DEPLOYMENT OF STATIC SYNCHRONOUS SERIES COMPENSATOR (SSSC) IN HIGH VOLTAGE TRANSMISSION LINE FOR OPTIMUM MANAGEMENT OF CONGESTION AND TO SCALE DOWN THE LINE LOSS

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ABSTRACT:

Congestion management is one in every of the technical challenges in facility release. In deregulated electricity market transmission congestion happens once there's poor transmission capacity to at the same time accommodate all constraints for transmission of a line. The VAR compensation is the main constrain when there is increase in load compensation at time will increase the capability curve of synchronous generator. Flexible AC transmission (FACTS) devices is another to scale back the flows in heavily loaded lines, leading to an accrued load ability, low system loss, improved stability of the network, reduced value of production and consummated written agreement demand by dominant the facility flow within the network. Correct location of a FACTS controller is vital to maximize its advantages. This paper combined to demonstrates the power of FACTS devices to scale back the disbursement and their impact on transmission with VAR compensation through SSSC. A sensitivity issue primarily based approach is employed for the optimum placement Move the Static synchronous series compensator (SSSC) to reduce the congestion value. The sensitivity of the congested line flow with relevancy flow in alternative lines has been used for the location of the SSSC. The system is designed in MATLAB/Simulation Software and outputs are generated.
Key words- congestion management, FACTS, Static synchronous series compensator

I. INTRODUCTION:

In a competitive electricity market, congestion happens when the transmission network is unable to accommodate all of the required transmissions because of a violation of system operational limits [1-3]. The management of congestion is somewhat additional advanced in competitive power markets and ends up in many disputes. In the present day competitive power market, every utility manages the congestion within the system victimization its own rules and tips utilizing an exact physical or financial mechanism [10]. The restrictions of an influence transmission network arising from environmental, right-of-way and value issues are fundamental to each bundled and unbundled power systems. Patterns of generation that lead to serious flows be likely to suffer higher losses, and to threaten stability and security, ultimately check that generation patterns economically undesirable. Hence, there's an interest in better utilization of accessible power grid capacities by installing new devices like versatile AC transmission systems (FACTS) [9]. versatile AC transmission systems devices will be an alternate to reduce the flows in heavily loaded lines, leading to an increased load ability, low system loss, improved stability of the network, reduced price of production and concluded contractual demand by dominant the facility flows in the network.

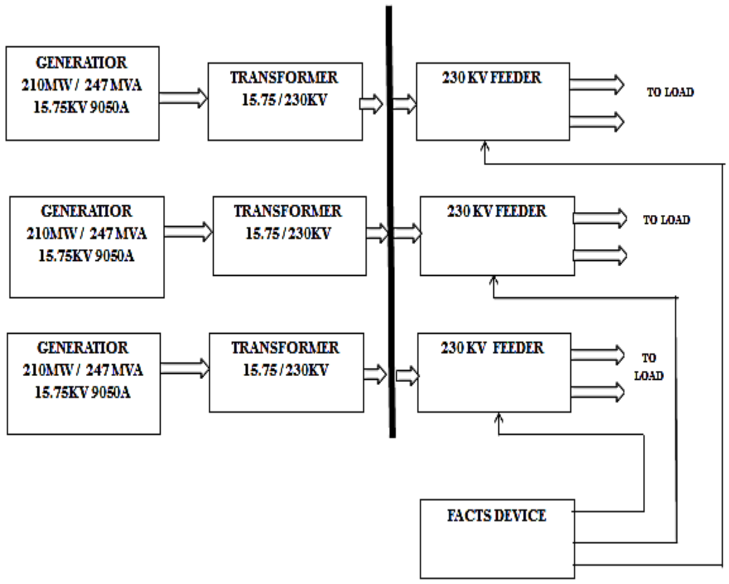

Fig.1.Block representation of proposed system

FACTS devices controls the ability flows in the network while not generation rescheduling or topological significantly [9]. The insertion of such devices in electrical systems looks to be a promising strategy to decrease the transmission congestion and to extend available transfer capability. Mistreatment manageable components like manageable series capacitors line flows are often modified in such the way that thermal limits are not violated, losses reduced, stability margins increased, written agreement demand concluded etc., without violating specific power dispatch [11]. The exaggerated interest in these devices is actually because of two reasons. Firstly, the recent development in high power natural philosophy has made these devices value effective and second, increased loading of power systems, combined with deregulation of power trade, motivates the utilization of power flow management as an awfully efficient means that of dispatching such that power transactions. It's vital to ascertain the situation for placement of those devices because of their considerable prices.

