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IMPROVEMENT OF POWER AND VOLTAGE QUALITY IN POWER SYSTEM DISTRIBUTION USING FACTS (SVC & DSTATCOM)

Ali Najim Abdullah, Mayyadah Sahib Ibrahim
Assistant lecturer, College of Engineering, Elect. Power & Machines Eng. Department
University of Diyala
ali_najim_1981@yahoo.com, eng.mayyadah@yahoo.com

ABSTRACT: - Power quality is one of the important fields in the electrical power and distribution system. In order to reduce the power losses and improve voltage level in electrical power and distribution system, Flexible AC Transmission Systems (FACTS) devices used to achieve that with a suitable way. FACTS devices in the last years used to solve many of power system problems. The FACTS controllers offer a great opportunity to regulate the power flow and responding almost instantaneously to the stability problems. In this paper static VAR compensator SVC and static synchronous compensator DSTATCOM used as a shunt devices connecting on the buses and injecting the VAR to improve reactive power Q. The FACTS devices applied on radial power distribution system 24-bus Electrical Iraqi super grid, some of these are laterals. The power flow simulator was used as tool to simulate this system and all the results are achieved and discussed.

Keyword:- FACTS controllers; SVC; DSTATCOM; Power Quality.

1- INTRODUCTION

In the last decades the demands on electrical power increased due to increase in load of the costumer for any reason, this lead to rise in generation and required installation a new transmission lines to support this demand, but this is limited, especially for old region and these demands will continue to increase because of the increasing number of non-utility generators and heightened competition among utilities themselves. Increased demand on transmission system, absence of long term planning and the necessity to provide open access to power generating companies and customers; all together have created tendencies toward a reduction of security and decreased quality of supply [1,2].

The Problems of voltage quality and power transmitted to the users can be solved in many methods; one of these is used Flexible AC Transmission Systems (FACTS) devices in power and distribution system network. A static VAR compensator (SVC) and static synchronous compensator STATCOM are FACTS controllers act to control one or more variables in a power and distribution system networks. To improve the voltages profile along the lines and enhance the power quality by reducing power losses in system network, reactive power controlled by generate or absorb VAR from SVC or STATCOM to the network through transformer or vice versa. FACTS controllers classified in to four categories according to connected to the network as series; shunt; combined series-series; and combined shunt-series.

In this work focus of used SVC and STATCOM models and their applications in a radial distribution system networks by using program for analysis and calculating steady-state modes of power systems for load flow analysis, to regulate voltage magnitude of the bus to the limited value and minimized power loss in the power distribution system network.

2- GENERAL DESCRIPTION AND CHARACTERISTICS OF SHUNT COMPENSATORS (SVC AND STATCOM)

The SVC and STATCOM are one type of FACTS devices controller, acts as shunt connected to the network through transformer and operating as reactive power compensators. The shunt controllers SVC and STATCOM are used more than other types of FACTS devices. The essential applications of SVC and STATCOM in transmission, distribution and industrial networks due to enhance the voltage and power quality because some groups of users required high power quality and another need accurate in voltage level [3].

To increase the power transmitted in steady-state condition and improvement the voltage profile along the line or at the users can be used SVC and STATCOM, this devices added to change in natural characteristics of electrical system network [4].

The FACTS devices can be controlled a certain variables of power system (Voltage, Angle and/or Impedance), therefor the shunt controllers such as SVC and STATCOM control voltage. The shunt controller may be variable impedance (reactor or capacitor), variable source, or a combination between them. Therefore, at the point of connection these devices, a shunt reactive current can be supplied into the system network. Even variable shunt impedance connected to the line voltage causes a variable current flow and hence represents injection of shunt current into the line.

As long as the injected phase current is in quadrature with the line voltage, the variable reactive power supplied or consumed by the shunt controllers (SVC and STATCOM) [5].

3- ADVANTAGES OF STATIC VAR COMPENSATOR SVC AND STATCOM

A. Advantages of Static Var Compensator SVC

As discussed in section I, the SVC and STATCOM are shunt connected devices. The application of SVC was initially for load compensation of fast changing loads such as steel mills and arc furnaces. It aim is to get better power factor and provided balance the currents on the source side whenever required [6]. It keeps the steady state and dynamic voltage at a bus with a required value, and has some ability to control stability, but not much to control active power flow [7]. Hence the technical objectives are.

- Reduced total power losses in the network and enhanced power transmitted,
- Improvement voltage level,
- Transient stability improvement,
- Improved power and distribution system stability,
- power system oscillation damping.

