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"A REVIEW ON SIMULATION BASED FOR CONTROL OF DSTATCOM"

Purbasha Ghosh [1]

[1] *Lecturer, Department of Electrical Engineering , Department, Government Polytechnic,, Gulzarbagh University, Patna, Bihar 800007*

ABSTRACT

The Power Quality Analysis aspires to bring out electricity consumers for improved power quality with application of power electronics. The research work involves in-depth analysis of the interaction among loads, power networks and various power quality improvement devices. It ultimately leads to better design of mitigation devices like Distribution Static Synchronous Compensator (DSTATCOM) and Fuzzy Logic Controller (FLC) to alleviate various power quality related problems. While compensating, the transient response of the DSTATCOM is very important for nonlinearly varying and unbalanced loads. Conventionally, a Proportional Integral (PI) controller is used to maintain the DC voltage at the reference value. The transient response of this controller is very faster than compared to that of the conventional DC voltage controller. The Fuzzy Logic Controller (FLC) based DSTATCOM has been implemented and it has been verified that its transient response is better than the PI Controller response.

Keyword: *DSTATCOM, FLC, Neutral Current, Load Balancing, Power Distribution.*

I. INTRODUCTION

One of the most common power quality problems today is voltage dip. A voltage dip is a short time (10 ms to 1 minute) event during which a reduction in rms voltage magnitude occurs. It is often set only by two parameters, depth/magnitude and duration. The voltage dip magnitude ranges from 10% to 90% of nominal voltage (which corresponds to 90% to 10% remaining voltage) and with a duration from half a cycle to 1 min. In a three-phase system. voltage dip by nature is a three-phase phenomenon, which affects both the phase-to-ground and phase-to-phase voltages. A voltage dip is caused by a fault in the utility system a fault within the customer's facility or a large increase of the load current. like starting a motor or transformer energizing.

Improved power quality is the driving force for today's modern industry. Consumer awareness regarding reliable power supply has increased tremendously in the last decade. This has lead to an additional thrust to the development of small distributed generation. Small isolated DG sets have thecapability to feed local loads and thus lads to improvement in reliability of power with low capital investment. These systems are also gaining increased importance in isolated areas where transmission using overhead conductors or cables is unrealistic or prohibitive due to excessive cost. Small generation systems in hilly terrains, islands, off shore plants. power distribution in rural areas, aircrafts etc. can be efficiently utilized even in developing countries.

However, these DG sets may have to be de-rated if induction motor loads are simultaneously started. One useful option is to use DSTATCOM in shunt configuration with the main system so that the full capacity of generating sets is efficiently utilized. DSTATCOM employs a voltage source converter (VSC) and generates capacitive and inductive reactive power internally. Its control is very fast and has the capability to provide adequate reactive compensation to the

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system.

II. DSTATCOM

DSTATCOM can he effectively utilized to regulate voltage for one large rating motor or for a series of small induction motors starting simultaneously. Induction motor loads draw large starting currents (5. 6times) of the full rated current andmay affect working of sensitive loads.

Thyristor based systems were initially proposed for reactive power compensation and were used for voltage flicker reduction due to arc furnace loads. However, due to disadvantages of passive devices such as large size, fixed compensation. possibility of resonance etc.. the use of new compensators such as DSTATCOM is growing to solve lower quality problems.

The use of DSTATCOM for solving power quality problems due to voltage sags. flickers, swell etc has been suggested. The purpose of DSTATCOM is to provide efficient voltage regulation during short duration of induction motor starting and thus prevent large voltage dips.

A centralized grid for instance, aids much transmission and distribution congestion that makes it more inefficient and unreliable. Additionally, there is a contentious risk for failure to meet peak demand periods often served by inefficientpower plants operating over a very short period of time (afew hours-per-year). These factors, added to increased powerconsumption due to population growth further stretch the traditional grid to its limits, raising serious concerns on economic impact of blackouts and interruptions beingwitnessed today. While most recently the Indian grids failure which affected half of the country with hundreds of millions hit by power cut caused by excessive power absorption, leading to massive snags in rail transport and medical facilities.

The distribution system is relatively perceived as an interface between the bulk and the custom powers, whose control objective is to strike a balance between the two for maintaining continuous healthy operation of the system. A good distribution control system is therefore expected to enhance the overall system efficiency through loss reduction and power quality control. Presently, distribution system equipment such as the tap changing transformers, synchronous machines, capacitor banks, static volt-ampere- reactive compensators (SVCs), and many other flexible ac transmission systems (FACTS) controllers at device level, including DSTATCOM are being applied for such control.