II. DESIGN AND IMPLEMENTATION OF PROPOSED SYSTEM:

The proposed system consists of a high voltage transmission system where deregulated electricity market transmission congestion occurs when there is insufficient transmission capacity to simultaneously accommodate all constraints for transmission of a line. The proposed system has the following methodology for designing.

A. STATIC SYNCHRONOUS SERIES COMPENSATION (SSSC):

Realities gadgets are acquainted in the transmission line with upgrade its capacity exchange ability; either in arrangement or in shunt. The arrangement remuneration is a financial technique for enhancing power transmission ability of the lines. As per Taher (2008), Static synchronous series - compensation (SSSC) (Figure 2) is a kind of arrangement compensator that can give numerous advantages to a power framework incorporating controlling force stream in the line, damping power motions, and moderating sub synchronous reverberation.

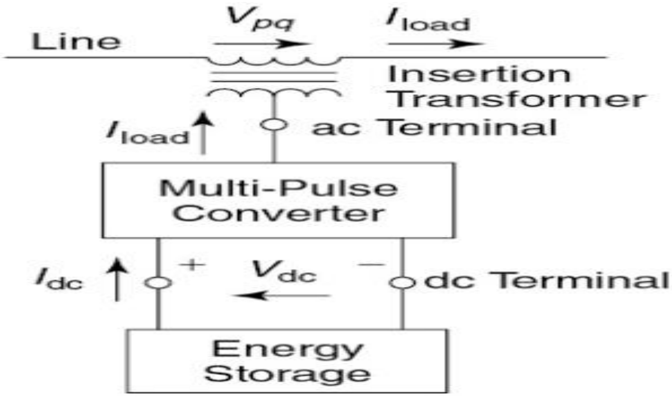

Fig.2.SSSC circuit representation

The TCSC idea is that it utilizes a to a great degree basic fundamental circuit. The capacitor is embedded specifically in arrangement with the transmission line and the thyrister-controlled inductor is mounted straightforwardly in parallel with the capacitor [1]. Subsequently no interfacing hardware like for instance high voltage transformers is required. This makes TCSC substantially more financial than some other contending FACTS innovations.

B.OPTIMAL POWER FLOW

Optimal power Flow (OPF) has been utilized in this work to ascertain phase communication and load plans, to oversee clog in the frameworks. It depends on the power stream confines by obliging all power requirements for transmission of line and the system information [2]. The for the most part acknowledged target is to limit the age cost, if loads are inelastic. In this work, it is accepted that the heaps are inelastic to the value varieties. Along these lines, the ideal capacity turns into the aggregate expense of providing power

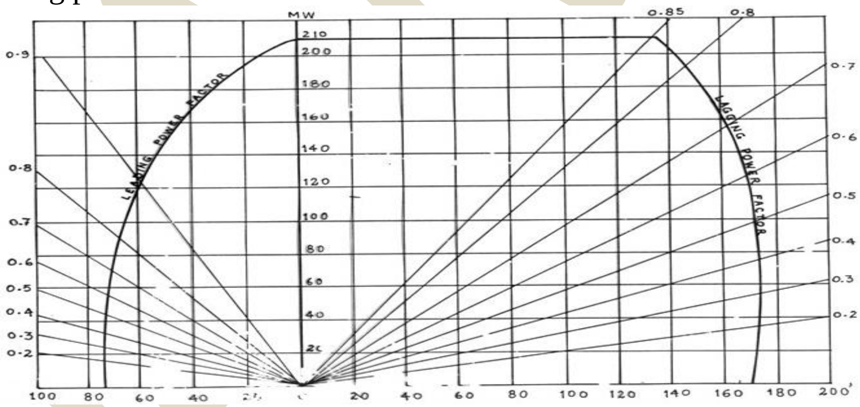

Fig.3. Capability curve for synchronous generator

C.VAR COMPENSATION:

SSSC a series version of STATCOM and it is an advanced kind of control series compensation. It produces the output voltage in quadrature with the line current such that the overall reactive voltage drop across the line is increased or decreased. Although it is like a STATCOM, the output voltage is in series with the line and hence it controls the voltage across the line, so its impendence. It has a capability to induce both inductive and capacitive voltage in series with the line and hence the power control. Compensators – SVC, SSSC and So on Using Power Electronics Compensators in Power Electronics .The growing capabilities of power electronic components have developed the use of FACTS devices. The higher power levels have been made available in converters for highest voltages. The overall starting points are network elements influencing the impedance or the reactive power of a part of the power system. For FACTS devices, it has two terms to be explained. One of the terms is dynamic, which is used to express the fast controllability of FACTS devices which is provided by the power electronics. This is one of the main differentiating factors from the conventional devices. Another one is static, which is used to perform the dynamic controllability because it has no moving parts like mechanical switches. This article discusses about compensators used in power electronics, which includes Static Synchronous Series compensator (SSSC). Compensators in Power Electronics the Static Synchronous Series compensators in power electronics mainly involve in series and shunt devices. Let us discuss about these types of devices Series Device have developed from mechanically or fixed switched compensations to the voltage source converter based devices.

