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Effect of capacitor on the variable power quality placement in distribution networks in one single instance in the city of Kerman

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Abstract: *Because of growing trend of privatization of power industry, losses and reducing it, has become one important priority in the distribution network. Appropriate Capacitor form is one of the main ways to reduce losses. In this article the effects of capacitor was analysis for the effects of compensate reactive power, voltage profile, power factor, harmonic current, current profile before and after capacitor placement Mark at Substation 20kv Zafar in Kerman city in a two-day period before and after setting capacitor and a week before and after capacitor placement, Review results involved with the recovery rate of the network parameters with suitable installation of the capacitor, which will dramatically improve.*
Key words*- improved power factor, capacitors placement, losses reduction, power quality*

INTRODUCTION

Reactive power flow in the Electricity distribution networks increased the losses and reduced capacity lines and transformers will be useful. For this reason in electricity distribution companies to reduce losses and to compensate reactive power and resale building network capacity, capacitor installation will be done by the Use of capacitors in electrical grids and different voltage levels, the issue is not new, but reviews what caused the installation and use of capacitors in the network, can be valuable and significant results achieved debate.
Capacitors along with its vital importance in the network have devastating effects is also in some cases any way they cannot ignore. In This paper moreover, the study of the positive use of capacitors in distribution systems study the effects and negative consequences of the subject and issues related to power quality. In distribution networks is not necessary that the capacitor be quite accurately determined [8]. Even when this choice is not completely optimized, a moderate choice will bring a significant loss reduction. In this paper, a sample substation (Zafar), which more consists of residential loads, is under the investigation [9].
For different values of parameters extracted from electrical Data logger TDL103 was used to measure the ability to be active at the same time, and is capable of Reactive power, current, voltage, power factor factors harmonic voltage and current, frequency and .... [5]. The results one show that by installing capacitors, highly reduced and reactive power reduction of active power proportion is due to the loss reduction network. The amount of power factor improvement and the network disturbance destruction has been also extracted from this electrical energy research.

2 The Effects of the capacitors

2-1- The losses reduction

One important advantages of using capacitors is the reducing losses in line distributed. Losses is due to flow from conductor resistance, a share this flow transfer active power and other share transfer reactive power

this power kwh meters and is not doing useful work, but must be provided. Using capacitors to supply reactive power, flow rate and reduce line losses as a function of the square of line current, the capacitor will reduce losses.

$$P_{LOSS} = R \times \left| I_S \right|^2 \Rightarrow P_{LOSS} = R \left| I_P^2 + I_Q^2 \right|$$

2-2 - providing reactive power

Production of reactive power can be done in two ways: 1) by plants in the manufacturing sector 2) by compensator synchronous, capacitors, Synchronous Condensers in distribution and transmission. the existence of Reactive power resources near the related consumption in addition to reduce the costs it reduces the network reactive load due to consumers inductor load and the balance between inductor state and capacitor network and the reduction of network reactive load to permissive extent will be [6].

Although at the time of construction of electricity networks by creating capacitor banks trying to create this balance loads but Inductive and unwanted subscribers destroyed this balance power and impose huge quantities of reactive load to the network.

3-2 - improvement of voltage profile

Capacitor is fixed impedance devices. At higher voltages, capacitors draw more current and produce more reactive shall.

$$I = I_{rated} \times V_{pu} \quad , \quad Q_{K\,\mathrm{var}} = Q_{rated} \times V_{pu}^2$$

That V pu is Per unit voltage based on voltage of capacitor therefore applied voltage than the voltage proportional to the square of its reactive power production is increased [6], [2].

4-2- harmonics

In an ideal power system applied voltage for the consumer and the flow of both sinuses perfect, but action is never an ideal situation, so the voltage and current waves in a practical system are never complete. This sinusoidal deviation from the sinusoidal waveform, the destruction of harmonic voltage and current waveforms are called. The main cause of destruction, are non-linear loads connected to distribution systems. Capacitors in distribution networks, are not production of the harmonic, but have specific impact on existing harmonic. The first capacitor effect is to divert the flow direction of Monique mainstream sources that producers harmonic the other network effect is that can cause resonance in the natural system [1].

