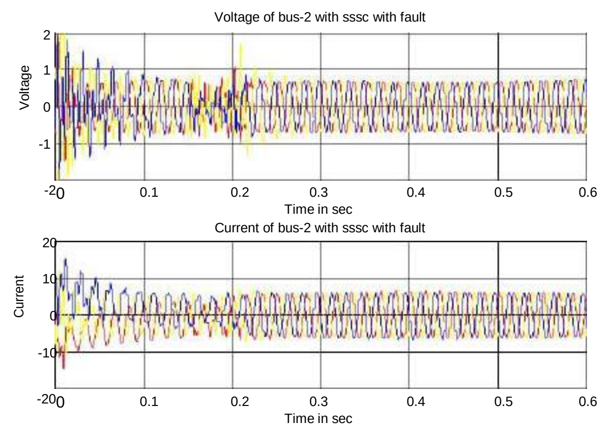

Fig.26 Voltage and Current waveform with (L-L-L-G) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-L-L-G fault is occur at bus 2 and system performance is checked with SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig.26 shows Voltage and Current at bus 2 with SSSC but with fault. During a L -L-L-G fault voltages is injected to the line. At the same time magnitude of current is constant is nearly 6.2 p.u.

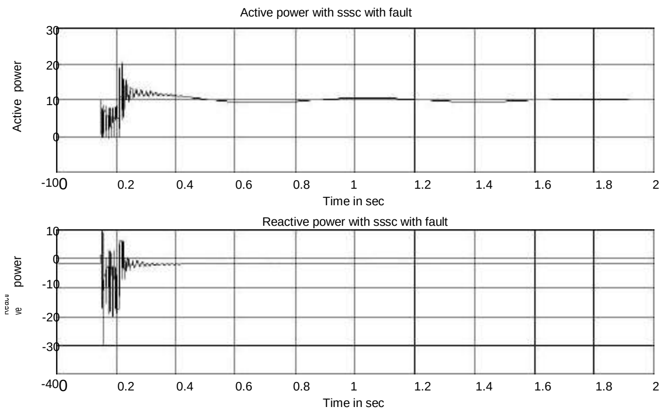

Fig.27 Active and reactive power waveform with (L-L) fault without SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-L fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transition time of [0.15 0.2]. Fig.27 shows Active and reactive power at bus 2 without SSSC but with fault.L-L fault has been occurred on transmission system. During the period of occurance of fault, Active power drastically reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out nearly 1.2 to 1.4 cycles. During fault,Reactive power reduces to negative value. The time required to damped out oscillation near about 0.4 to 0.6 sec. and also avg Active power is 9.883 and Reactive power is -1.82 without connecting of SSSC.

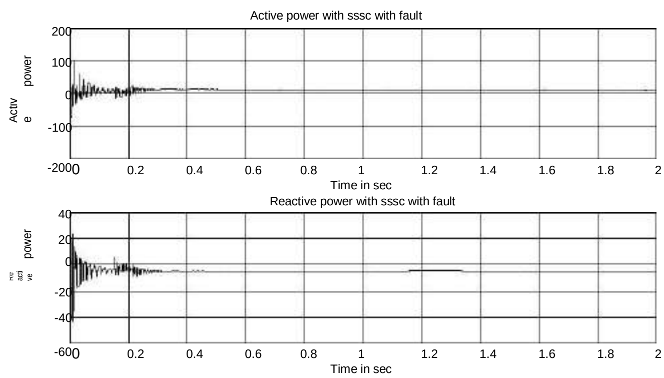

Fig.28 Active and reactive power waveform with (L-L) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

During the period of occurance of fault, Active power nearly reduces to zero. Fault is cleared 0.2 sec. As soon as fault is clear, active power starts increasing and is damp out nearly 0.3 to 0.4 cycles. During fault,reactive power reduces to negative value. The time required to damped out oscillation near about 0.25 to 0.3 sec. and also avg Active power is 9.940 and Reactive power is -5.05 with connecting of SSSC.

