International Journal of Advanced Research in Science Management and Technology

An Overview on Power Quality Problems by Using D-STATCOM

Snehal B. Nerkar[1], Prof. K. M. Mahajan[2]

PG Scholar, KCE Society's College of Engineering and Information Technology, Jalgaon, M.S., India[1]

Assistant Professor, KCE Society's College of Engineering and Information Technology, Jalgaon, M.S., India[2]

ABSTRACT— Voltage sag and harmonics are frequently occurred problems related while, non linear loads are be placed. This effects the critical loads connected at same line of common coupling of the distribution line. Here this paper presents an overview to overcome the power quality issues and analysis of different harmonics and sag disturbing the distribution line by FACTS devices known as Distribution Static Compensator (D-STATCOM) . The control method of Unit Template Algorithm for reference current generation is proposed in this paper. The modle of distribution line and D-STATCOM are implemented by MATLAB-SIMULINK software.

KEYWORDS- Sag, Harmonics, D-STATCOM, Distribution line, Unit Template Algorithm.

I. INTRODUCTION

Electric utilities and end users of electrical power has been progressively concerned about the electric power quality. In the power industry and consumer premises the term power quality issues has become the most important part. The Electricity power sector transfer issue is not cramped to only energy efficiency and environment but more importantly on regulation and quality of supply or quality of power. The quality of Electrical Power can be describe as the degree of any deviation from the minimal values of the frequency and voltage magnitude. Power quality may also be describe as the degree to which both the delivery of electric power and affects the performance of electrical equipment during the operation. From a customer perspective, a problem of power quality is defined as any power problem manifested in current ,voltage, or frequency deviations that result in power wastage of customer of equipment or failure. It is beyond a major concern in the present era; it especially becomes foremost with the introduction of highly evolved devices, whose execution is very sensitive to the quality of power supply. Nowadays modern industrial processes are build on a large amount of power electronic devices such as adjustable speed drives and programmable logic controllers (PLC). Most of electronic devices are very delicate to disturbances and hence industrial loads become less easy-going to power quality problems such as harmonics, voltage dips, voltage swells, interruptions, flickers, and notches. For generating the reference current an unit template algorithm is discussed in this paper. Actual source current in the hysteresis controller compared with the reference current [3]. Hysteresis controller generates switching pulses and it is given to the IGBT of the voltage source converter. The DSTATCOM is connected at distribution line to eject or absorb the reactive current at PCC. The elimination of harmonics are done by compensating current, keeps the input waveform sinusoidal during the operation of nonlinear loads. Therefore, in this paper two power quality issues i.e voltage sag and harmonics are addressed.

II. D-STATCOM

It is a shunt connected power device having voltage source converter (VSC), DC energy storage, coupling transformer and output filer. Balanced three phase AC voltages are generated from DC energy source by the voltage source converter [1]. This voltages generated from VSC are in phase and given to the interconnected grid through coupling transformer. Effective control of reactive and active power flow in D-STATCOM and distribution line is achieved by proper adjustment of magnitude and phase of the D-STATCOM. The Active filter (AF) technology is now implemented for providing compensation for reactive power, harmonics, or neutral current in ac networks [2]. It has been implementing and evolved in the past quarter century of development with varying configurations, solid-state devices and control strategies. AF's are also implemented to regulate terminal voltage, to eliminate voltage harmonics, to suppress voltage flicker, and to improve voltage balance in three-phase systems. These wide range of objectives is achieved either in combination or individually, depending upon the requirements and configuration and control strategy which have to be selected appropriately. This section describes the present status and history of development of the AF technology. The widespread use of solid-state control of ac power, the power quality issues became significant. There are a large number of publications which covering power quality survey, analysis, measurements, cause, and effects of reactive power and harmonics in the electric networks [3]. AF's are basically divided into three types, namely, two-wire (single phase), three-wire, and four-wire three-phase configurations to meet the requirements of the three types of nonlinear loads on supply systems. The single-phase loads, such as ovens, domestic lights, TV's, air conditioners, computer power supplies, , Xerox machines and laser printers behave as nonlinear loads and cause power quality problems. The single-phase (two wire) AF's are investigated in varying configurations and different control strategies to meet the needs of single-phase nonlinear loads. Starting in 1971, many configurations, such as the active shunt filter, active series filter, and combination of shunt and series filter have been developed and commercialized also for uninterruptible power supply (UPS) applications . Both concepts based on a voltage-source inverter (VSI) with capacitive energy storage and a current source inverter (CSI) with inductive energy storage are used to develop single-phase AF's. Since major amounts of ac power are absorbed and consumed by three phase loads such as ASD's with solid-state control. Lately, most of ASD systems incorporate AF's in their front-end design. A substantial number of publications have reported on three phase three wire AF's starting in 1976. Active series, active shunt, , and combinations of both, named as active power quality conditioners as well as passive filters combined with active series and active shunt AF's are some typical configurations used. Most control strategies such as instantaneous reactive power theory initially developed synchronous frame *d–q* theory , notch filter method and synchronous detection method are used in the development of three-phase AF's. The problem of excessive neutral current is observed in four-wire three-phase systems, mainly due to nonlinear unbalanced loads, such as fluorescent lighting, computer power supplies, etc. Settling the problems of neutral current and unbalanced load currents has been attempted in for four-wire systems. These attempts are of varying nature, like harmonic compensation, elimination/reduction of neutral current, load balancing, reactive power compensation , and combinations of these. A large number of volumes of work is reported on the theories related to the measurement and detection of the various quantities, such as reactive power, real power, etc., in the presence of harmonics in the supply systems with nonlinear loads. These concepts and theories are quite relevant to extract the control signals for AF's and for the development of instruments to measure conventional and newly defined quantities in the presence of unbalance and harmonics. For expressing the effectiveness of AF's, it is important to develop good measuring systems, and these new concepts have given a new force to instrumentation technology in this field. The problems of load unbalance and reactive power were recognized long ago, and they became increased in the presence of nonlinear loads [4]. Many publications report on solid-state compensators for reactive power, voltage flicker, and balancing the nonlinear reactive loads, such as traction loads, arc furnace, etc. Many terminologies, such as static flicker compensators, static var compensators, static var generators, etc., have been used in the literature. The advent of fast self-commutating solid-state devices becomes one of the major factors in advancing the AF technology.

