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Power Quality Improvement by DSTATCOM Control by Artificial Neural Network Technique

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Abstract – *Distribution system faces various types of power quality problem such as voltage, Current unbalance, voltage variations also harmonics generated by the non linear loads. Therefore it's necessary to design a system that compensates power quality problems. In this paper shunt compensating device DSTATCOM (Distribution Static Converter) control by artificial neural network is used to eliminate power quality problem.*

Key Words: Power Quality, DSTATCOM, Linear and Non Linear Loads, PWM, Artificial Neural Network (ANN), ISCT, VSC.

1. INTRODUCTION

In present era, many types of load are working in domestic, commercial as well as in industrial system with power quality problems. Non linear loads are working on precise control on system's waveform for their operation. When non linear loads are switching on causes harmonics generated and enter into the system. Harmonics are the integral multiple of fundamental frequency. Its need to design a compensating system that eliminate above power quality [1] problem. When any load phases off and heavy loads are connected causes source voltage are disturbed DSTATCOM (Distribution Static compensator) is used to compensate harmonics by extracting it from the loads by proposed control technique.

2. SYSTEM DESIGN

In distribution system [2] where three phase linear and non linear loads are connected with three phase AC 415 V 50 Hz power supply through source impedance. DSTATCOM is connected at PCC (Point of Common Coupling) through coupling inductor [2], [5], [9]. Shown in fig. 1.

3. PROPOSED CONTROL DESIGN

In control design shown in fig. 2 instantaneous symmetrical component theory (ISCT) [2] is used for generating the reference supply current. In this technique, PCC phase voltage, average load power and average power factor angle is used. Here average load are estimated by instantaneous load current and PCC phase voltage. Instantaneous load current with PCC (Point of Common Coupling) phase voltage generate instantaneous load power. This instantaneous load power is passes to LPF (Low Pass Filter). Instantaneous load power has both ac and DC power component. After LPF, average load powers *(PLdc)* are extracted [2].

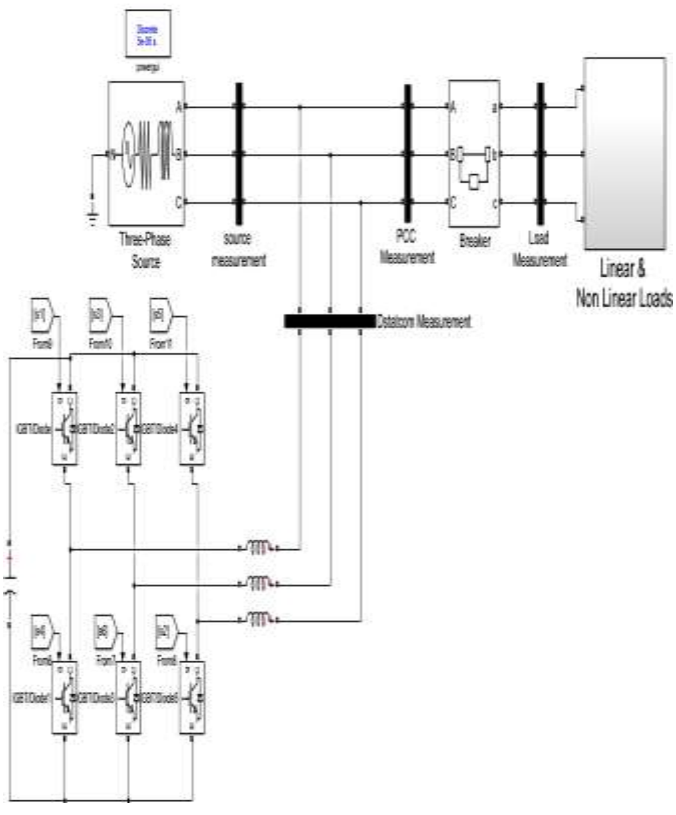

Fig -1: Distribution System with DSTATCOM

$$PLinst = Vsa \cdot ILa + Vsb \cdot ILb + Vsc \cdot ILc \quad (1)$$

$$PLinst = PLdc + PLac \quad (2)$$

Instantaneous active power of load which have *PLac* is the pulsating ripple component. *PLdc* is the average power consume by loads.

