Analysis of Maximum Loading Point with the Help of SVC, STATCOM in Six Bus Power System

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Abstract- **The power consumption in per capita is increase due increase the population, so fulfil this energy demand or maintain the voltage stability FACT devices are introduce. In this paper represent the maximum power transfer at different loading condition with the help of PV curve for this analysis SVC, and STATCOM are used or compare for best performance in six bus system. This analysis has done in MATLAB SIMUATION.**

Key Words- **Maximum loading point, STATCOM, SVC.**

I. INTRODUCTION

The increment in loading of a given existing power transmission system the results voltage instability and voltage collapse. This has become a major concern in power system planning and operation. Recently developed power electronic based controllers (FACT Device) have been used to fulfil this requirement. These controllers make the transmission system more flexible in terms of controlling the active and reactive power transfer and as well as the voltage profile of a power system.

Basically STATCOM and SVC are used for maintain maximum loading point. These devices are shunt FACT devices and connected in parallel to the transmission system in six bus network.

II. LITRATURE REVIEW-

Mohanty Alok Kumar and Barik Amar Kumar had describes the comparison between STATCOM and TCSC on Static Voltage Stability Using MLP Index in power system network [1]. Murali D., et al.,(2010) This paper compare UPFC with SSSC, TCSC, SVC respectively for improve the transient stability of a two-area power system network, which is capable to control the active and reactive power to the transmission line Simulations are carried out in Matlab/Simulation[2]. Nagesh H. B. and P. S. Puttaswamy (2013) present the location of FACT devices to analysis of static voltage stability of a power system. This analysis uses the L-index of load buses. It gives the information no load to full load voltage collapse. In IEEE-14 bus system a suitable size and location of SVC, STACOM is calculated by this technique. Which gives the continuation power flow and voltage stability [3]. Nitve Bhakti and Naik Rajani (2014) Author compare the PSAT toolbox technique with the Newton rapson and fast decoupled method. This comparison is based on the steady state analysis of IEEE-6 bus system. The bus voltage is constant by changing the load that the power flow calculated with PSAT and other method. It is observed that PSAT is fast and a high-precision process as the Newton rapson and fast decoupled method [4]. Rai Aarti(2013)voltage instability is one of the phenomena which result a major blackout to overcome this problem fact devices are used to improve power system security and increase voltage stability margin, so that maintain the characteristics of bus voltages and power in desired level. IEEE 6 bus system is used under different loading condition to calculate the performance, evaluation of FACT devices it is supported by the simulation results by matlab [5]. Ronad Basangouda F., et al., (2013) "gives the comparison of FACTS to improve the voltage profile and power. The of performance of the UPFC is higher with the other FACTS devices such as SVC, TCSC, and SSSC respectively. The cost of FACT device also given [6]. Sharma P. R. and Dube Anirudh (2012) shows that the best location of SVC,UPFC in WSCC in 3 machine 9 bus system for minimization of real power losses, improving voltage profile of the buses and enhancing system stability. Performance of UPFC is best compare to SVC. Eigen Value Analysis by Power System Analysis Toolbox (PSAT) software is used for Power Flow Analysis [7]. Singh Bindeshwar, et al., (2010) presents the different parameter of voltage stability, like causes of voltage instability, types of voltage stability. This parameter analysed with the help of all FACT Controllers-SVC, TCSC, SSSC, STATCOM, UPFC, IPFC, in Power System [8]. Thakur Chitra, and Mr. Sahu Saurabh (2013) represent the optimal location of FACT devices by changing the voltage magnitude and the line loading. SVC and STATCOM FACTS device are used for the control of voltage and power flow in long distance transmission line. In this paper the two machine 4-bus test system are used and simulated using MATLAB Simulink [9]. Titus, S., et al., (2013) investigates the improvement of transient stability of system under three phase fault using FACTS devices like TCSC, STATCOM and UPFC. From the simulation results it is obtained that UPFC regains its stability limit very fast as compare to others [10]. Yome-sode, A. et al., (2007) Present a comparison of FACT devices for static voltage stability. Various performance measures including PV curves, voltage profile, and power losses which are compared under normal and contingency condition. Placement and sizing techniques of series FACT devices and UPFC are proposed for loading margin enhancement. This paper provides utilities to have an appropriate choice of FACT derive for enhancing loading margin and static voltage stability [11].

III. STATIC VAR COMPENSATOR (SVC)- Principle and operation of SVC- "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". The primary purpose is usually for rapid control of voltage at weak points in a network. SVC is similar to a synchronous condenser but without rotating part in that it is used to supply or absorb reactive power.