III. LITERATURE SURVEY

Power quality is a major concern in the present era; it becomes especially important with the implementation of sophisticated devices, whose performance and operation is very sensitive to the quality of power supply. Modern industrial processes are based on a large amount of programmable logic controllers and electronic devices and adjustable speed drives. These electronic devices are very sensitive to disturbances and thus industrial loads become less tolerant to power quality problems such as voltage swells, voltage dips, and harmonics [5]. Voltage dips are considered one of the most intense disturbances to the industrial equipment. Over voltages and Swells can cause over heating tripping or destruction of industrial equipment such as motor drives. Most of electronic equipment's are very sensitive loads due to harmonics because their control depends on either the peak value or the zero crossing of the supplied voltage, which are all affected by the harmonic distortion. This paper analyzes the key issues in the power quality problems. As one of the effective power quality problems, the origin, consequences and mitigation techniques of voltage sag/swells and interruptions problem will be discussed in detail. The study describes the techniques of mitigating the problems in a distribution system by a solid state power electronics based devices called Distribution Static Compensator (D-STATCOM). Voltage from device is connected into the system to correct the problems. The performance and analysis of the D-STATCOM is studied for the power quality problems to be viewed. Technical literature on the AF's has been reported since and, in the last two decades, has boomed. Around1990, most of commercial development projects were completed and put into practice [7]. A number of configurations discussed earlier have been investigated, but could not be developed commercially because of complexity considerations and cost. Initially reported configurations were quite general and the rating of solid-state devices involved was significant, which resulted in high cost. Due to these reasons, the technology could not be translated to field applications. Later on, the rating of active filtering method was reduced by the introduction of supplementary passive filtering without deteriorating the overall filter performance [9]. Besides, modern AF's are capable of compensating quite high orders of harmonics (typically, the 25th) dynamically. However, as high-order harmonics are small, they are compensated and mitigated by using a passive ripple filter . This approach has given augment to field applications, and in countries such as U.S and the Japan., AF acceptability for field applications has increased up to the 1000-kVA range. Another major attempt has been to separate out various compensation aspects of the AF's to reduce the cost and size. Although, additional features get included on specific demand. Economic considerations were the disruption at the initial stages of AF development, but now they are becoming affordable due to a reduction in the cost of the devices used. With the harmonic contamination in present-day power systems, the demand for the AF is increasing. Recommended standards such as IEEE-519 , will result in the increased use of AF.

III. PROBLEM DEFINITION

The phenomenon of power quality and issues through application of power electronics is studied in the paper. The aim of the control scheme is to maintain constant voltage magnitude at the point where a sensitive load is connected at distribution line, under system disturbances. The wide range of power quality disturbances covers sudden and short duration variations, e.g. oscillatory and impulsive transients, short interruptions, voltage sags, as well as steady state deviations, such as harmonics. This paper, specifically examine the use of a power electronic shunt compensator named as DSTATCOM to correct the current drawn from a utility to closely approximate balanced sinusoidal waveforms, without adversely affecting the performance of voltage at the point of common coupling. Thus, adjustment of the feedback gains makes it possible to reduce voltage fluctuation in transient states, when the active filter has the function of combined voltage regulation and harmonic damping. By using UPQC the control scheme of a shunt active power filter must calculate the current reference waveform for each phase of the inverter to maintain the dc voltage constant and generate the proper inverter gating signals. To correct the effects of supply voltage distortion, the series compensator is required to inject or absorbed appropriate harmonic voltages. A novel strategy for the improvement of power quality isses based on custom solid state power devices the analysis of the results obtained from various techniques are presented.