B. Advantages of STATCOM

The STATCOM is an advanced static VAR compensator when used a voltage source converter (VSC) instead of the controlled reactors and switched capacitors. The SVCs need self-commutated power semiconductor devices such as GTO, IGBT, IGCT, MCT, etc this caused higher costs and losses as comparison with the SVC which used thyristor devices.
Here technical preference of a STATCOM over a SVC.

- It has fast response.
- It improved phase angle and voltage magnitude.
- It requires less space as bulky passive components (such as reactors) are eliminated.
- It can be interfaced with real power source such as battery, fuel cell.
- It has superior performance during low voltage condition as the reactive current can be maintained constant.

Therefor firstly STATCOM was called as advanced SVC and then named as STATCON (STATic CONdenser) or STATic synchronous COMpensator STATCOM [6,8].

4- MODELING OF STATIC VAR COMPENSATOR SVC

In order to maintain, improve or control specific parameters of the electrical power system, typically bus voltage a shunt connected static var compensator (SVC) generator or absorber whose output is adjusted to exchange capacitive or inductive current[9]. There are more than one version of SVCs, (a) Thyristor Controlled Reactor (TCR), (b) Thyristor Switched Reactor (TSR), and (c) Thyristor Switched Capacitor (TSC).

With an appropriate coordination of the capacitor switching and reactor control Fig. (1), the VAR output can be various continuously and rapidly between capacitive/inductive values[7]. It has separate equipment for leading and lagging reactive power; the TCR or TSR for absorbing reactive power and TSC for generating the reactive power[9]. There are two models are presented in this class, these, variable shunt susceptance model and firing-angle model[10].

A. Shunt Variable Susceptance Model

Practically the SVC can be controlled reactance with either firing-angle limits or reactance limits. The equivalent circuit of the variable shunt susceptance shown in Fig. (2) Used to derive and give the SVC nonlinear power and the linearized equations required by Newton's method[10]. The SVC is modeled as a synchronous generator with no active power generation. Therefore assuming that the SVC has no resistive components $G_{SVC} = 0$. This means that draws no active power from the network. So its reactive power is a function of bus voltage magnitude at connection point node k and the SVC equivalent susceptance, B_{SVC} [11].

$P_k = 0$

The current drawn by the SVC and the reactive power injected at bus k is:

$$I_{SVC} = jB_{SVC}V_k \quad (1)$$

$$Q_{SVC} = Q_k = -V_k^2 B_{SVC} \quad (2)$$

The linearized equation for SVC is given below

$$\begin{bmatrix} \Delta P_k \\ \Delta Q_k \end{bmatrix}^{(i)} = \begin{bmatrix} 0 & 0 \\ 0 & Q_k \end{bmatrix}^{(i)} \begin{bmatrix} \Delta\theta_k \\ \Delta B_{SVC}/B_{SVC} \end{bmatrix}^{(i)} \quad (3)$$

At the finished of iteration (i), the variable shunt susceptance B_{SVC} is

$$B_{SVC}^{(i)} = B_{SVC}^{(i-1)} + \left(\frac{\Delta B_{SVC}}{B_{SVC}}\right)^{(i)} B_{SVC}^{(i-1)} \quad (4)$$

The variation in susceptance represents the total SVC susceptance required to regulate the nodal voltage magnitude at the desired value and improve power transmitted[10].

B. Firing angle Model

This is another model of SVC, which circumvents the additional iterative process as shown in Fig. (3)[10]. This model consists of a TCR in parallel with a capacitors. TCR branch includes reactors connected with antiparallel thyristors circuit as control elements. The system voltage on the branch is sinusoidal. The firing angle is limited by interval $[\pi/2, \pi]$[12]. The thyristor's firing angle control allows the SVC to have an almost instantaneous speed of response[11]. The variable firing angle α will be represented as α_{SVC}[10]. In the case of no harmonic is generated by the TCR and when the thyristors are gated into conduction.

