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Comparative Analysis of STATCOM and SVC for Reactive Power Enhancement in A Long Transmission Line

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Abstract- In recent power system scenario, the main concern is about the maximum power transfer capability from generating station to the distribution station. But between these, the transmission system i.e. transmission of power from generating station to distribution grid is the most vital thing. So in order to have a reliable and quality power transmission FACTS controllers (Flexible AC Transmission System) are introduced in the transmission system. FACTS are an emerging technology which motivates towards power quality improvement and increased control flexibility of power system. Generally FACTS controllers are of series type, shunt type and combined series-series and combined series-shunt type. In this paper a shunt type controllers i.e. STATCOM (Static Synchronous Compensator) and a SVC (Static VAR Compensator) have been considered. Here the variation of voltage and reactive power by the introduction of STATCOM & SCV at middle of long transmission line has been investigated. All these analysis is carried out by the mat lab simulink models of STATCOM & SVC. This comparison output revels that STATCOM performs better than SVC in Volt /VAR control.

***Keywords*:** FACTS, power quality, STATCOM, SVC.

I. Introduction

Now a day the power system is approaching towards greater complexity. This is due to the increasing demand of good quality power by consumers. To maintain a good quality of power the system needs a optimal control strategies for the generation, transmission and distribution of electric power [1-8]. It's being a huge responsibility of transmitting power from one station to other with lowest cost of generation. So current power system wants a flexible system which can anyhow provides increased control flexibility, maximum power transfer capability [9], grid flexibility and compensation at the time of need. All these strategies can be achieved by the emerging technology of FACTS. FACTS stand for flexible AC transmission system. FACTS are the combination of various power electronics based controllers. These controllers may be of shunt or series connected types or combination both [1-6]. Shunt connected controllers are connected in parallel to the transmission line and injects current to the system at the point of connection.SVC & STATCOM are some examples of shunt controllers. Series connected controllers are connected in series with the transmission line and injects voltage to the line at the time of need [7-4]. SSSC, TCSC, TSSC, TSSR are some examples of series connected controllers.

In this work SVC and STATCOM has considered for reactive power enhancement. Simulation has been done separately for SVC and STATCOM, voltage and current profiles are compared between SVC and STATCOM. Finally STATCOM has the edge in better performance for the enhancement of reactive power compensation.

II. List of Devices Considered for the Study

The study has been carried out by introducing STATCOM and SVC in long transmission line.

A. STATCOM (Static Synchronous Compensator)

The Static Synchronous Compensator (STATCOM) is a shunt device of the Flexible AC Transmission Systems (FACTS) family using power electronics to control power flow and improve transient stability on power grids [11-16]. The STATCOM regulates voltage at its terminal by controlling the amount of reactive power injected into or absorbed from the power system. When system voltage is low, the STATCOM generates reactive power (STATCOM capacitive) [12-14]. When system voltage is high, it absorbs reactive power (STATCOM inductive). STATCOM is represented in fig 1.

The variation of reactive power is performed by means of a Voltage-Sourced Converter (VSC) connected on the secondary side of a coupling transformer. The VSC uses forced-commutated power electronic devices (GTOs, IGBTs or IGCTs) to synthesize a voltage V2 from a DC voltage source [13]. The principle of operation of the

STATCOM is explained on the figure below showing the active and reactive power transfer between a source V1 and a source V2[15]. The system voltage to be controlled and V2 is the voltage generated by the VSC.

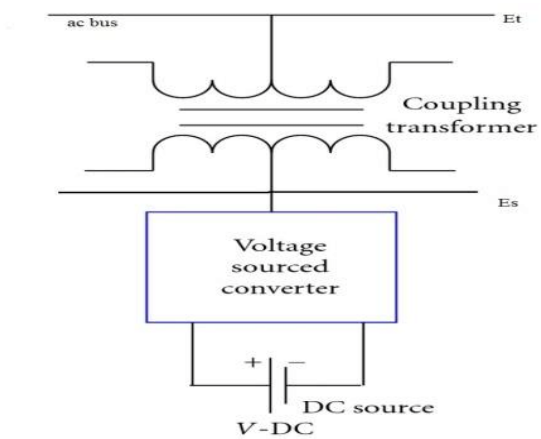

Fig 1:- STATCOM.

B. SVC (Static VAR Compensator)

Static VAR Compensator is "a shunt-connected static VAR generator or absorber whose output is adjusted to exchange capacitive or inductive current so as to maintain or control specific parameters of the electrical power system (typically bus voltage)" fig 2. SVC is based on thyristors without gate turn-off capability. The operating principal and characteristics of thyristors realize SVC variable reactive impedance [10]. SVC includes two main components and their combination: Thyristor-controlled and Thyristor-switched Reactor (TCR and TSR); and Thyristor-switched capacitor (TSC) [3].

