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ABSTRACT

Power electronics based equipments are rapidly evolving as significant components in the modern power distribution system. It deals with more advantages such as compact, flexible control, energy efficient and reliablewhich have enhanced as compared to traditional equipments. On the other hand, the use of these devices gives rise to some of the serious power quality problems, such as, generation of harmonic currents which propagate to other connected feeders and demand increased reactive power from AC mains and introduces other power quality problems. Moreover, modern equipments are becoming highly sensitive to the voltage supplied to them. An increasing the generation capacities of existing power stations is difficult and expensive due to environmental constraints. Hence, improving the quality of power can not only make the power distribution systems healthier and efficient, but it also results in reduced power losses, and thus saving in terms of costs. The custom power devicesare widely used to tackle some of the important power quality problems. Recent trends are geared towards the realization of multitasking devices which can mitigate several power quality problems simultaneously. The unified power quality conditioner (UPQC) is one of the most versatile custom power devicethat can compensate significant power quality issues, such as, voltage harmonics, voltage sag, voltage swell, voltage unbalance, voltage flicker, current harmonics, load reactive power, currents unbalance, and neutral current. A UPQC consists of two voltage source

converters connected back to back with each other sharing a common self-supporting DC link. One converter is controlled as a variable voltage source in same manner as in the DVR (Dynamic Voltage Restorer), and the other as a variable current source which is similar in operation as that of the DSTATCOM (Distribution Static Compensator). The existing literature suggests the dependency on a shunt converter to compensate the load reactive power demand. Moreover, the series converter is always utilized to overcome all the voltage related problems. The voltage sags, swells and the flickers are short duration power quality problems.

Hence, this traditional approach of utilizing the UPQC to compensate the power quality problems shows a significant drawback of under usage of the available series converter. The present doctoral work is based on the design of unified power quality conditioners (UPQCs),the design a novel control algorithms for UPQC to carry out an analytical study on the flow of active and reactive powers among the utility, UPQC and the load with a novel approach, integration of distributed generation (DG) with UPQC and at last a comparative study among the multiple voltage controller of the UPQC to mitigate the power quality problems. A novel algorithm of series VSC termed as a power angle control (PAC), in which both the series and shunt converters share the load reactive power in co-ordination with each other without affecting the basic UPQC compensation capabilities. This eventually results in a better utilization of the series converter, reduction in the shunt converter rating to some extent and ultimately in the reduction of the overall cost of UPQC. Moreover, this work also integrates the DG system with the UPQC a new functionality for UPQC in which, the requirement of active power of UPQC is supplied by the DG system. These concepts are successfully validated through MATLAB simulation.