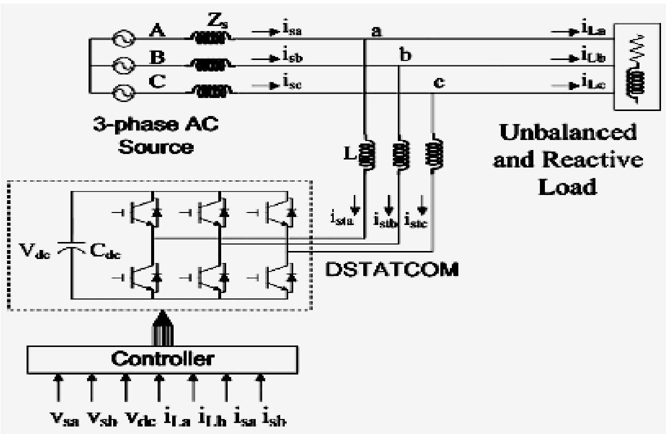

Fig. 1. Block Diagram of DSTATCOM

Though, there are numerous challenges facing the area at the moment in terms of the smart-grid de-centralizing functionality which include: voltage and reactive power compensation (now known as Volt-VAR optimization); distribution system automation (DSA); power factor correction (PF); phase current balancing; integrate-able low loss transformers (to improve efficiency), distributed resources (typically, between 1kW - 50MW), and dispersed energy storage facilities (normally sited at consumer

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loads), which call for radical change in the type of controllers designed in these equipment for general system power quality improvement. To understand this phenomenon, the losses regarding distribution lines and transformers have been classified into resistive and reactive components. While, resistive load losses are unavoidable, reactive load losses which emanate from capacitive and inductive circuit properties (cancelling each other) can be avoided. In a very large quantity, the reactive power increases distribution line currents being responsible for further energy losses. The distribution transformers often operate at efficiency higher than 98%, thus making their core losses negligible. Though, transmission and distribution system losses togetherconstitute 9% of the total from generation to the consumer's feeder. Out of this figure only 2 - 3% of the losses is attributable to the feeder lines and coupling transformers. The current wave of smart grid evolution, a number of multinational electricity companies are actively investing into DSTATCOM technologies with the hope of integrating such within the smart grid context..

III. Literature review

Mehdi Hosseini et al [2009] This paper presents a reliability assessment algorithm for distribution systems using a Static Series Voltage Regulator (SSVR). Furthermore, this algorithm considers the effects of Distributed Generation (DG) units, alternative sources, system reconfiguration, load shedding and load adding on distribution system reliability indices. In this algorithm, load points are classified into 8 types and separated restoration times are considered for each class. Comparative studies are conducted to investigate the impacts of DG and alternative source unavailability on the distribution system reliability. For reliability assessment, the customer-oriented reliability indices such as SAIFI, SAIDI, CAIDI ASUI and also load- and energy-oriented indices such as ENS and AENS are evaluated. The effectiveness of the proposed algorithm is examined on the two standard distribution systems consisting of 33 and 69 nodes. The best location of the SSVR in distribution systems is determined based on different reliability indices, separately. Results show that the proposed algorithm is efficient for large-scale radial distribution systems and can accommodate the effects of fault isolation and load restoration.

Rahmat Allah_Hooshmand et al [2011] Thyristor controlled reactor with fixed capacitor (TCR/FC) compensators have the capability of compensating reactive power and improving power quality phenomena. Delay in the response of such compensators degrades their performance. In this paper, a new method based on adaptive filters (AF) is proposed in order to eliminate delay and increase the response of the TCR compensator. The algorithm designed for the adaptive filters is performed based on the least mean square (LMS) algorithm. In this design, instead of fixed capacitors, band-pass LC filters are used. To evaluate the filter, a TCR/FC compensator was used for nonlinear and time varying loads of electric arc furnaces (EAFs). These loads caused occurrence of power quality phenomena in the supplying system, such as voltage fluctuation and flicker, odd and even harmonics and unbalancing in voltage and current. The above design was implemented in a realistic system model of a steel complex. The simulation results show that applying the proposed control in the TCR/FC compensator efficiently eliminated delay in the response and improved the performance of the compensator in the power system.