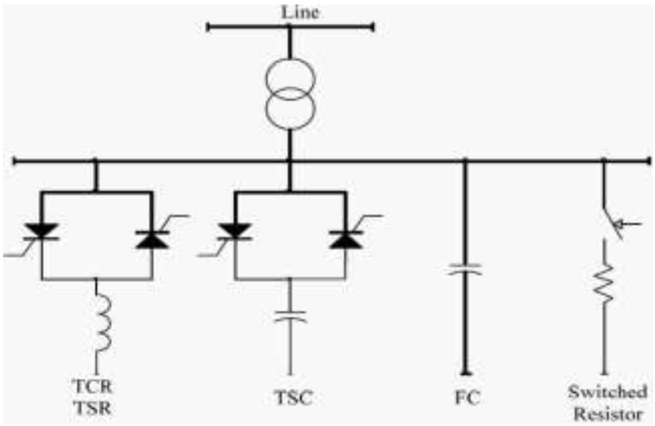

Fig.1 Schematic diagram of SVC

IV. STATCOM (Static Synchronous Compensator) - Static Synchronous Compensator (STATCOM): "A Static synchronous generator operated as a shunt-connected static var compensator whose capacitive or inductive output current can be controlled independent of the ac system voltage". A STATCOM is comparable to a Synchronous Condenser (or Compensator) which can supply variable reactive power and regulate the voltage of the bus where it is connected. STATCOM is the Voltage-Source Inverter (VSI), which converts a DC input voltage into AC output voltage in order to compensate the active and reactive power needed by the system STATCOM exhibits constant current characteristics when the voltage is low/high under/over the limit. This allows STATCOM to

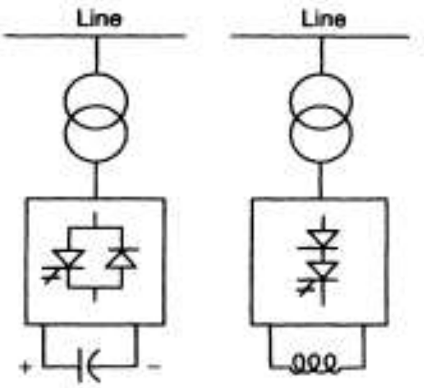

Fig.2 Schematic diagram of STATCOM

V. DISCRIPTION OF SIMULATION MODEL-

Model Description – Six bus systems are used that is shown in single line diagram. This model consist of three generators G1=2100MVA at bus1, G2=700MVA at bus2, G6=1400MVA at bus6. They supply three phase to phase voltage of 400kv. This generator also injected active and reactive power to the system or three (PQ or load) buses these six buses (B1 to B6) are connected to each other through three phase transmission line. L12= 450 km, L14= 200km, L15=250 km, L13= 300 km, L23= 250 km, L24= 250 km, L34= 150 km, L46= 450 km, L45= 350 km, and L56= 300 km, L61=450 km respectively. The constant loads are connected of 700 MW at bus-5, 500 MW at bus-4 and 250 MW at bus-3. Variable dynamic load 2500+j1000 MVA at bus-3.

The rating of STATCOM, SVC, 200MVA.

VI. MATLAB SIMULATION MODELS-

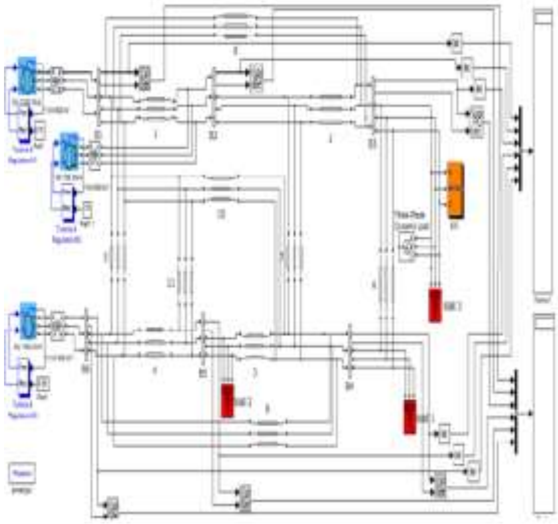

Fig.3 Matlab Simulation Model With Svc at B3 Bus

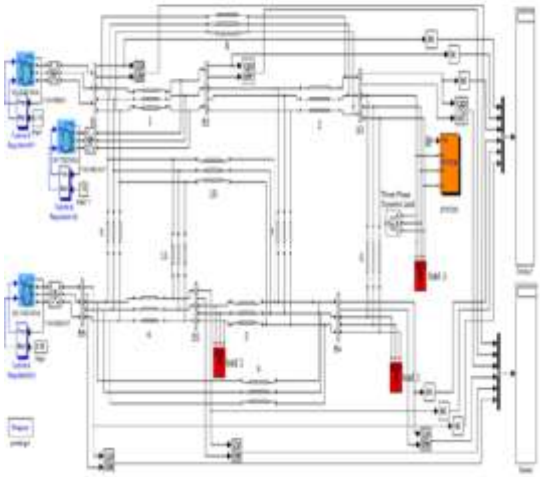

Fig. 4 Matlab Simulation Model With Statcom at B3 Bus

VII. SIMULATATION RESULT AND ANALYSIS-

Analysis of Maximum loading point with the help of PV curve for SVC, STATCOM.