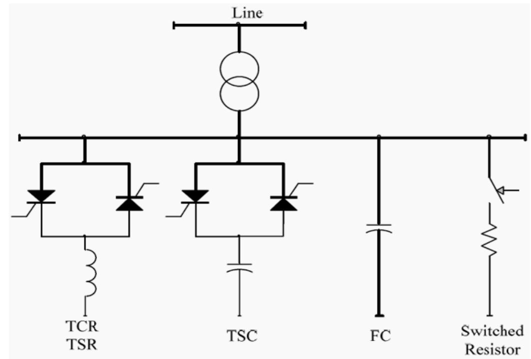

FIG 2: Static VAR Compensators (SVC): TCR/TSR, TSC, FC and Mechanically Switched Resistor.

III. System Considered for Simulation

The power network consists of two 500 KV equivalents (respectively 3000 MVA and 2500 MVA) connected by a 600 Km transmission line as shown in Fig.3. The SVC and STATCOM is located at the midpoint of the line (bus B2). The parameters of the system are listed in Table I.

Table 1. System Parameters

STATCOM	Rating of STATCOM	100MVA
	Dc voltage	40V
Transmission line	Resistance per unit length	0.01755Ω/km
	Inductance per unit length	0.8737×10-3 H/Km
	Capacitance per unit length	13.33×10-9 F/km
	length	600 km
AC source	Sending end	500KV

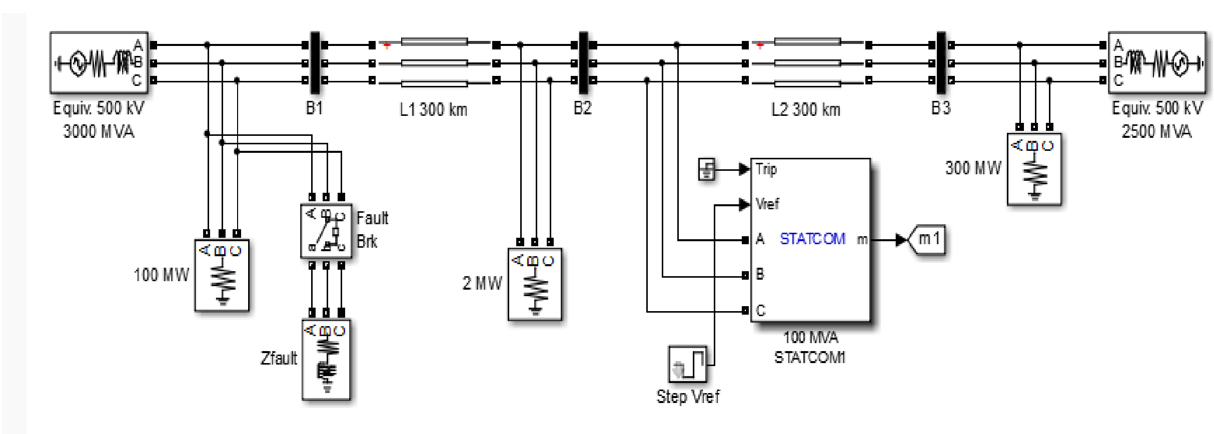

FIG 3: Simulation block diagram of the power system with a shunt FACTS device in Matlab simulink.

IV. Simulation Results

The simulation results of the power system using the shunt FACTS controller has been discussed in this section. The measured voltage in the compensator bus on SVC (red trace) and the STATCOM (black trace) is shown in fig 4. It is observed that the STATCOM is very effective during the power system disturbances.

The measured reactive power generated by the SVC (red trace) and the STATCOM (black trace) is shown in fig 5. We can see the duration of fault of 10 cycles, the reactive power generated by the SVC is -0.51pu and the STATCOM is 0.35pu.

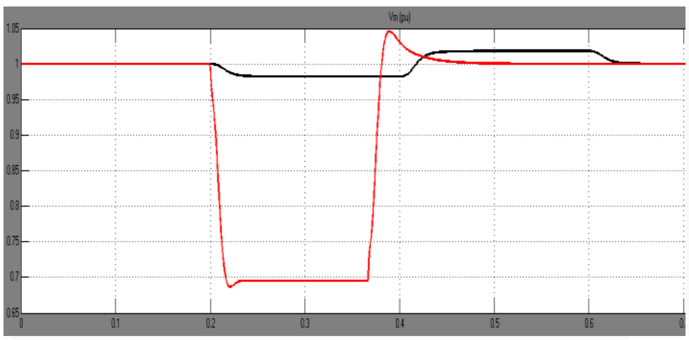

FIG 4: Voltage comparison between SVC and STATCOM, (X-axis represents time(sec), Y-axis represents voltage(pu)).

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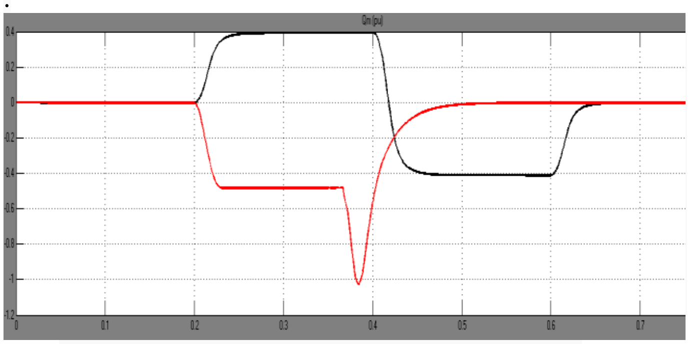

FIG 5: Reactive power comparison between SVC and STATCOM, (X-axis represents time(sec), Y-axis represents reactive power(pu)).

