ABSTRACT

New technology has driven the development of ever more flexible, cost effective, high performance electrical equipments. However, such increasingly sophisticated equipments inject non-sinusoidal current, which distort the power supply voltage. The harmonics, which cause the voltage distortion, lead to malfunctioning, abnormal heating and vibrations in equipment connected to network.

Also Use of 3-ϕ induction motor (IM) in various industries is almost 80% of their total drives requirements. Performance of these induction motors is affected by the unbalance in input voltages due to the flow of negative sequence current, which heats up the rotor and generates breaking torque. Due to the very low value of negative sequence impedance offered by the induction motor as compared to its positive sequence impedance, a very small negative sequence voltage component in the input may give rise to considerable negative sequence current causing deterioration to a great extent in the performance of induction motor. Therefore even low unbalance factor (ratio of negative sequence to positive sequence) in input voltage has to be carefully looked into. Voltage unbalances occur quite often in distribution systems. Fig. 1 shows the schematic of this conventional induction motor drive and the effect of input voltage unbalance.

This research work presents a three-phase series active filter to eliminate voltage harmonics in distribution system along with negative sequence & zero sequence compensator. It is based on instantaneous active reactive power theory (p-q theory). A three phase IGBT based voltage source inverter with DC bus capacitor is used as three-phase series active filter and negative & zero sequence compensator. Reference voltages and distorted voltages are derived through PTs from three-phase system for the computation of desired compensation voltages.

It is well known that the average power flow due to positive sequence voltage and negative sequence current is zero

$$(V_m \sin(\omega t) I_m \sin(\omega t) +$$
$$(V_m \sin(\omega t - 120) I_m \sin(\omega t + 120))$$
$$+ (V_m \sin(\omega t + 120) I_m \sin(\omega t - 120)) = 0$$

Similarly the negative sequence voltage will generate nonzero power with negative sequence current.

Hence this concept is used for generating the reference signal for negative sequence compensator using instantaneous α-β-0 theory.

Finally using Instantaneous Active Reactive Power Theory the compensating signal was derived, which can compensate the voltage due to negative sequence, zero sequence, & harmonics present. This is the contribution of this thesis.

The three-phase, three legs IGBT based voltage source inverter with DC bus capacitor regulates the compensating voltages in the close vicinity of the desired reference voltages. The performance characteristics of the active filter is simulated and tested experimentally. The experimental results established the superiority of the series type active filter over passive tuned filter.