The reactor is directly conducts, therefore the controllable element as being short-circuited. The reactor consists of a few resistance and the current is normally inductive and

sinusoidal, lagging the voltage by 90^{o}. This occur at firing angle α of $\pi/2$, which is the current zero-crossing measured with reference to the voltage zero-crossing.
The relationship between the firing angle α and the conduction angle σ and between the firing angle α and the firing time ωt is given by

$$\sigma = 2(\pi - \alpha) \quad (5)$$
$$\omega t = \alpha + k\pi \qquad k = 0,1,2,\ldots. \quad (6)$$

Other conduction occurred with firing angles in the range $[\pi/2 < \alpha < \pi]$, in radians. Where TCR currents, as a function of the firing angle and for the voltage condition shown in Fig. (3), with $v(t) = \sqrt{2}V\,sin\,\omega t$, the TCR current $i_{\mathrm{TCR}}(t)$ is given by

$$i_{\mathrm{TCR}} = \frac{1}{L}\int_{\alpha}^{\omega t} \sqrt{2}\,V \sin\omega t \; dt = \frac{\sqrt{2}V}{\omega L}(\cos\alpha - \cos\omega t) \quad (7)$$
$$\alpha \le \omega t \le (\alpha + \sigma)$$

The fundamental frequency current for TCR, $\mathrm{I_{TCR\,f1}}$, is given by applying Fourier analysis.

$$I_{\mathrm{TCR\,f1}} = \frac{V}{j\omega L\pi}[2(\pi - \alpha) + \sin 2\alpha] \quad (8)$$

The equivalent susceptance of TCR as a function of the controllable firing angle parameters α:

$$I_{\mathrm{TCR}} = -jB_{\mathrm{TCR}}V \quad (9)$$

$$B_{\mathrm{TCR}} = \frac{2(\pi - \alpha) + \sin 2\alpha}{\omega L\pi} \quad (10)$$

For the positive sequence representation:

$$I_{\mathrm{SVC}\,(1)} = jB_{\mathrm{SVC}}V_{(1)} \quad (11)$$
$$B_{\mathrm{SVC}} = B_{\mathrm{C}} - B_{\mathrm{TCR}} = \frac{1}{X_C X_L}\left\{X_L - \frac{X_C}{\pi}[2(\pi - \alpha) + \sin 2\alpha]\right\} \quad (12)$$

Where $X_L = \omega L$ and $X_C = \frac{1}{\omega C}$

The reactive power (Q_k) injected at bus k is given by substitution equation (12), in (2) [10,13].

$$Q_k = \frac{-V_k^2}{X_C X_L}\left\{X_L - \frac{X_C}{\pi}[2(\pi - \alpha_{SVC}) + \sin 2\alpha_{SVC}]\right\} \quad (13)$$

The linearised SVC equations is given as

$$\begin{bmatrix}\Delta P_k \\ \Delta Q_k\end{bmatrix}^{(i)} = \begin{bmatrix}0 & 0 \\ 0 & \frac{2V_k^2}{\pi X_L}[\cos(2\alpha_{SVC}) - 1]\end{bmatrix}^{(i)} \begin{bmatrix}\Delta\theta_k \\ \Delta\alpha_{SVC}\end{bmatrix}^{(i)} \quad (14)$$

At the end of iteration (i), the variable firing angle SVC is updated according to

$$\alpha_{SVC}^{(i)} = \alpha_{SVC}^{(i)} + \Delta\alpha_{SVC}^{(i)} \quad (15)$$

5- MODELLING OF STATCOM AND PRINCIPLE OF OPERATION

A. Modeling of STATCOM

The power flow equations for the STATCOM are obtained below and assuming the following voltage source converter representation in Fig. (4).

$$E_{vR} = V_{vR}(\cos\delta_{vR} + \sin\delta_{vR}) \quad (16)$$
$$S_{vR} = V_{vR}I_{vR}^* = V_{vR}Y_{vR}^*(V_{vR}^* - V_k^*) \quad (17)$$

The active and reactive power equations are given for the converter and bus k, respectively:

$$P_{vR} = V_{vR}^2 G_{vR} + V_{vR}V_k[G_{vR}\cos(\delta_{vR} - \theta_k) + B_{vR}\sin(\delta_{vR} - \theta_k)] \quad (18)$$
$$Q_{vR} = -V_{vR}^2 B_{vR} + V_{vR}V_k[G_{vR}\sin(\delta_{vR} - \theta_k) - B_{vR}\cos(\delta_{vR} - \theta_k)] \quad (19)$$

$$P_k = V_k^2 G_{vR} + V_k V_{vR}[G_{vR}\cos(\theta_k - \delta_{vR}) + B_{vR}\sin(\theta_k - \delta_{vR})] \quad (20)$$

$$Q_k = -V_k^2 B_{vR} + V_k V_{vR}[G_{vR}\sin(\theta_k - \delta_{vR}) - B_{vR}\cos(\theta_k - \delta_{vR})] \quad (21)$$

