ABSTRACT

Industrial growth with increased automation has made electricity as the key resource for the modern society. The demand for electricity is growing each day, even though gap between available electrical energy and demand is widening. Further, as the volume of power transmitted and distributed increases, the associated loss becomes an important issue of concern. Added to it is also the proliferation of sensitive electronics and critical processes, which impose need for high quality and reliable supply. Within the given constraints of power availability, transmission and distribution losses, economics, supply of uninterrupted quality and reliable power to consumers, Power Quality (PQ) has assumed sustained concern in the present scenario.

Narrowing down further in respect of power quality, reactive power control and voltage distortion can be considered to be the most important aspects. Deployment of the Voltage Source Converters (VSCs) in AC to DC bidirectional power conversion, especially in the area of dynamic reactive power compensation, also appears to be major area of interest for researchers. Continued advancement of technology, both on the power devices and control electronic also facilitates range of solutions getting explored by researchers. However, with co-existence of other equipment with diversified technology already in use in industries and utilities, assuring the power conversion quality at economical costs poses challenges, with requirements demanding multi-disciplinary efforts to engineer a given field solution.

Work in this thesis is oriented to meet this objective, by covering design; implementation and working of PWM based VSCs, for dynamic reactive power compensation in single and three phase applications. Novel concepts facilitating the extension of the designs for varied applications and economics are then covered. Some of the concepts cover field installations, while the others cover simulation and/or experimental results. The design implementation also addresses current generation of embedded controllers and ensures through novel hardware engineering and software practices, reliable operation in actual field conditions. As a part of power quality the work presented also includes economical technique for controlling sudden voltage dips/rises in the industry networks and unity power factor based Electronic Transformer.

The thesis thus becomes a comprehensive information base for facilitating further new generation products while bridging the gap being faced on the economical concerns for the method already in use for improving power quality.