3 Analysis effects of installed capacitor in samples substation (Zafar) before and after the capacitor placement

In this land of substation has been used 20kv transformer 630kv, 20kv to 380v with a maximum 60% load to full load in the name of substation Zafar Kerman city. An effect of Rate has been installed for capacitors, capacitor banks substation 20×12.25 Kvar reacting the switching has been installed. Analysis of different electrical parameters and registration information on behavior, Data Logger TDL103 was used. In this study, the information Data logger a two-day period (10/15/2012 before capacitor placement and 10/21/2012 after capacitor placement) and a week before and after capacitor placement are under the investigation.

3-1- Reactive power curve

As shown in reactive power curve in the form of a one-day [1] after the capacitor placement reactive power, reduces to high amount and this decreasing depends on the number and capacity of capacitor banks that are enter at circuit.

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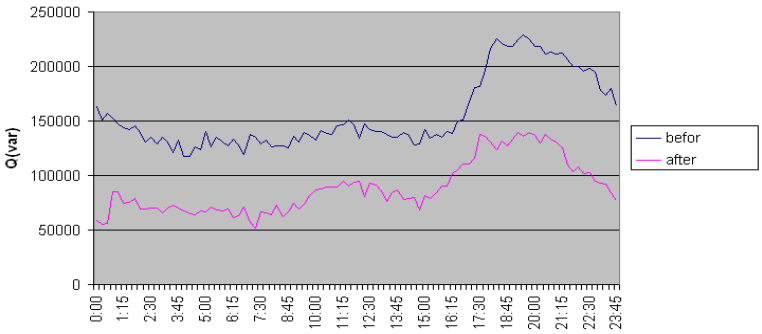

Figure 1_a) reactive power after and before capacitor placement

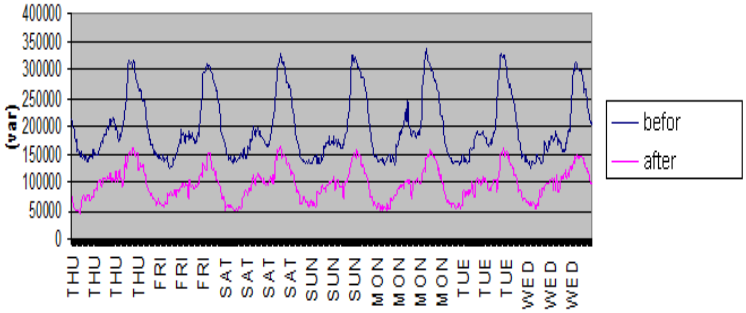

Figure 1_b) reactive power after and before capacitor placement (one week)

As shown in Figure (1_a and 1_b) peak in reactive power before installing the capacitor is equal 230 kvar respectively for one day and one week. The transition capacitance value was 139.6kvar, which reduces the capacitor bank 90.4 Kvar Reactive powers that is passing from the transformers. This amount equal to 36% of total capacitance value installed in the network. For better comparison and analysis of performance and impact on the capacitor reactive power passing from a period of two transformers and one day week information and calculations were extracted from the results in Table 1.

Table 1: medium reactive power substation joker before & after capacitor placement

	One week	One day
Q_{Before} (kvar)	195	156
Q_{After} (kvar)	98	85

As can be seen in this table passing average reactive power during the period (one day a week) has been calculated on an average one-day period the amount of reactive power passing is 45.5% and capacitors in a week period 49.8% passing reactive power compensation.

3-2 - active power curve

One important advantages of using capacitors is to reduce casualties distribution line that casualties are due to the flow resistance through the conductor the share of current reactive power is transferred to the capacitor after the placement by reducing reactive power, the current passing conductor resistance reduced a

losses with the square of flow decreases. The below curve shows graphic value after the capacitors can be active placement.