The linearised STATCOM model is given below, where the voltage magnitude V_{vR} and phase angle δ_{vR} are taken as the state variables[10]:

$$\begin{pmatrix} \Delta P_k \\ \Delta Q_k \\ \Delta P_{vR} \\ \Delta Q_{vR} \end{pmatrix} = \begin{pmatrix} \frac{\partial P_k}{\partial \theta_k} & \frac{\partial P_k}{\partial V_k}V_k & \frac{\partial P_k}{\partial \delta_{vR}} & \frac{\partial P_k}{\partial V_{vR}}V_{vR} \\ \frac{\partial Q_k}{\partial \theta_k} & \frac{\partial Q_k}{\partial V_k}V_k & \frac{\partial Q_k}{\partial \delta_{vR}} & \frac{\partial Q_k}{\partial V_{vR}}V_{vR} \\ \frac{\partial P_{vR}}{\partial \theta_k} & \frac{\partial P_{vR}}{\partial v_k}V_k & \frac{\partial P_{vR}}{\partial \delta_{vR}} & \frac{\partial P_{vR}}{\partial V_{vR}}V_{vR} \\ \frac{\partial Q_{vR}}{\partial \theta_k} & \frac{\partial Q_{vR}}{\partial V_k}V_k & \frac{\partial Q_{vR}}{\partial \delta_{vR}} & \frac{\partial Q_{vR}}{\partial V_{vR}}V_{vR} \end{pmatrix} = \begin{pmatrix} \Delta\theta_k \\ \frac{\Delta V_k}{V_k} \\ \Delta\delta_{vR} \\ \frac{\Delta V_{vR}}{V_{vR}} \end{pmatrix} \quad (22)$$

B. Principle of Operation

The principle of operation is based on comparison between the magnitude voltage generation from the voltage source converter (VSC) V_{vR} and the magnitude of bus voltage V_k. If the magnitude of the bus voltage V_k is greater than the magnitude voltage producing from (VSC) V_{vR} the reactive power is flowing from network to VSC and the STATCOM is absorbing the reactive power. if the magnitude of the bus voltage V_k is less than V_{vR} the reactive power is flowing from VSC to power system, then the STATCOM is producing reactive power and if the V_k is equal to V_{vR} the reactive power exchange is zero. Therefore the reactive power (Q_{vR}) at bus k is given

$$Q_{vR} = \frac{|V_k|^2}{X_{vR}} - \frac{|V_k||\mathrm{V_{vR}}|}{X_{vR}}\cos(\theta_k - \theta_{vR}) \quad (23)$$

6- SIMULATION AND RESULTS

The case of study of load flow is applying to radial distribution system as shown in a single line Fig. (5). The value of distributed voltage is 11kV as used in Iraq network and all data required of the system such as resistance, inductance per unit length of transmission lines, and loads in each bus or node is given in table 1.

This system consists of one slack bus and twenty four distributed buses and twenty four branch. The results of this test system achieved by program for analysis and calculating steady-state modes of load flow for power systems. This program are used to analytic of power flow, determine the required active and reactive power from the slag bus, calculated power losses in the network and calculating magnitude and phase angle of voltage at all load buses.

The results of load flow calculation for the distribution system network in the nodes and branches and power loss in this system without used FACTS showed in table 2. Table 3 shows the results with used FACTS at bus 10 and 15.

7- CONCLUSION

Twenty four bus systems are modeled and simulated. The simulation results are done with and without SVC and DSTATCOM (absorb and injected reactive power). The voltage level (voltage magnitude) at load buses and power transmitted in a power distribution system during steady state condition improved by using FACTs devices (SVC and DSTATCOM).

FACTs devices were connected as a shunt connected to the network through a transformer and used on the buses which has the voltage less than the acceptable limit to maintain the voltage level in a specified limit, minimized the power losses.

The VAR for FACTS devices required to determine power flow in all branches of Transmission lines. The simulation results are in line with the predictions. The scope of present paper is the modeling and simulation of Twenty four bus systems.