Reference supply current are generated [2] by using eq. (3), (4) & (5),

$$Isa\_ref = \frac{Vsa + (Vsb - Vsc)\cdot\beta}{[A]} \times PLdc \quad (3)$$

$$Isb\_ref = \frac{Vsb + (Vsc - Vsa)\cdot\beta}{[A]} \times PLdc \quad (4)$$

$$Isb\_ref = \frac{Vsc + (Vsa - Vsb)\cdot\beta}{[A]} \times PLdc \quad (5)$$

Vsa, Vsb & Vsc is PCC phase voltage.

$[A]$ is defined as,

$$[A] = \sum_{i=a,b,c} Vsi^2 \quad (6)$$

Now, calculate terminal voltage of PCC phase voltage [2], [3] by eq. (7),

$$Vt = \{1/2(Vsa^2 + Vsb^2 + Vsc^2))^{\frac{1}{2}} \quad (7)$$

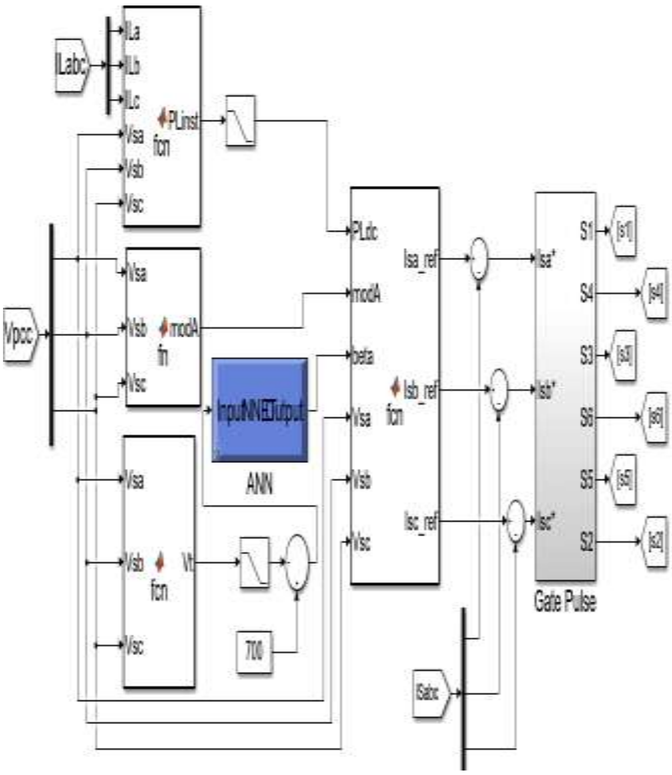

Fig-2: Proposed Control Design

After that this terminal voltage is apply to LPF (Low Pass Filter) to eliminate ripples present on it during non linear load switching. Then compared with reference PCC terminal voltage. After the comparison error is generated and this is goes to artificial neural network (ANN) [7] where it is regulated to get desired output. Artificial neural network have input layer, three hidden layer and output layer shown in fig. 3. Hidden layer is activated by logistic sigmoid transfer function [7] and output is activated by linear transfer function [7]. Output of ANN is the value of β. Compute reference current and compared with sensed supply current to generate gate pulse for switching of VSC (Voltage Source Converter) of DSTATCOM.

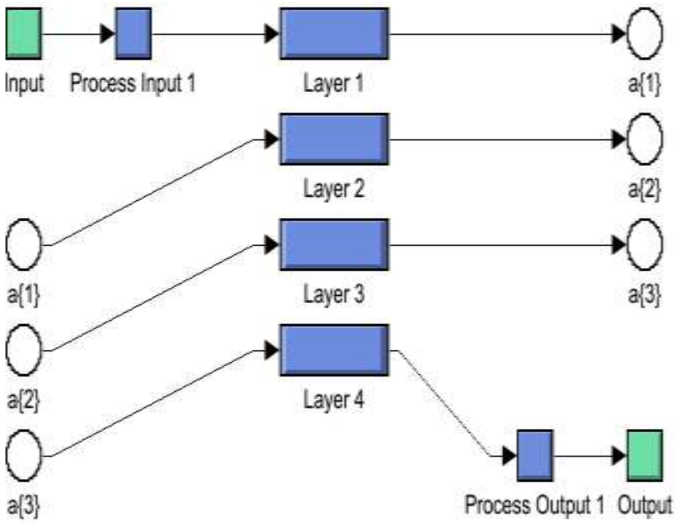

Fig -3: Artificial Neural Network Architecture

4. RESULT & DISCUSSIONS

Distribution system with DSTATCOM is simulated firstly without compensation when load phase “c” is off during 0.5 second to 0.8 second where source voltage having short duration RMS variations [1] and second one heavy load is connected to the system at the duration of 1.4 second to 1.8 second. Due to which source voltage have undervoltage power quality issues [1]. Source Voltage and source current without compensation shown in fig. 4 & fig. 5,