III. SIMULATION OF PROPOSED SYSTEM:

The proposed system is simulated in the matlab/Simulink simulation software. The simulation diagram for SSSC implemented high voltage transmission line is as shown in the figure 4.

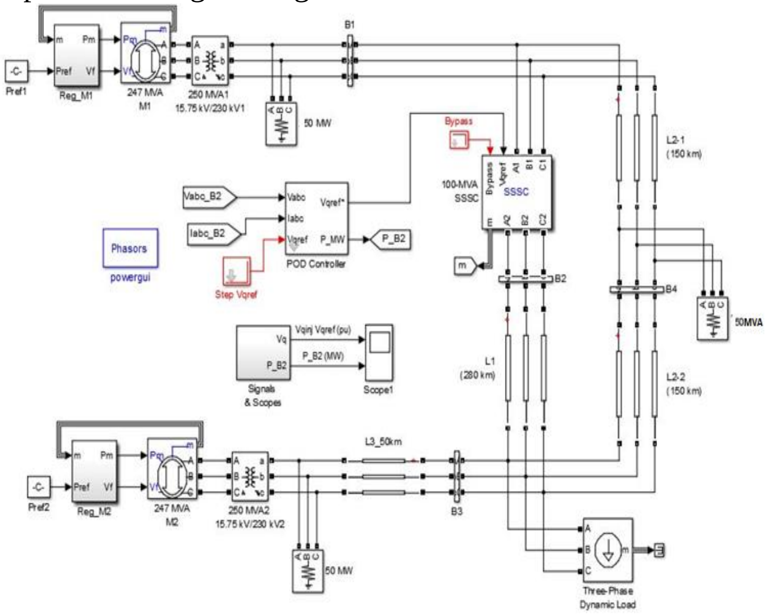

Fig.4.simulation diagram of proposed system SSSC

The pod controller for the proposed SSSC controller is as shown in the figure 5.

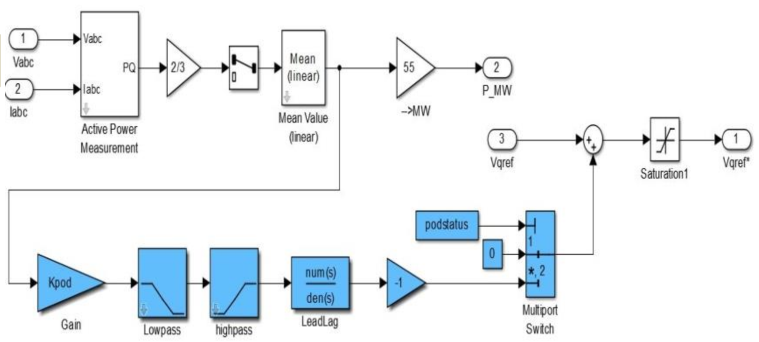

Fig.5.POD controller for SSSC

The static series synchronous compensator is as shown in the figure 6. This shows the simulation model of proposed system.

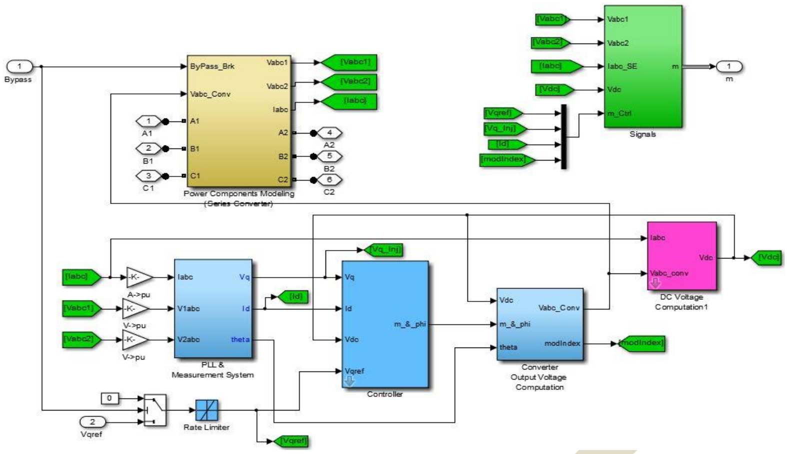

Fig.6.SSC simulation model

The VAR compensation is done in a simulation as shown in the figure 7.