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Table 1. Branches and load bus data required for test system

Branch data			Load bus data		Branch data			Load bus data	
Branch (i-j)	R (Ω)	X (Ω)	P_j, MW	Q_j MVAr	Branch (i-j)	R (Ω)	X (Ω)	P_j, MW	Q_j MVAr
0-1	0.04960	0.04240	0	0	12-13	0.05148	0.05460	0.2125	0.1325
1-2	0.11550	0.12250	0.2125	0.1325	13-14	0.06600	0.07000	0.2125	0.1325
2-3	0.03135	0.03325	0.2125	0.1325	14-15	0.03300	0.03500	0.2125	0.1325
3-4	0.06600	0.07000	0.2125	0.1325	1-16	0.01815	0.01925	0.3400	0.2120
4-5	0.06600	0.07000	0	0	16-17	0.01815	0.01925	0.3400	0.2120
5-6	0.19800	0.21000	0.3400	0.2120	5-18	0.01815	0.01925	0.2125	0.1325
6-7	0.02640	0.02800	0.2125	0.1325	18-19	0.01815	0.01925	0.2125	0.1325
7-8	0.03960	0.04200	0.3400	0.2120	19-20	0.01815	0.01925	0.2125	0.1325
8-9	0.00825	0.00875	0.2125	0.1325	20-21	0.01815	0.01925	0.2125	0.1325
9-10	0.04785	0.05075	0	0	10-22	0.01815	0.01925	0.2125	0.1325
10-11	0.11550	0.12250	0.2125	0.1325	22-23	0.03120	0.03350	0.2125	0.1325
11-12	0.03828	0.04060	0.2125	0.1325	23-24	0.03120	0.03350	0.2125	0.1325

Table 2 Results of power flow and voltage magnitudes at each node without used FACTS

Branch (i-j)	Bus voltage (j) kV	dU, %	Power flow			
			P_{ij}, MW	P_{ji}, MW	Q_{ij} MVAr	Q_{ji} MVAr
0-1	10.96479	-0.32009	5.07045	-5.05571	3.20135	-3.18875
1-2	10.88783	-1.01972	4.37558	-4.34985	2.76462	-2.73733
2-3	10.86797	-1.20027	4.13735	-4.13103	2.60483	-2.59812
3-4	10.82829	-1.56099	3.91853	-3.90655	2.46562	-2.45292
4-5	10.79078	-1.902	3.69405	-3.68334	2.32042	-2.30906
5-6	10.70421	-2.689	2.83304	-2.81402	1.77875	-1.75856
6-7	10.69406	-2.78127	2.47402	-2.47206	1.54656	-1.54448
7-8	10.68015	-2.90772	2.25956	-2.25710	1.41198	-1.40938
8-9	10.66768	-2.93018	1.9171	-1.91673	1.19738	-1.19699
9-10	10.66499	-3.04554	1.70423	-1.70253	1.06449	-1.06269
10-11	10.64582	-3.21981	1.06486	-1.06326	0.665	-0.6633
11-12	10.64074	-3.266	0.85076	-0.85042	0.5308	-0.53044
12-13	10.63561	-3.31263	0.63792	-0.63766	0.39794	-0.39767
13-14	10.63122	-3.35254	0.42516	-0.42501	0.26517	-0.26501
14-15	10.63013	-3.36245	0.21251	-0.21249	0.13251	-0.13251
1-16	10.96292	-0.33709	0.68012	-0.68002	0.42412	-0.42402
16-17	10.96013	-0.34554	0.34002	-0.33999	0.21202	-0.21200
5-18	10.78841	-1.92354	0.85029	-0.85013	0.53031	-0.53014
18-19	10.78662	-1.93981	0.63763	-0.63754	0.39761	-0.39755
19-20	10.78544	-1.95054	0.42504	-0.42500	0.26505	-0.26501
20-21	10.78484	-1.95599	0.21250	-0.21249	0.13251	-0.13250
10-22	10.66319	-3.0619	0.63767	-0.63758	0.39768	-0.39759
22-23	10.66111	-3.08081	0.42508	-0.42501	0.26509	-0.26501
23-24	10.66007	-3.09027	0.21251	-0.21249	0.13251	-0.13250

The voltage profile for test system represented in Fig.(6) and the power losses in this system without used FACTS equal to active and reactive is 98 kW and 101 kVAr respectively as shown in Fig. (7).