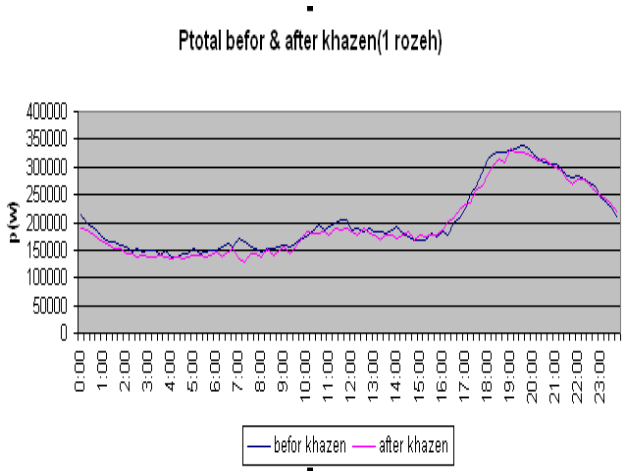

Figure 2) reactive power before & after capacitor placement

In Table (2), average values of attracted active of transformer in the period of one day a week. Before and after capacitor placement is shown that active power reduction passing from the transformer is show.

Table 2: medium reactive power substation joker before & after capacitor placement

	One week	One day
P_{Before} (kw)	193.2	204.7
P_{After} (kw)	189.7	197.8

3-3- voltage curve

In the study of figure (3) that shows the voltage curve before and after the capacitor placement that little change has been done, but almost 1.7% rate increase equivalent to 3.7 volt of voltage increase.

Table 3: medium voltage substation joker before & after capacitor placement

	One week	One day
V_{Before} (v)	233	234.7
V_{After} (v)	238	238.7

Of course, it should mention that the increase in voltage is not always beneficial, especially in a state of low load that it increases the voltage and destroys the equipment.

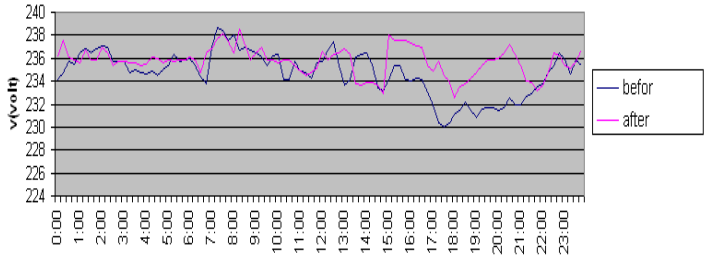

Figure (3): medium voltage before & after capacitor placement

Figure (3) shows curves of medium voltage capacitor before and after phases of placement in substation Zafar.

3-4- curve of harmonic current

According to review current harmonic curve before and after capacitor Zafar Substation as it can be seen Figure (4). After installing capacitor current harmonic factors (THD_i) significantly has increased. Increased THD cause problems including:

1- Burning protective equipment off.
2- Global warming and decreasing excessive transformer life and speeding up the destruction of insulation transformer oil.
3- Destroying customer's equipment.

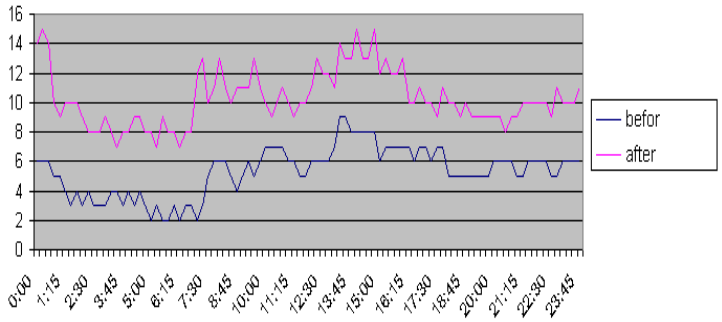

Figure 4) harmonic current curve before & after capacitor placement

Before capacitor placement the value of THD_i 26.5 was equals (a period of one day) after the capacitor placement3.1. Value of 3.10 has increased. The most common problems occur beyond the harmonic limitation of the distribution system as it follows [7]:

1) Destroying protective equipment such as fuses,
2) Too warning the transformer increasing losses and reduces its life and destroys it is oil.