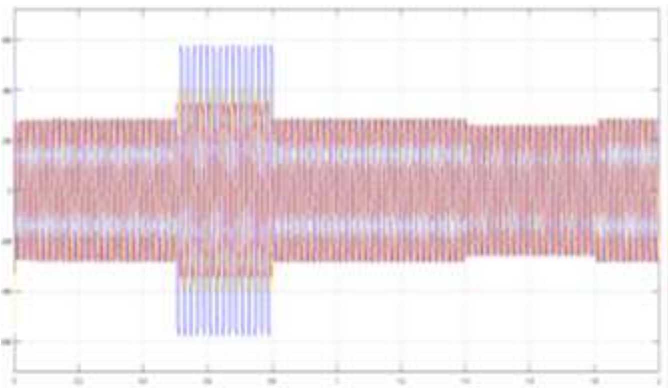

Fig -4: Source Voltage without Compensation

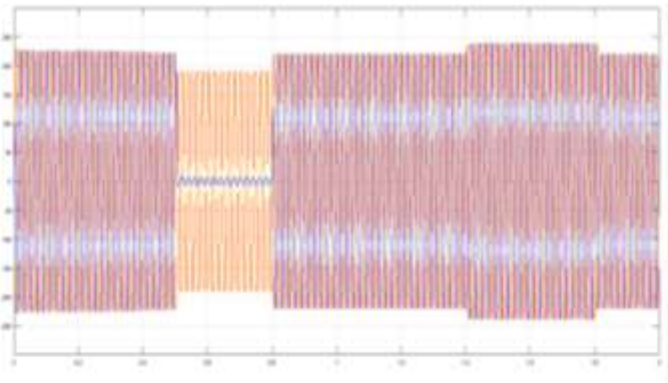

Fig -5: Source Current without Compensation

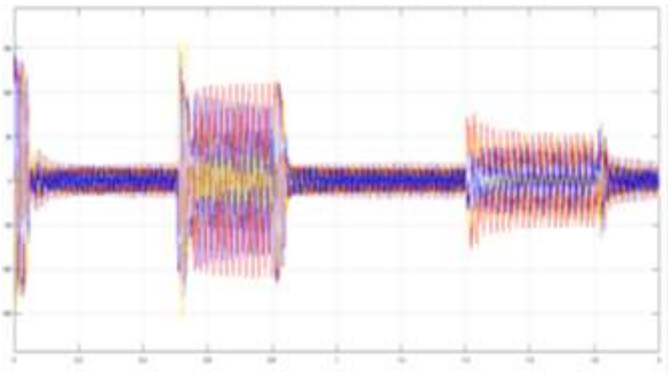

Fig -6: Compensating Current

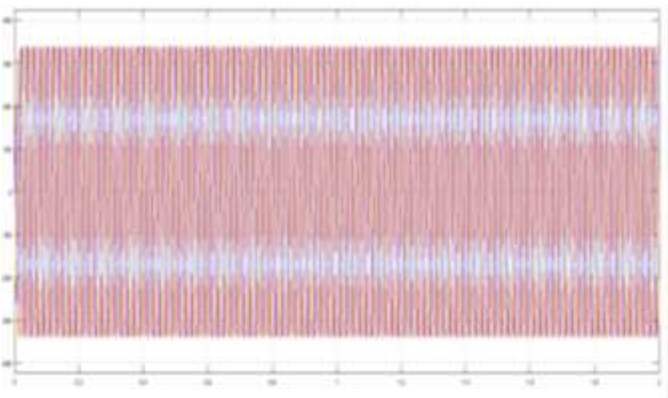

Fig -7: Source Voltage with compensation

Then applying DSTATCOM, power quality issues during 0.5 second to 0.8 second and 1.4 second to 1.8 second are compensate by compensating current shown in fig. 6 provided by DSTATCOM where source voltage are become sinusoidal with balanced waveform shown in fig. 7.

5. CONCLUSION

Distribution system with DSTATCOM controlled by proposed control technique having satisfactory performance. Proposed control technique work satisfactory with fast response on power quality issues.

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