Table 3 Results of power flow and voltage magnitudes at each node with used FACTS

Branch (i-j)	Rec. bus voltage (j) kV	dU, %	Power flow			
			P_{ij}, MW	P_{ji}, MW	Q_{ij}, MVAr	Q_{ji}, MVAr
0-1	10.97465	-0.23045	5.04535	-5.03473	0.67558	-0.66650
1-2	10.92622	-0.67072	4.35461	-4.33637	0.24238	-0.22303
2-3	10.91411	-0.78081	4.12387	-4.11940	0.09053	-0.08579
3-4	10.89082	-0.99254	3.90690	-3.89844	-0.0467	0.05567
4-5	10.86972	-1.18436	3.68594	-3.67836	-0.18817	0.19621
5-6	10.83245	-1.52318	2.82807	-2.81379	-0.72652	0.74167
6-7	10.82889	-1.55554	2.47379	-2.47220	-0.95367	0.95535
7-8	10.82485	-1.59227	2.25970	-2.25758	-1.08785	1.09010
8-9	10.82445	-1.59590	1.91758	-1.91720	-1.30210	1.30250
9-10	10.82365	-1.60318	1.70470	-1.70267	-1.43500	1.43715
10-11	10.81608	-1.67200	1.06500	-1.06377	-0.33484	0.33614
11-12	10.81483	-1.68336	0.85127	-0.85097	-0.46864	0.46897
12-13	10.81483	-1.68336	0.63847	-0.63813	-0.60147	0.60183

13-14	10.81699	-1.66372	0.42563	-0.42522	-0.73433	0.73476
14-15	10.81915	-1.64409	0.21272	-0.21249	-0.86726	0.8675
1-16	10.97278	-0.24745	0.68012	-0.68002	0.42412	-0.42402
16-17	10.97185	-0.25590	0.34002	-0.34000	0.21202	-0.21199
5-18	10.86736	-1.20581	0.85028	-0.85013	0.5303	-0.53014
18-19	10.86559	-1.22190	0.63763	-0.63763	0.39764	-0.39755
19-20	10.86441	-1.23263	0.42504	-0.42500	0.26505	-0.26501
20-21	10.86382	-1.23799	0.21250	-0.21250	0.13251	-0.13249
10-22	10.82187	-1.61936	0.63767	-0.63758	0.39768	-0.39758
22-23	10.81983	-1.63790	0.42508	-0.42501	0.26508	-0.26501
23-24	10.81880	-1.64727	0.21251	-0.21250	0.13251	-0.13250

The voltage profile for distribution system represented in Fig.(6) and the power losses in this system with used FACTS equal to active and reactive is 73kW and 75kVAr respectively shown in Fig. (7).