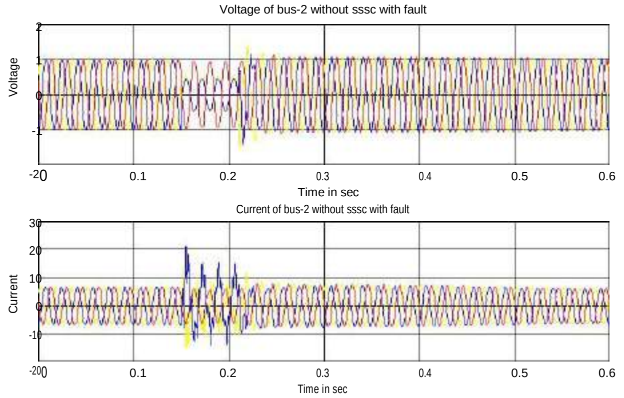

Fig.29 Voltage and Current waveform with (L-L) fault without SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

A L-L fault is occur at bus 2 and system performance is checked without SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig.29 shows Voltage and Current at bus 2 without SSSC but with fault. During a L-L fault voltage is drop to zero during a Fault period At the same time magnitude of current is high as compared to healhy condition.

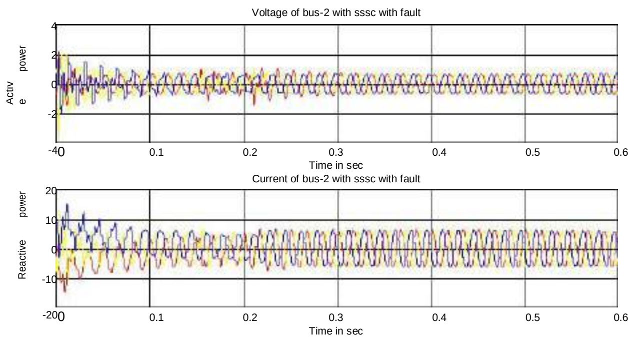

Fig.30 Voltage and Current waveform with (L-L) fault with SSSC with A ground R.of =1.66 and Fault Resistance of = 1 ohm

Here, a L-L fault is occur at bus 2 and system performance is checked with SSSC. Ground resistance used is 1.66 ohms and Fault resistance of 1 ohm with a transistion time of [0.15 0.2]. Fig.30 shows Voltage and Current at bus 2 with SSSC but with fault. During a L-L fault voltages is injected to the line. At the same time magnitude of current is constant is nearly 6.2 p.u.

IV. CONCLUSIONS

The onset of series connected FACTS controller like SSSC has made it possible not only to regulate power flow in critical lines. SSSC has reactive voltage control which can inject controllable reactive voltage in quadrature with the line current, emulating either inductive or capacitive reactance in series with transmission line.

In this paper, the operation of SSSC model is verified by connecting it in series with the transmission line. SSSC has been studied on two machine power system and connected at bus-2. Thus from this paper, SSSC can be effectively used to damp out power oscillations on power transmission system with and without fault. It can also able to control power flow at particular or desired point.

The application of the SSSC can be expanded in future for complex and multi-machine system to mitigate the problem of power oscillation in power systems.

REFERENCES

[1] D.M. Tagare, “Reactive power management”, Tata Mc-graw hill company, New Delhi, India, 2004, pp: 434-456.
[2] N.G. Hingorani and L Gyugyi, “Understanding FACTS: Concepts and technology of Flexible AC transmission system”, IEEE Inc. New York, USA, 0-7803-3455-8.
[3] R. Mohan Mathur and Rajiv K. Verma, “Thyristor – based controllers for electrical transmission systems”, Willey publication, New York, USA, 2002, pp: 1-13.
[4] Sen, K.K., "SSSC-static synchronous series compensator: theory, modeling, and application," Power Delivery, IEEE Transactions on, vol.13, no.1, pp.241-246, Jan 1998.
[5] M. H. Rashid, “Power electronics – circuits, devices and applications”, prentice hall, Englewood Cliffs, New Jersey.07632, 1988.
[6] Faridi, M.; Maeiiat, H.; Karimi, M.; Farhadi, P.; Mosleh, H., "Power system stability enhancement using static synchronous series compensator (SSSC)," Computer Research and Development (ICCRD), 2011 3rd International Conference on , vol.3, no., pp.387,391, 11-13 March 2011.
[7] P. Suman, N. Vijaysimha and C.B. Saravanan, “Static synchronous series compensator for series compensation of EHV transmission line” IJAREEIE, Vol. 2, Issue 7, pp: 3180-3190, July 2013.
[8] Sunil Kumar, L.; Ghosh, A., "Modeling and control design of a static synchronous series compensator," Power Delivery, IEEE Transactions on, vol.14, no.4, pp.1448 -1453, Oct 1999