Table 4: medium harmonic current factor substation Zafar

	One week	One day
$THD_{i\ Before}$ (v)	6.38	5.26
$THD_{i\ After}$ (v)	10.2	10.3

3-5- The power factor curve

Installation of capacitors in a distribution substation injection reactive power source reduces the power factor correction and as a result of voltage drop feeder reduces total. As we know, power factor depending reactive power is a passing from the transformer. By placement capacitor some of the reactive power is compensated through a capacitor, so the amount of output reactive power of the transformer and power factor dropped to a close the following can be concluded.

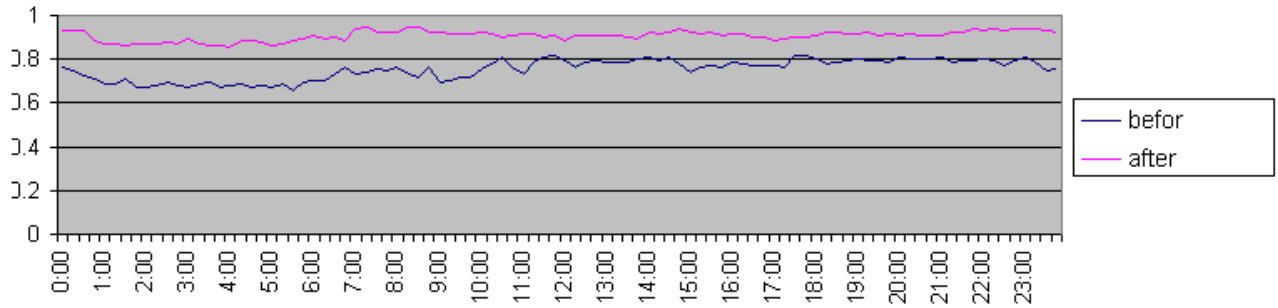

Figure 5) power factor curve before & after capacitor placement

In Table below the average amount shows power factor capacitors before and after a two-day period in one week. As can be seen after the power factor capacitors placement has improved dramatically.

Table 5: medium power factor substation joker before & after

	One week	One day
PF_{Before}	0.76	0.745
PF_{After}	0.89	0.907

4 Conclusions

By studying presented curves in the previous section the following results can be achieved:

1- An appropriate capacitor reduces the substation reactive power distribution transformer will be passing this to reduce the amount entered in the capacitor depends on the network. In this study, the average value of the 85 Kvar 156 Kvar reached.

2- By capacitor placement in distribution substation and amount of reactive current supplied and in conclusion the passing flow through the line resistance and cause reduction of losses and releases the line capacity.

3- Capacitors Installation in distribution of substations in a significantly increasing voltage do not cause but, this increase also causes minor benefits such as improved profile voltage, voltage confirm, ... and causes destructive and disadvantages such as additional voltage that causes damage to the protective equipment created. According to capacitor placement the amount of medium voltage has increased to 3.7 v.

4- Capacitor placement increases the current harmonic factors (THD_i). This increasing in direct relation with the entered circuit capacitor, witch its average value gets from 5.26 to 3.1.

5- To create conditions ideal for power factor in distribution networks should be possible to close the unit power factor with capacitors Rate this can be done. How much power by feeding each capacitor (the capacitor depends on the capacity) to the reactive power absorption time is close, power factor improvement further finds that its average value was 0.745 to 0.907. One can even reach your pre-phase power factors, in addition to compensating reactive power transformer downstream part of the network and reactive power transformer 20 kv as well, but the amount of compensation and therefore are in a certain amount of pre-phase regulators require further consideration.

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