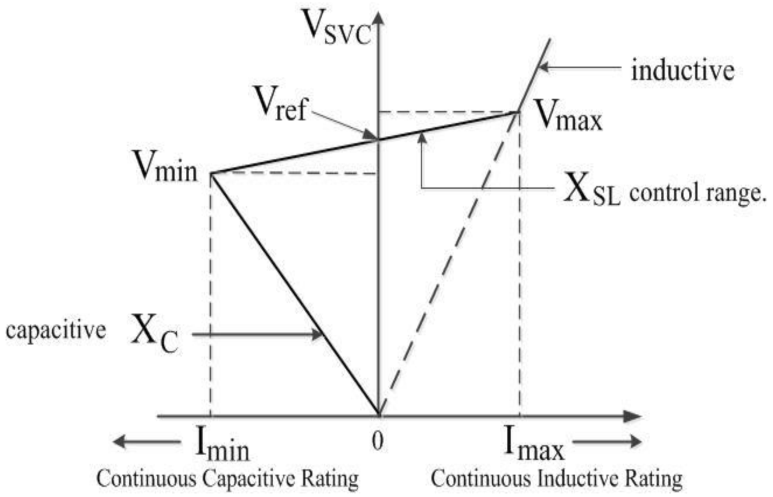

Figure 1. V-I characteristics of SVC

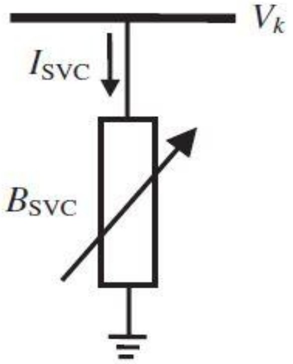

Figure 2. Variable shunt susceptance of SVC

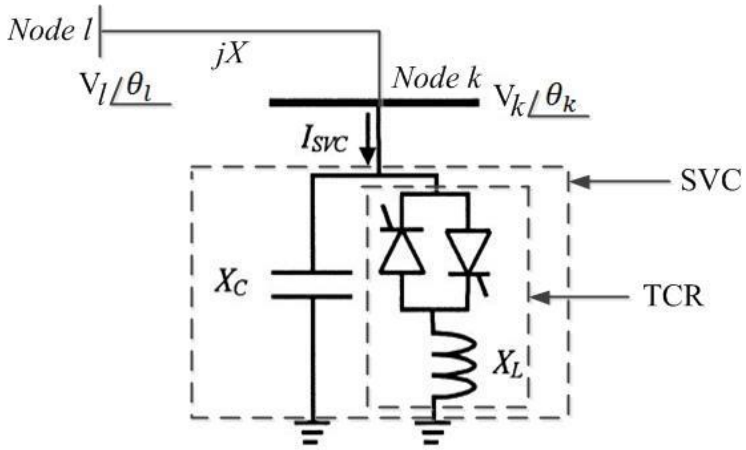

Figure 3. Equivalent circuit of SVC connected with bus k of distribution system

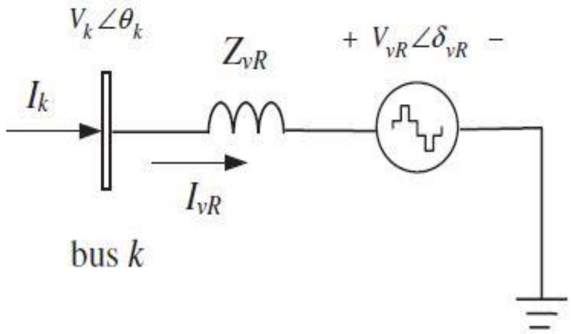

Figure 4. Equivalent circuit of static compensator (STATCOM) connected with bus k of network

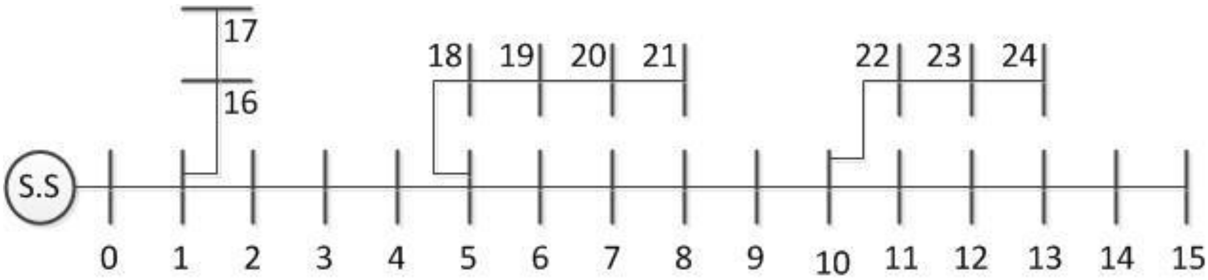

Figure 5. One line diagram for redial distribution system (case of study)

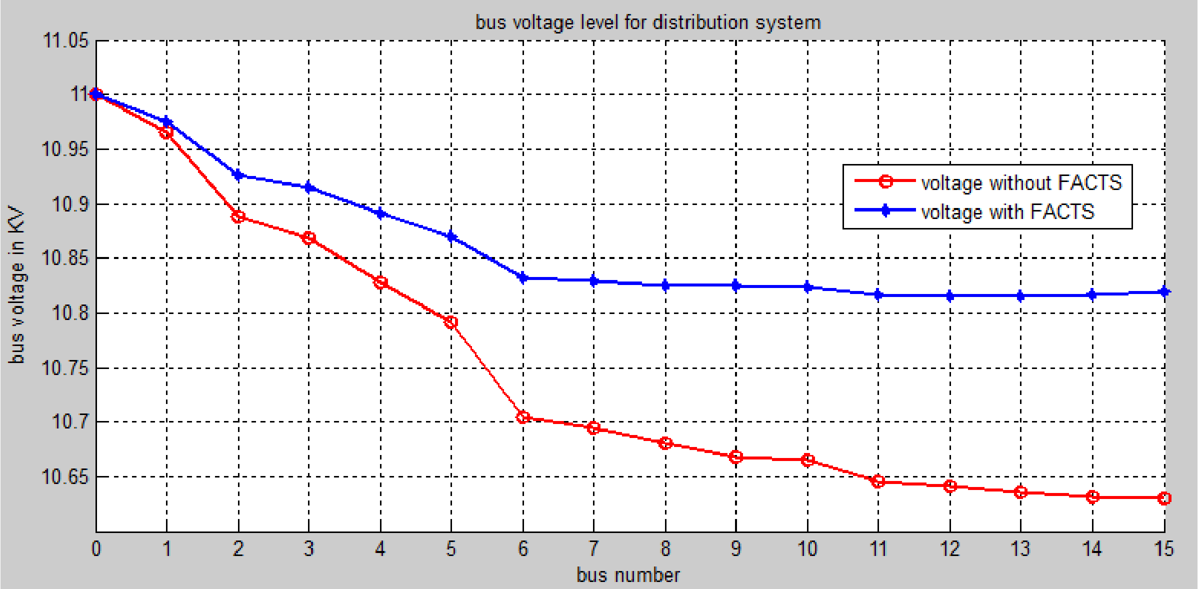

Figure 6. Voltage profile for radial distribution system (case of study)