Rahmat Allah_Hooshmand et al [2011] The voltage & current harmonics produced by nonlinear loads in power systems cause a reduction in power quality. In order to improve the power quality, active power filters (APFs) can be used. In this paper, a new control system for designing active filters despite nonlinear loads of electric arc furnaces (EAFs) is presented. The system is composed of three main parts: computation of reference currents, regulation of DC capacitor voltage, and production of firing pulses. In the first part, the active filter control system is presented based on the combination of the synchronous detection method and instantaneous power theory. In the second part, the DC capacitor voltage regulator is applied, producing a reference current and a proper voltage regulator is developed. For the third part of the control system, we use a PI controller to provide some conditions that follow the reference current in a complete cycle, and generate firing pulses by the hysteresis method. The proposed control system not only reduces the voltage and current harmonics in power systems but can also improve the power quality indices. The above design was implemented in the EAF system of the Mobarakeh steel complex (Isfahan, Iran). The simulation results show the effectiveness of the APFs in improving the power quality indices

IV. PROPOSED MODEL WITH FUZZY LOGIC

The simulation model proposed in this paper having DSTATCOM consists of the transformer, Voltage Source Converter and a fuzzy controller is shown in below Fig. 3.1 and 3.2 respectively. A static synchronous compensator (STATCOM) is one of the most operative solutions to regulate the line voltage. The STATCOM consists of a voltage source converter connected in shunt with the power system and permits to control a leading or lagging reactive power by means of correcting its ac voltage. A STATCOM for installation on a distribution power system called DSTATCOM, has been researched to clear voltage fluctuations and voltage flickers.

Fuzzy control is a control method based on fuzzy logic. Just as fuzzy logic can be described as "computing with words rather than numbers. Fuzzy control can be simply described as "control with sentence rather than equations". Controllers based on fuzzy logic give the linguistic strategies control conversion from expert knowledge in automatic control strategies.

The development of control system based on fuzzy logic involves the following steps:

1. *Fuzzification strategy*
2. *Knowledge base*
3. *Rule base elaboration*
4. *Fuzzy inference*
5. *Defuzziffication strategy.*

Fuzzy Logic Controller has advantages over the PI Controller. It does not require an accurate mathematical model can work with imprecise inputs, it can handle non- linear functions and it is more robust. As per the simulation results presented in following sections show that the Fuzzy Logic Controller have a better dynamic behavior than the PI Controller.

The FLC based compensation scheme eliminates voltage and current magnitude of harmonics with good dynamic response.

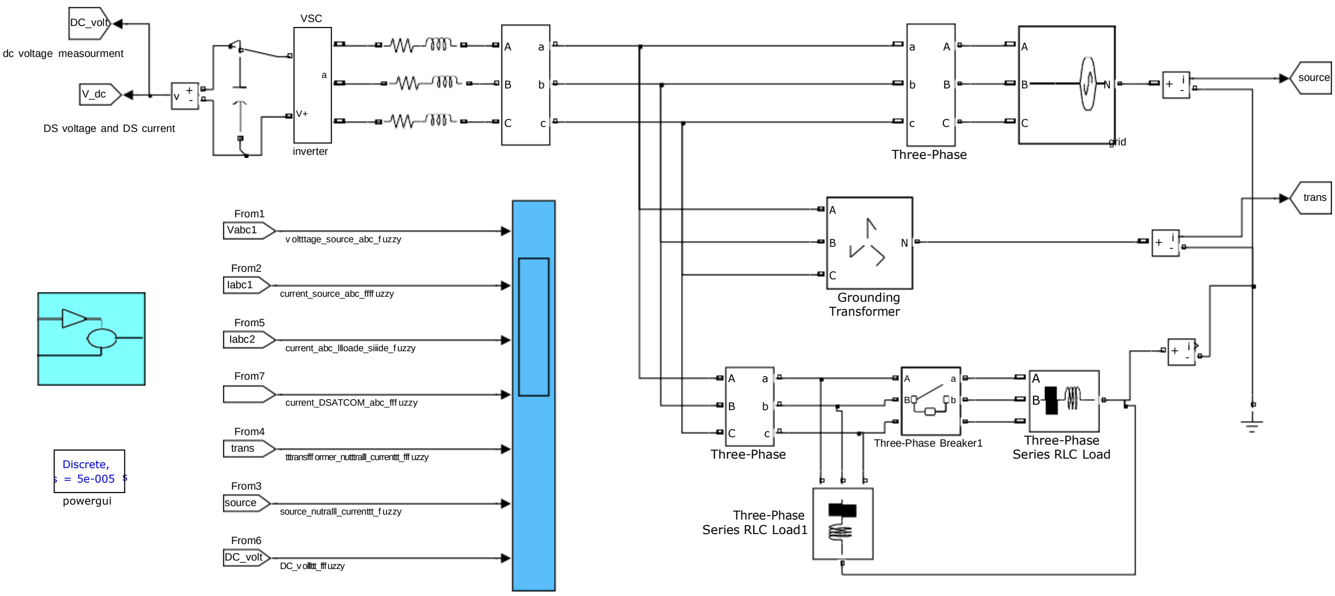

Fig. 2 Proposed Fuzzy Control Block

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