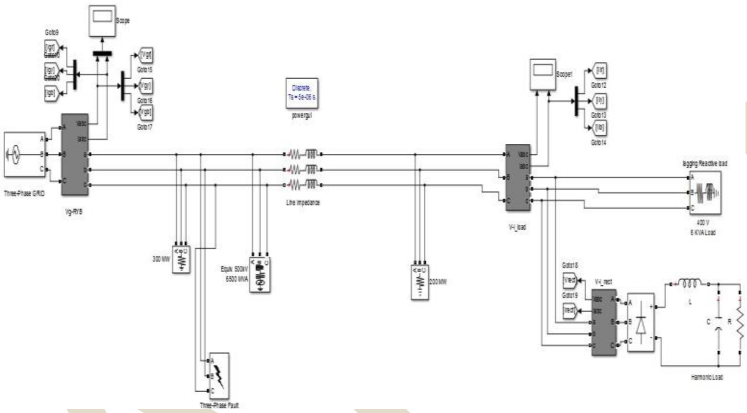

Fig.7.Highvoltage line grid system

The implemented SSSC is connected when there is a requirement in the VAR therefore the system is concluded with the simulation output in the next section.

IV. SIMULATION OUTPUT AND RESULTS:

The output result of synchronous generator is the voltage reference and MW power generated is as shown in the figure.

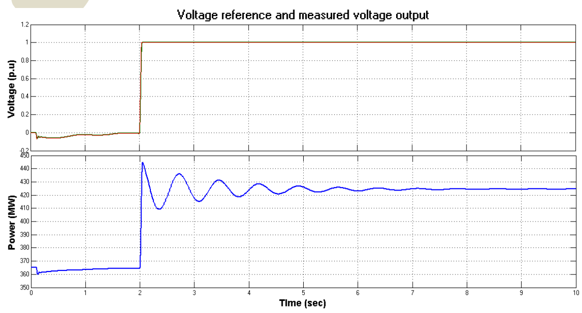

Fig.8.Voltage in P.U and MW generation

From the output graph it is known that generated power is about 420 MW is maintained constant with the help of SSSC. The voltage is also maintained for 1 p.u is also shown in the same figure

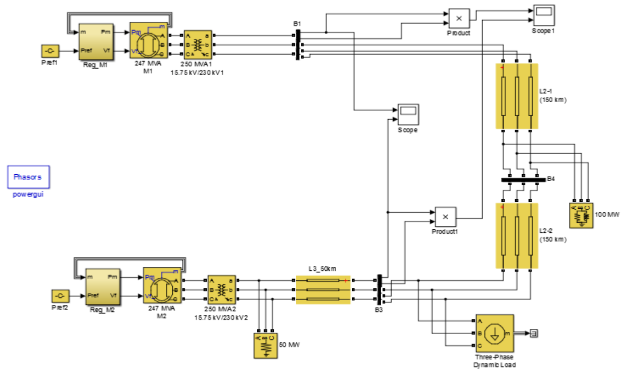

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Fig.9.Matlab Simulation Circuit - Without SSSC

Thus the system voltage and current is maintained at constant value as shown in the figure

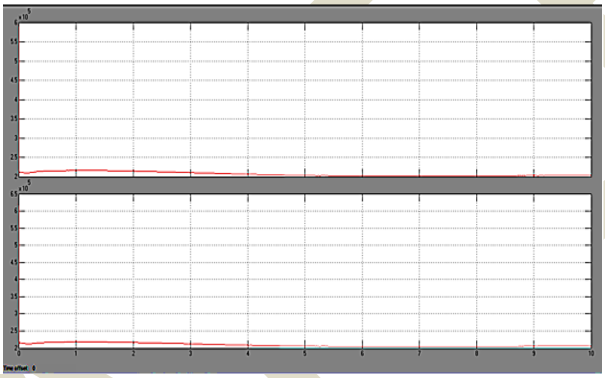


Fig.10.System Voltage without SSSC

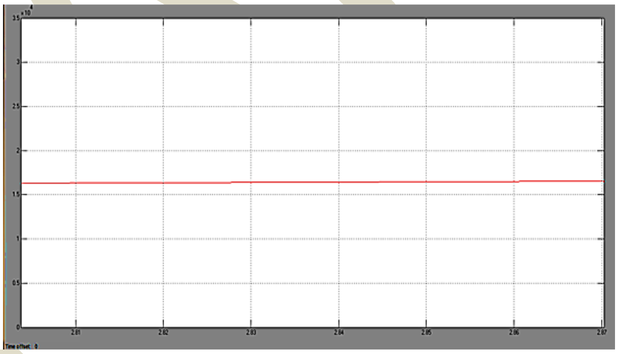


Fig.11.Waveform of Input Voltage Generation without VAR

The figure 11 shows the waveform of voltage generation without any VAR in Line. The current from generating station is shown in the figure 12.