V. Conclusion

Comparative Analysis of STATCOM and SVC for Reactive Power Enhancement has been conducted for long transmission line of 600km with voltage range of 500KV in MATLAB/Simulink platform. Real and reactive power flows have been taken accordingly with reference to the point of installation of FACTS devices in the long transmission line. At first analysis has been done for a compensated system when STATCOM was installed at middle of the transmission line. Similar type of analysis has been performed by introducing of SVC in transmission line. Comparison of voltage and reactive power has done between two models. The comparison output shows that STATCOM performs better than SVC in Volt /VAR control.

References

[1]. Shaswat Chirantam, Ramakanta Jena, Dr.S.C.Swain, Dr.P.C.Panda, "Comparative analysis of STATCOM and TCSC FACTS controller for power profile enhancement in a long transmission line" 2017 2nd International Conference on Communication and Electronics Systems (ICCES).

[2]. M.Mandavian, M.Janghorbani, E.Ganji, I.Eshaghpour, "Voltage Regulation in Transmission Line by Shunt Flexible AC Transmission System Devices" 2017 14th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON).

[3]. R.M. Malkar, V.B.Magdum, "Recent Trends in Real and Reactive Power Flow Control with SVC and STATCOM Controller for Transmission Line" International Journal of Application or Innovation in Engineering & Management (IJAIEM), ISSN 2319 - 4847, Volume 5, Issue 3, March 2016.

[4]. Karisma Hawisa, Rajab Ibsaim, Amer Daeri, "Voltage Instability Remedy using FACTS,TCSC Compensation First A'',17th International conference on sciences &Techniques of Automatic control and computer engineering- STA'2016, Sousse, Tunisia, December 19-21,2016.

[5]. Singh, Mukesh Kumar, and Nitin Saxena. "Performance Analysis and Comparison of Various FACTS Devices in Power System." July 2013, ISSN No.(Online): 2277 2626 (2013).

[6]. Karthikeyan , M., and P. Ajay-D -Vimalraj "Optimal location of shunt FACTS devices for power flow control." Emerging Trends in Electrical and Computer Technology (ICETECT), 2011 International Conference on. IEEE, 2011.

[7]. Kumar, Prashant "Application of FACT devices for voltage stability in a power system." Proc. IEEE 9th Int. Conf. Intelligent Systems and Control, Coimbatore, India. 2015.

[8]. Aswin R, Jo Joy "Comparison between STATCOM & TCSC on static voltage stability using MLP Index'', International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering,vol.2,special issue 1,December 2013.

[9]. S Bagchi, R Bhaduri, P N Das, S Banerjee , "Analysis of Power Transfer Capability of a Long Transmission Line using FACTS Devices'',2015 International Conference on Advances in Computing, Communications and Informatics (ICACCI).

[10]. T. Fetouh, M.S. Zaky, "New approach to design SVC-based stabiliser using genetic algorithm and rough set theory", IET Generation, Transmission and Distribution, Vol. 11, No. 2, pp. 372-382, Jan. 2017.

[11]. Hridya K. R., Mini V., R. Visakhan, Asha Anu Kurian, "Analysis of voltage stability enhancement of a grid and loss reduction using series FACIS controllers," 2015 IEEE Tnternational Conference on Power, instrumentation, Control and Computing (PiCC), 2015, pp. 1-5.

[12]. S.A.Karrare, V. M. Harne,‖ Simulation of D-STATCOM in Power Distribution System for Power Quality Enhancement using MATLAB Simulink Tool‖, International Journal of Electronics, Electrical and Computational System, Volume 6, Issue 4, April 2017.

[13]. H. Myneni, G. S. Kumar and D. Sreenivasarao, "Power quality enhancement by current controlled Voltage Source Inverter based DSTATCOM for load variations," 2015 IEEE IAS Joint Industrial and Commercial Power Systems / Petroleum and Chemical Industry Conference (ICPSPCIC), Hyderabad, 2015, pp. 182-188.

[14]. S. R. Arya, B. Singh, R. Niwas, A. Chandra and K. Al-Haddad, "Power Quality Enhancement Using DSTATCOM in Distributed Power Generation System," in IEEE Transactions

on Industry Applications, vol. 52, no. 6, pp. 5203-5212, Nov.-Dec. 2016.

[15]. M. Mangaraj, T. Penthia and A. K. Panda, "Power quality improvement by a 3-phase 4-leg supercapacitor based DSTATCOM," 2016 IEEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics Engineering (UPCON), Varanasi, 2016, pp. 91-97.

[16]. S. Singhai, M. N. Ansari and M. Jain, "Application of DSTATCOM for power quality improvement using isolated zig-zag/star transformer under varying consumer load," 2016 International Conference on Electrical Power and Energy Systems (ICEPES), Bhopal, 2016, pp. 270275.