LOAD BALANCING AND VOLTAGE HARMONIC REDUCTION IN A POWER SYSTEM USING DSTATCOM

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Abstract : This paper illustrates using a distribution static compensator (DSTATCOM) for balancing the load in the power system and to reduce the harmonics present in the system generated by the non linear loads present in the system. The method includes the reactive power compensation that is to inject the reactive power by using the DSTATCOM. By this way the unbalancing of the load and non linearity can be reduced and current waveform can be obtained to be pure sinusoidal.

Keyword: Harmonic Compensation, Load Compensation, Distribution Static Compensator,Power Quality Issues

Introduction : Modern power system comprises of large interconnected network consisting of many buses. The demand of energy is increasing day by day due to large increase of population of the country. To cope up with the ever increasing energy demands energy efficiency movements had been carried which has been of change of load use patter due to this most of the loads that are being used now a days are the non linear loads. The non linear loads life LED bulbs, CFL, induction heaters reduces the energy consumption but distorts the waveform pattern of the current waves. The distrotion in current waves are due to the current harmonics injected to the system by the non linear loads present at the load centres.

Along with this problem another problem associated with the power system is that the distribution of the load is not even due to the large interconnectivity. This creates unbalance in the three phase current waveform. The unbalanced load current and the harmonics present in the current causes derating of the devices and also causes overheating. This canalso causes some power quality problems like voltage sags, voltage swells etc.

This paper discusses the uses of DSTATCOM to elimininating the unbalance and harmonics present in the system thus by using DSTATCOM the system current waveform can be made sinusoidal and symmetrical.

DSTATCOM: Distribution static compensator (DTATCOM) is basically a static compensator used in the distribution system to improve the power quality of the power system. A DTATCOM comprises of a fully controlled inverter circuit and a dc source connected with its input. A DTATCOM is connected in parallel with the load and the point at which a DTATCOM is connected is called point of common coupling PCC. By controlling the inverter triggering pattern a DTATCOM can be made to absorb the reactive power from the system or to inject reactive power to the system. The schematic diagram of reactive power compensation through DTATCOM can be seen in figure 1

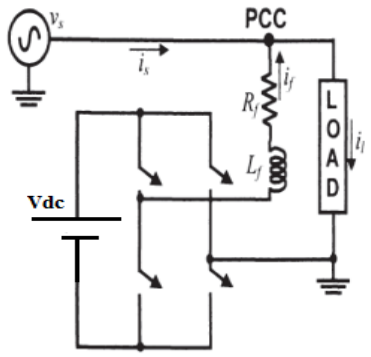

Fig 1 **Schematic Diagram of the DSTATCOM Compensation**

As seeen from the figure which shows the DTATCOM configuration for the sigle phase system it consits of a dc voltage source, 4 switches which control the current of the DSTACOM. It is connected in parallel with the load at a point known as point of common coupling.

Working of the DTATCOM: As seen from the figure 1 if we assume that the load is a non linear load. The instantaneous load current will have the following current components

$I_l=I_{lp}+I_{lq}+I_{lh,}$

here I_{lp} and I_{lq} are the real and reactive part of the load current and I_{lh} represents the harmonic component of the load current. By using DSTATCOM the reactive and harmonic component of load current is compensated. So the current that must be injected by the DSTATCOM must be

$I_f^*=I_{lq}+I_{lh}$

I_f^* is known as to be the reference current of the DSTATCOM. If the inverter can be made to track the reference current accurately then the harmonics will be eliminated in the source current I_s and the source current power factor will be equal to unity.

In a three phase system if the load is unbalanced such that the reactive power requirent of all the three phase are different and the real power requirement of all the three buses are same then the unbalancing in source current waveforms can also be eliminated .

Three phase shunt Compensation Structure: The three phase DSTATCOM compensation structure is shwon in the figure 2

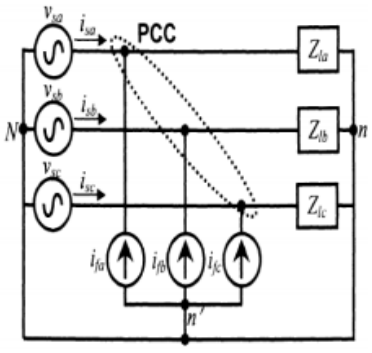

Fig 2 **Three Phase DSTATCOM Compensation Structure**

Figure 2 shows the three phase four wire structure of the DSTATCOM compensation. The three phase supply voltages are V_{sa},V_{sb}, and V_{sc}. The three phase source currents are I_{sa},I_{sb}, and I_{sc}. Star connected load is present and load may not be balanced. In this case the DTATCOM currents are injected in such a manner that the source currents are balanced, free from harmonic contents and Source current power factor is unity.

Let the load connected is a non linear load then the three phase load current will be

$I_{la}=I_{lap}+I_{laq}+I_{lah}$ then the compensator current for phase a must be $I_{fa}^*=I_{laq}+I_{lah}$

$I_{lb}=I_{lbp}+I_{lbq}+I_{lbh}$ then the compensator current for phase b is $I_{fb}^*=I_{lbq}+I_{lbh}$

$I_{lc}=I_{lcp}+I_{lcq}+I_{lch}$ then the compensator current for phase c is $I_{fc}^*=I_{lcq}+I_{lch}$

Discussions: If the unbalancing is caused by the unbalancing in the reactive power requirement of the load then by using dtatcom by controlling inverter to track these reference current source current can be made balanced, harmonic free and to be at unity power factor. Thus power quality problem can be eliminated by using the DSTATCOM compensation as mentioned above.

Results : from the methodology discussed it can be concluded that the reactive power compensation by using DSTATCOM can balance the load as well as it can reduce harmonics and improve the power factor of the system. Thus this proves to be a great advantage in the distribution system. Also it is adaptable to the load changes thus system will also be dyanamic. Also the distortions present in the current waveforms can be reduced by using this technology.

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