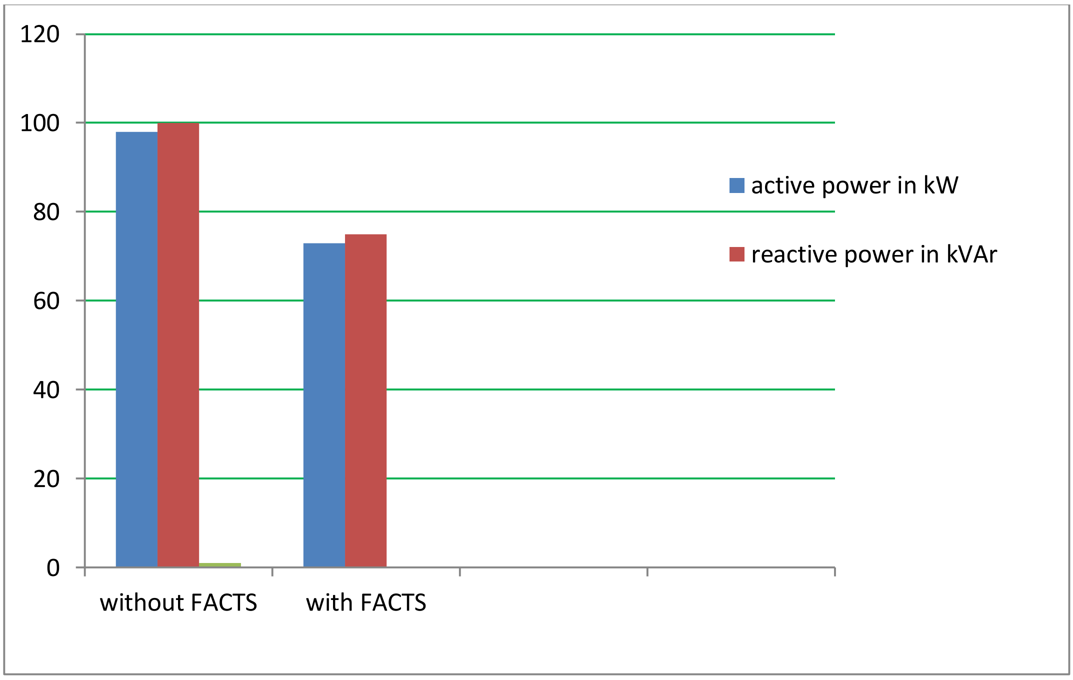

Figure 7. Total active and reactive power losses in radial distribution system (case of study)

تحسين جودة القدرة والفولتية للطاقة الكهربائية في انظمة التوزيع باستخدام الـ SVC & DSTATCOM (FACTS)

الخلاصة

جودة الطاقة الكهربائية هي من المجالات المهمة في انظمة التوزيع والنقل للطاقة الكهربائية. لتقليل الخسائر و تحسن مستوى الفولتية في انظمة الطاقة الكهربائية نقوم باستخدام اجهزة (FACTS) لإنجاز ذلك بشكل مناسب. استخدمت اجهزة FACTS في السنوات الاخيرة لحل الكثير من المشاكل في نقل وتوزيع الطاقة الكهربائية. حيث ان مسيطرات الـ (FACTS) تقدم فرصة لتنظيم سريان القدرة والاستجابة لها بشكل لحظي للمحافظة على استقراريه الشبكة الكهربائية. في هذا البحث تم استخدام SVC و STATCOM كأجهزة تربط على التوازي مع منظومة شبكة الطاقة الكهربائية في عقد التوصيل لتحسين القدرة الغير فعالة (Reactive power). هذه التقنية طبقت واستخدمت على نظام توزيع شعاعي يتكون من 24 عقدة. (برنامج تحليل و حساب سريان القدرة لنظم الطاقة الكهربائية) يقوم بمحاكاة هذا النظام لتحليل سريان القدرة (power flow) وحساب الخسائر (power losses) في نظام التوزيع وكذلك قيم الفولتية في كل عقدة ولقد نوقشت النتائج التي تم الحصول عليها.