IV. PROPOSED SOLUTION

This paper presents an overview to overcome the power quality issues and analysis of different harmonics and sag disturbing the distribution line by FACTS devices known as Distribution Static Compensator (D-STATCOM) . The control method of Unit Template Algorithm for reference current generation has been proposed in this paper. The modle of distribution line and D-STATCOM are implemented by MATLAB-SIMULINK software. Figure 1 shows the generalized block diagram of D-STATCOM connected to distribution line.

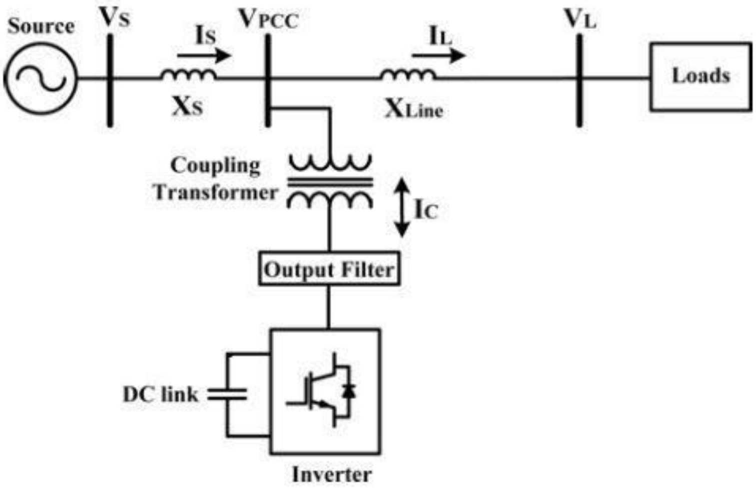

Fig.1 A generalized connection of D-STATCOM to Distribution Line

VI. CONCLUSION

An substantial review of AF’s has been presented to provide a clear viewpoint on various aspects of the active filter (AF) to the researchers and engineers working in this field. The substantial increase in the use of solid-state power control results in harmonic pollution above the tolerable limits. Utilities are finding it difficult to maintain the power quality at the consumer end, and consumers are paying the penalties indirectly in the form of increased plant downtimes, etc. At present, AF technology is well developed, and many manufacturers are fabricating AF’s with large capacities. The utilities in the long operation will produce the consumers with nonlinear loads to use the AF’s for maintaining the power quality at tolerable levels. A large number of AF configurations are available to compensate harmonic current, reactive power, neutral current, unbalance current, and harmonics. The consumer can select the AF with the required features. It is hoped that this survey on AF’s will be a useful reference to the users and manufacturers.

REFERENCES

[1] Abhayrajsinh J. Rana, “Application of D-STATCOM for Power Quality Improvement in Distribution Line” 2016 International Conference on Computationj of Power.

[2] Mohammed Barghi Latran, Ahmet Teke and Yeliz Yoldaz, “Mitigation of Power Quality Problems using Distribution Static Synchronous Compensator: A comprehensive review” 2015.

[3] Bhim Singh, P. Jayaprakash, D.P. Kothari, Ambrish Chandra and Kamal Al Hadad, “Comprehensive Study of D-STATCOM Configuration” IEEE Transaction 2014.

[4] Bhim Singh and Jitendra Solanki, “A Comparision of Control Algorithms For D-STATCOM” ,2009.

[5] Bhim Singh, Alka Agya A.P. Mittal and J.R.P. Gupta, “Modeling Design and Anlysis of Different Controllers for D-STATCOM”,IEEE Conference 2008.

[6] Ambrish Chandra, Bhim Singh, B.N Singh and Kamal Al Haddad, “An Improved Control Algorithm of Shunt Ative Filter for Voltage Regulation, Harrmonic Elimination, Power Factor Correction, and Balancing of Non-linear Load”, IEEE Transaction, 2000.

[7] Bhim Singh and Sushil Kumar, “ Modified Power Balance Theory for Control of D-STATCOM”, IEEE Conference, 2010.

[8] Mahesh K. Mishra, Arindam Ghosh and Avinash Joshi, “Operation of D-STACOM in Voltage Control Mode”, IEEE Transaction, 2003.

[9] Joao L. Afonso, H.J. Ribeiro da Silva and Julio S. Martins, “Active Filters For Power Quality Improvement”, IEEE Conference, 2001.