Power Quality Enhancement using DVR based on Ant colony Controller

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***Abstract*—PI controller tuning is a difficult task under varying operating conditions. Optimal tuning of PI gains is required to get the best response of PI controllers. This paper presents the Dynamic Voltage Restorer (DVR) using ant colony optimization based PI controller (ACOPI). The simulation results demonstrate that the optimized PI controller by ant colony (ACO) presents an advantage of little response time and best control performances compared to the classical PI. The major benefit of this approach is to provide a faster DC voltage response for different voltage disturbances. The simulation results show that the approach for finding the optimal controller parameters is not easy to be implemented, but very effective in improving power quality. The total arrangement is planned, established and validated by using MATLAB–SIMULINK environment.**

Keywords—Dynamic voltage restorer; sag; swell; ant colony optimization; metaheuristics

I. INTRODUCTION

Recently, the increased numbers of sensitive loads such as computers, medical equipment, and automation and Information Technology devices have been integrated into the electrical power distribution system. These devices, which are operated continuously during 24x7 hours period, demand highly reliable input power supply and voltage stability. Supplying unreliable power supply to these devices brings severe losses to the domestic and industrial customers [1]. A voltage dip is commonly defined as any low voltage drop event between 10% and 90% of the nominal RMS voltage, lasting between 0.5 cycles and 1 min [2]. In comparison with interruptions, voltage dips affect a large number of customers and for some cases may cause extremely serious problems. Voltage dips are one of the most occurring power quality problems. They occur more often and cause severe problems and economical losses. There are different ways to mitigate voltage dips, swells and interruptions in transmission and distribution systems. At present, a wide range of very flexible controllers which capitalize on newly available power electronics components are emerging for custom power applications. Among these, the distribution static compensator and the dynamic voltage restorer are the most effective devices; both of them based on the voltage source converter (SVC) principle [3]. DVR is a series custom power device, which has excellent dynamic capabilities. It is well suited to protect sensitive loads from duration voltage sag or swell. DVR is basically a controlled voltage source installed between the supply and a sensitive load. It injects a voltage on the system in order to compensate any disturbance affecting the load voltage. In August 1996, Westinghouse Electric Corporation installed world's first dynamic voltage restorer in Duke Power Company's 12.47 kV substation in Anderson, South Carolina. This was installed to provide protection to an automated rug manufacturing plant. Prior to this connection, the restorer was first installed at the Waltz Mill test facility near Pittsburgh for full power tests. Another was installed to provide service to a large dairy food processing plant in Australia [4-5].

II. MODELING OF DVR

The basic idea of a DVR is to inject dynamically controlled the missing voltage into the system through series injection transformer whenever the defaults of voltage are present in the system supply voltage. There are three single-phase transformers connected to a three phase converter with energy storage system and control circuit. The amplitudes of the three injected phase voltages are controlled so as to eliminate any detrimental effects of a bus fault to the load voltage. This means that any differential voltage caused by transient disturbances in the AC feeder will be compensated by an equivalent voltage generated by the converter and injected on the medium voltage level through the booster transformer. As a consequence, the voltage disturbance is unseen by the loads.

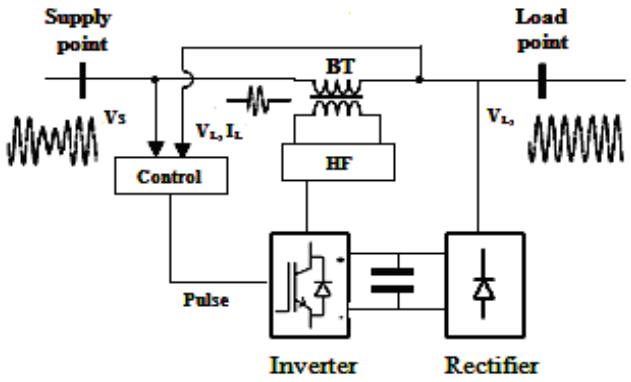

Fig. 1. Schematic diagram of DVR System

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