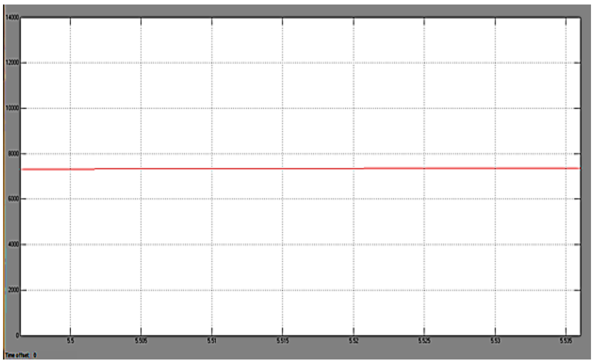


Fig.12. Waveform of Input Current for without VAR

Power generated at generating synchronous generator is as shown in the figure 13. The power generated is of about 180 MW.

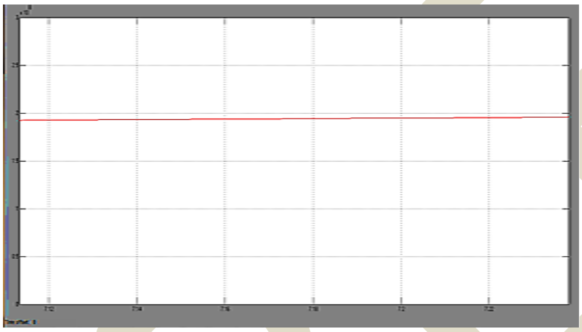


Fig.13.Input Generation Power Waveform for without VAR

The voltage at bus 1 is shown in the figure 14. The voltage is about 230kV. The current waveform is as shown in the figure 15.

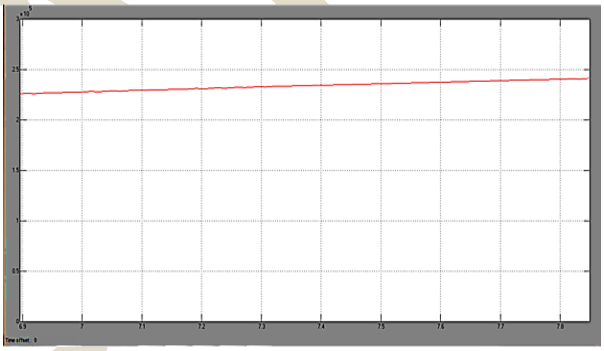


Fig.14.Bust 1 Input Voltage Waveform

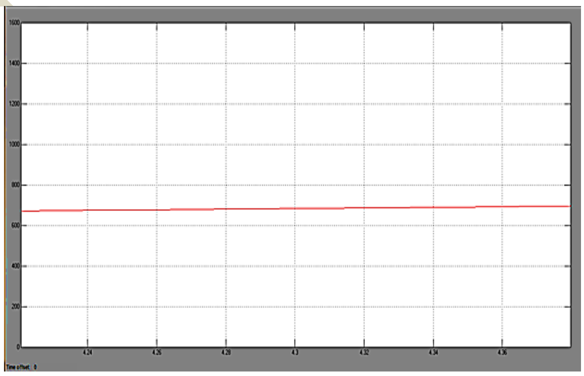


Fig.15.Bus 1 Input Current waveform

The power at Bus 1 calculated to be 210MW is shown in the figure 16.

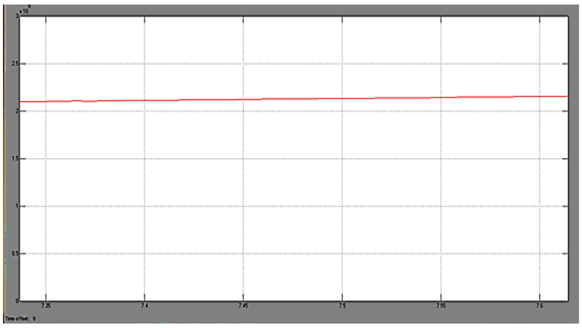


Fig.16.Power input Waveform of Bus 1

Voltage output waveform at bus 1 is as shown in the figure 17 and current waveform is shown in the figure 18.