Active power & bus voltage at bus b1

Increment of load in mw at bus b3	Active power & bus voltage at bus b1					
	P in pu			V in pu		
	Without FACT	SVC at b3 bus	STATCOM at b3 bus	Without FACT	SVC at b3 bus	STATCOM at b3 bus
250	52.13	54.6	54.94	1.79	1.79	1.79
400	52.6	55.1	55.49	1.77	1.78	1.78
600	53.03	55.63	56.02	1.77	1.77	1.77
800	53.13	**55.63**	**56.21**	1.76	1.76	1.76
1000	**53.13**	55.44	56.08	1.76	1.75	1.75
1200	52.66	55.01	55.7	1.76	1.74	1.74
1400	52.05	54.41	55.15	1.73	1.73	1.73
1600	51.32	53.61	54.43	1.72	1.72	1.72
1800	50.41	52.63	53.5	1.71	1.71	1.71
2000	49.59	51.52	52.43	1.7	1.7	1.7

Table no1.Active power & bus voltage at bus B3

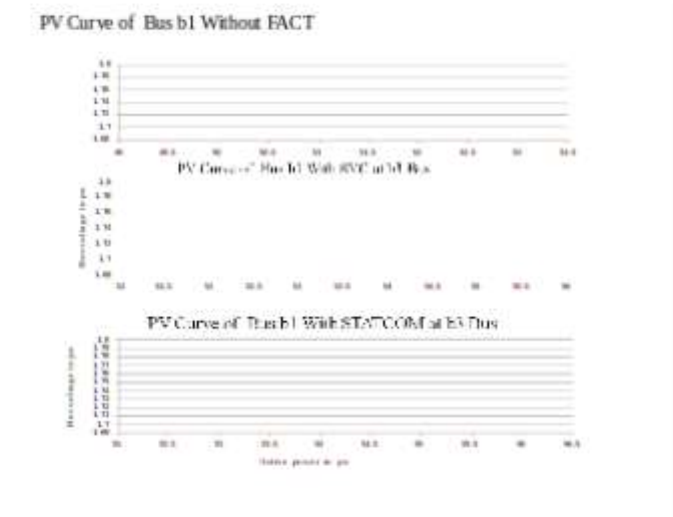

Fig. 5 PV curve for bus b1

Active power & bus voltage at bus b2

Increment of load in mw at bus b3	Active power & bus voltage at bus b2					
	P in pu			V in pu		
	Without FACT	SVC at b3 bus	STATCOM at b3 bus	Without FACT	SVC at b3 bus	STATCOM at b3 bus
250	15.27	15.77	15.82	1	1.01	1.01
400	15.70	16.23	16.3	1	1.01	1.01
600	16.23	16.78	16.88	0.99	1	1
800	16.67	17.25	17.37	0.98	0.99	0.99
1000	16.67	17.61	17.76	0.98	0.97	0.97
1200	17.29	17.88	18.04	0.96	0.96	0.96
1400	17.45	18.06	18.24	0.95	,95	0.95
1600	17.54	18.15	18.36	0.94	0.94	0.94
1800	**17.55**	**18.16**	**18.38**	0.92	0.93	0.93
2000	17.54	18.09	18.33	0.91	0.92	0.92

Table2 Active power & bus voltage at b2 bus

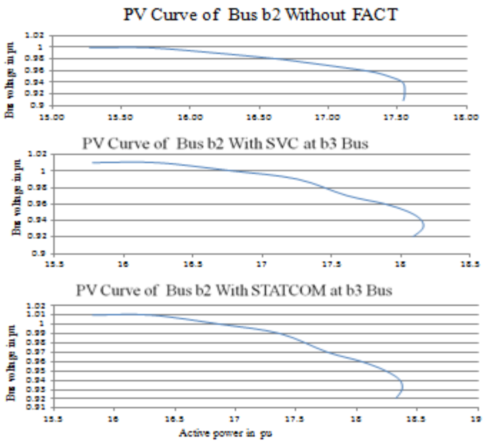

Fig. 6 PV curve for bus b2

Comparision of Maximum Loading Point of different buses			
Bus	Pmax (pu) Without FACT	Pmax (pu) With SVC (200 MVA) at B3 bus	Pmax (pu) with STATCOM (200MVA) at B3 bus
B1	53.13	55.63	56.21
B2	17.55	18.16	18.38
B3	24.31	25.25	25.56
B4	20.19	20.86	21.05
B5	12.96	13.25	13.29
B6	10.98	11.88	12.06

Table3 Comparision of Maximum loading point of different buses

VIII. CONCLUSION

Maximum power handling capacity is increased with the help of shunt compensation. For this SVC and STATCOM are used and from the result it is obtained that STACOM supply the maximum power as compare to the SVC in each buses.

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