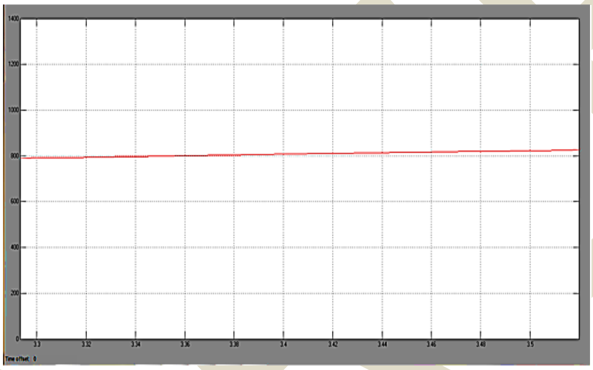


Fig.17.Input Voltage Waveform Bus 3

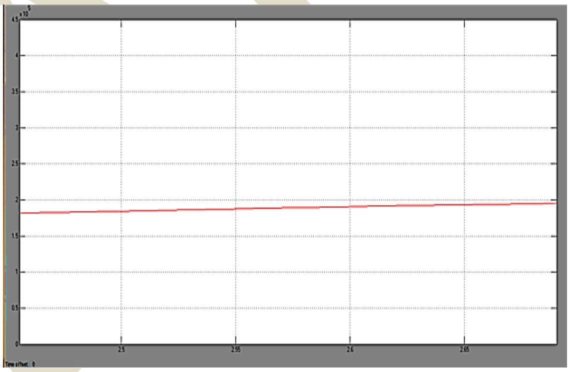


Fig.18.Current Waveform at Bus 3

The power at Bus 3 is calculated to be 200MW is also shown in the figure18.

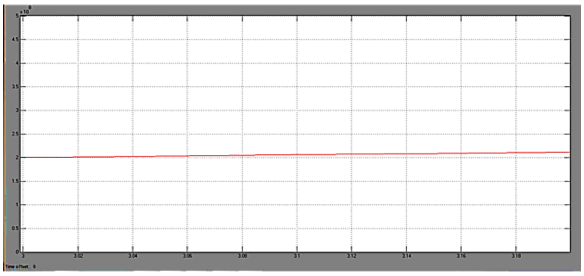


Fig.19.Power Output Waveform at Bus 3 without VAR

When the input VAR is introduced in the circuit SSSC enhance the capability the Voltage at generation after VAR of 160MVAR is shown in the figure 20. The voltage is measured to be about 15kV.

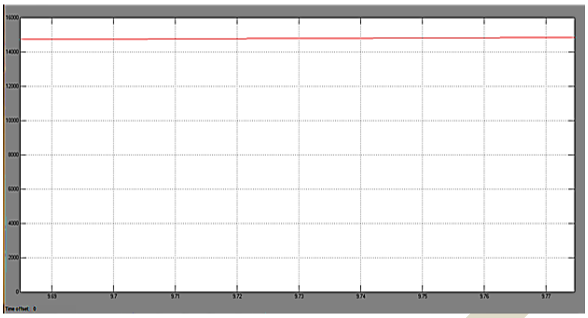


Fig.20.Input Voltage of Generation with VAR 160MVAR

The voltage at Bus 1 to be of about 225kV as it is shown in the figure 21.

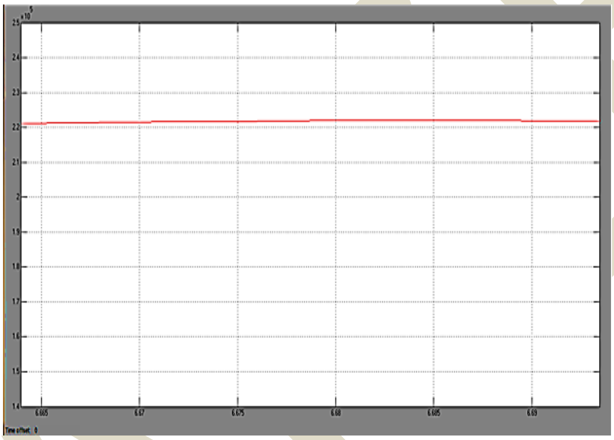


Fig.21. Waveform of Voltage at Bus 1 with 160MVAR

Voltage at Bus 3 is of about 220kV with VAR injection.

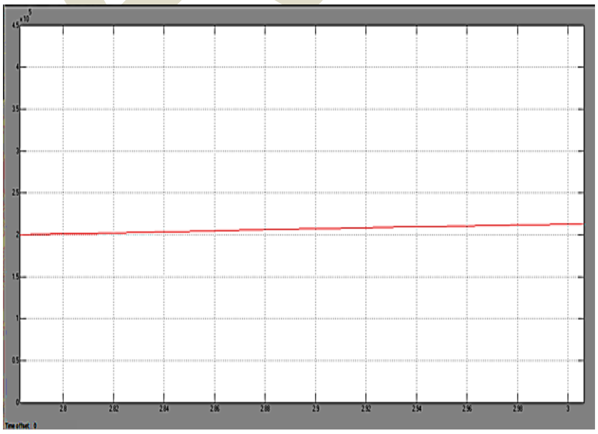
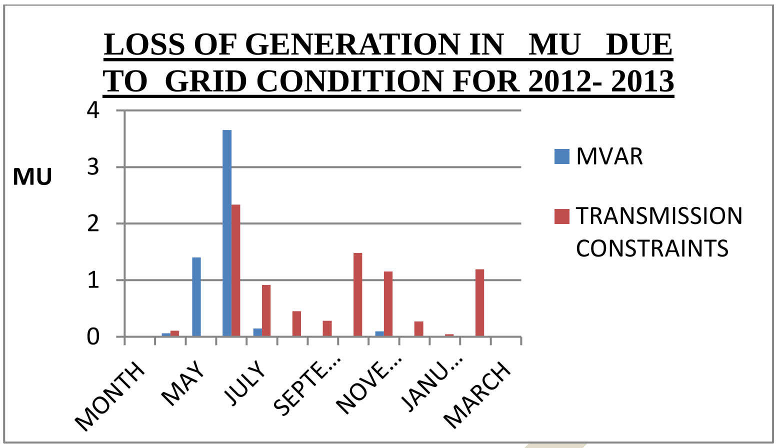
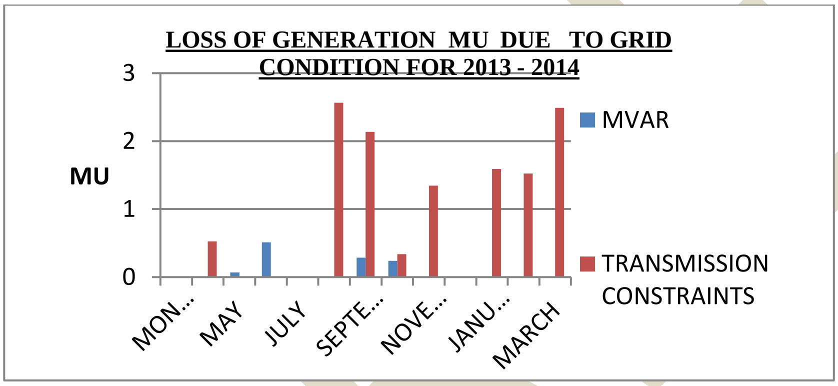
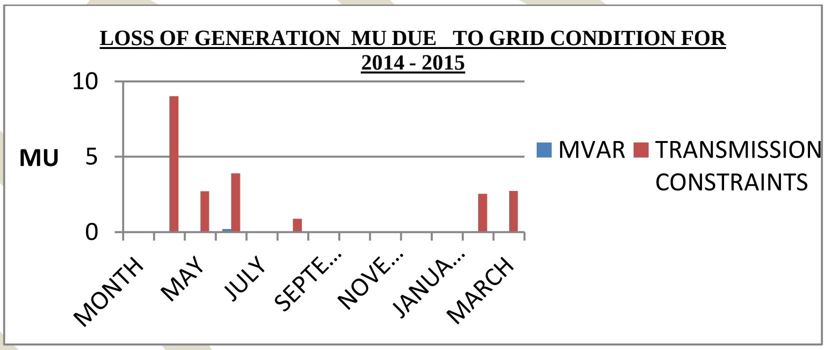


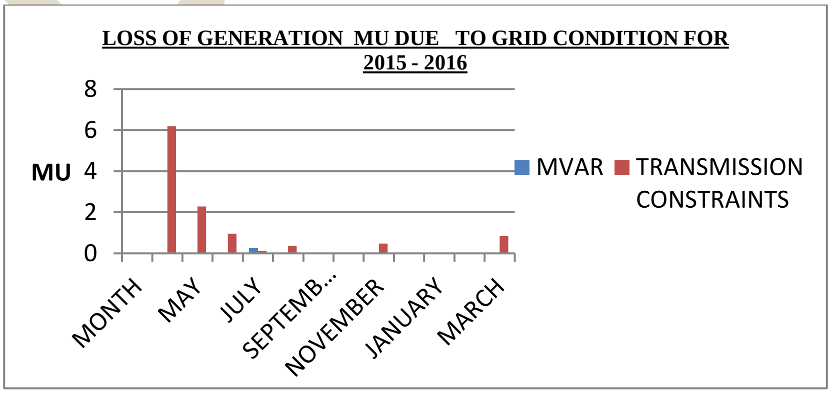
Fig.22. Bus 3 Voltage Waveform with VAR 160MVAR

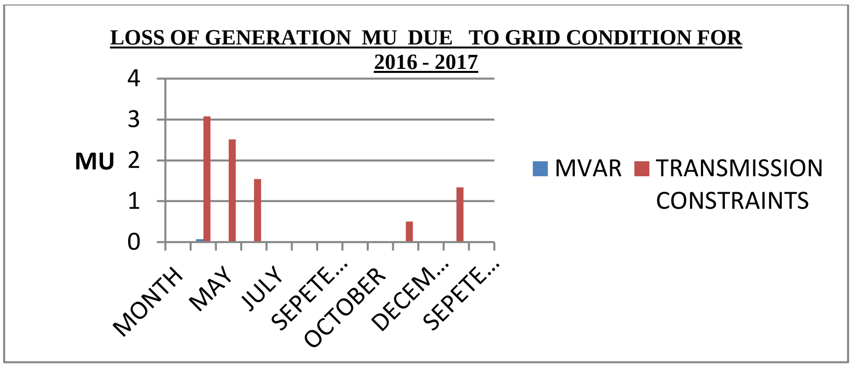
DATA CHARTS FOR VAR OVER PAST YEARS:

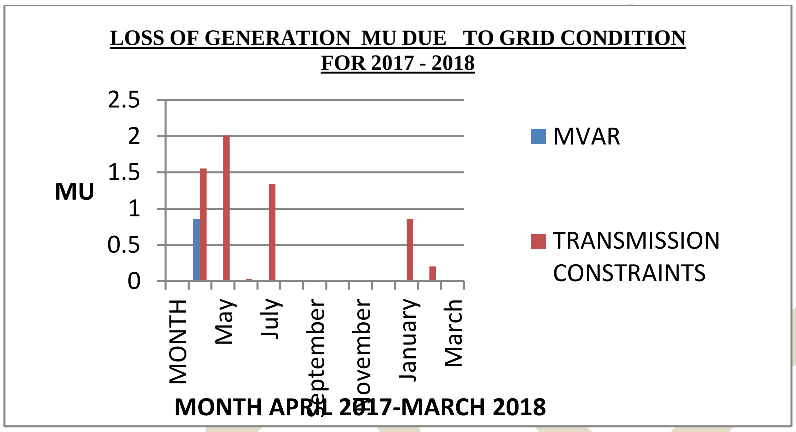


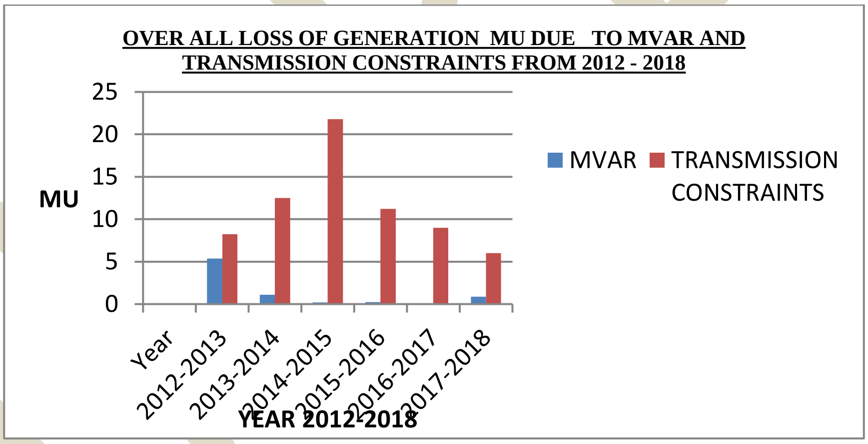












CONCLUSION:

A new method of compensation a high voltage transmission line is simulated in this paper. Static Series Synchronous Compensator (SSSC) is introduced in the line for line compensation which is really needed in the ever growing power system. The var compensation is thus achieved by considering the previous section output voltage and current waveform. Thus the system voltage and current is kept constant is also verified by the simulation diagram represented in this paper.

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